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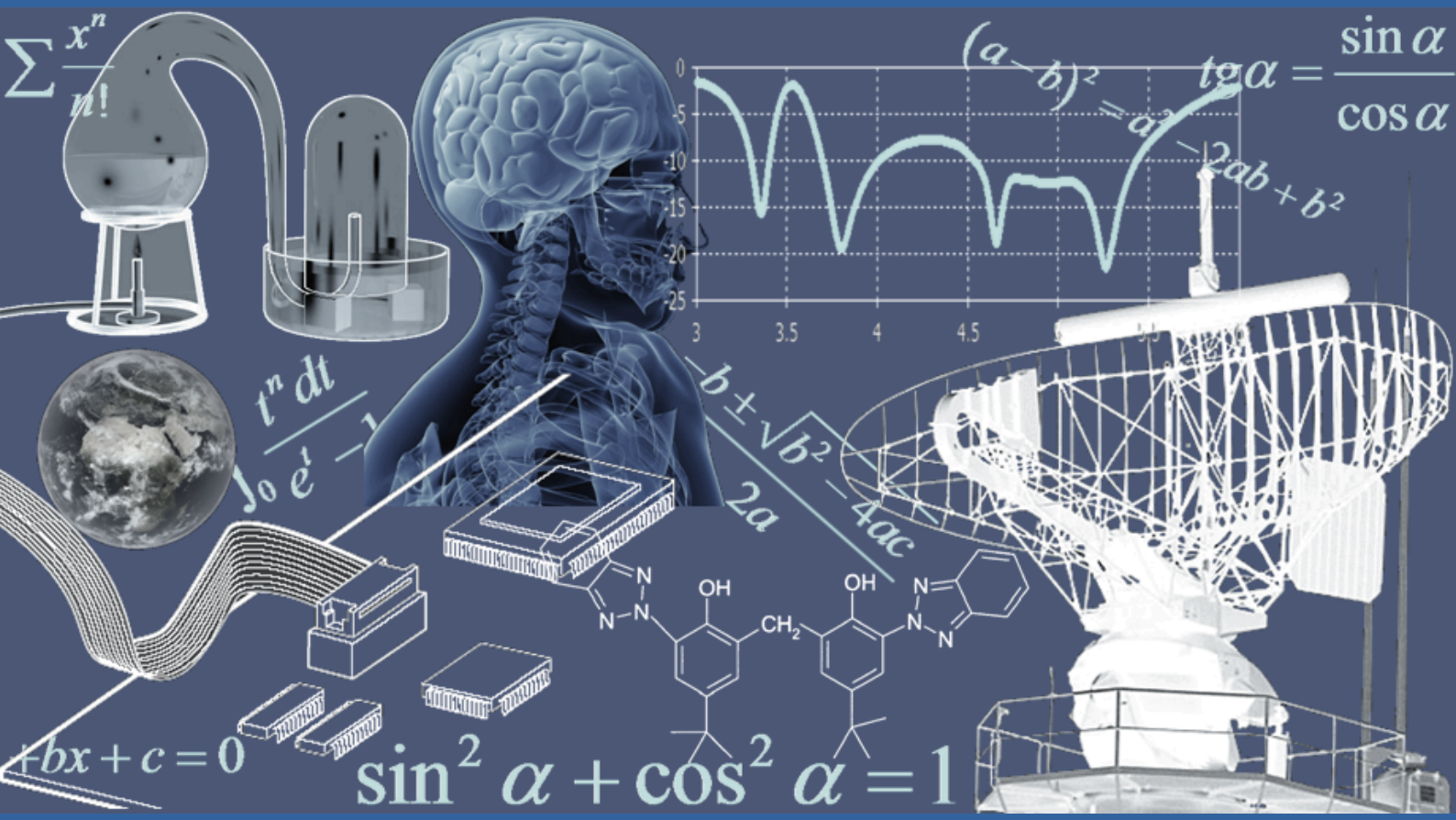

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Power Scavenging from Moving Vehicles on Road

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ABSTRACT: In the current scenario, population is increasing day by day therefore the demand of power is also increasing with it, The extensive usage of energy has resulted in reduction of conventional resources of power. Therefore, to overcome this problem we need to implement the technique which will not only overcome the energy crisis but also prevent the environment. Conventional resources like fossil fuels and nuclear energy requires careful handling and spoils the environment too. Hence the focus is now shifting towards the renewable resources of energy. This paper emphasizes on the idea that there is possibility of generating power by specially designed speed breaker. We can convert the energy which is being wasted everyday on the roads by the moving vehicles, into electricity and store it in the batteries. As we know, vehicles on road are increasing gradually with every passing day; this will help us to generate electricity as these vehicles pass through the speed breakers. This paper explains clearly, the working principle of the system, its practical implementation, output power calculation and its advantages. The energy we generate from speed breaker is enough for lighting street lights during night, by using this arrangement we can store a lot of power. The suggested model is an eco-friendly method for generating power i.e.; it does not consume any fuel.

KEYWORDS: Energy crisis, conventional resources, power generation, speed breaker, vehicles, practical implementation, output power calculation, street lights.

1 INTRODUCTION

During last few decades, Power has become the most important need for human life, works-in industry, agriculture, transportation and so on. But we know that the resources for power generation are limited, and this has cause the energy crisis. The increasing power demand results reduce in conventional resources for power generation and increase the carbon dioxide emission; it provides a need to think on non-conventional energy resources or renewable energy resources which are eco-friendly to environment [1] , [2]. In this paper we are looking forward to conserve the kinetic energy which is wasted on roads every day. The Idea to generate electricity through speed breakers can bring revitalization in field of power generation. The number of vehicles passing over the speed breaker in roads is increasing gradually. According to statistics provided by the Provincial Excise & Taxation Departments, Government of Pakistan, from 2001 to 2010 there is tremendous vehicular growth as shown in Fig1; there are approximately 4.78 million vehicles on roads in 2001 and this figure reached to 7.86 million in 2010. The rate of growth of vehicle in Pakistan has been almost 64.5 percent during the last decade. So we can tap enough power from the vehicles moving over the power generating speed breaker (PGS).

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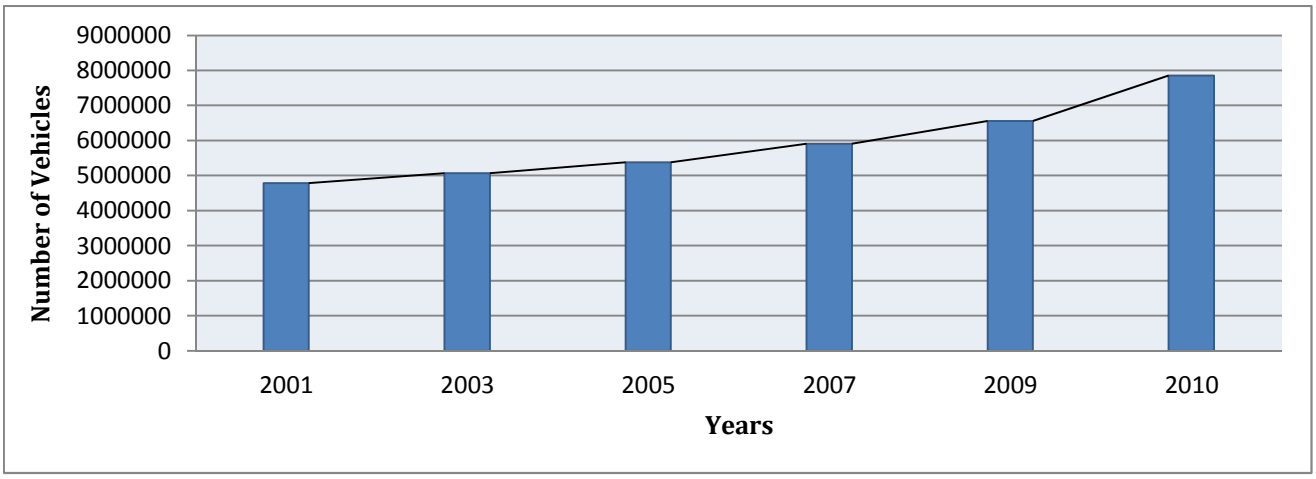

Fig. 1. Vehicular Growth in last 10 years

2 SCOPE OF THE PAPER

Power consumption is gradually increased with rapid urbanization. Some of the highlights of current power consumption in Pakistan is: House hold energy consumption is 43.2 percent, Industrial 30.1 percent, Agriculture 13.3 percent, Government sector 7.2 percent, Commercial 5.5 percent, and Street lights energy consumption is 0.7 percent as shown in Fig 2.The demand power of Pakistan is approximately 20,000MW in 2012 and generated power capacity is only 15,000MW. The power is mainly generated by thermal, hydro, oil, gas and nuclear power plants; the share of natural gas reached to 26 percent, oil 30.0 percent, hydro electricity 32 percent, nuclear electricity 3 Percent, and by other sources like solar wind, coal is 5 percent. Hydro electricity 32 percent, nuclear electricity 3 Percent, and by other sources like solar wind, coal is 5 percent. Contribution of each conventional source in power generation is shown in Fig 3. Pakistan; unlike the top developed countries has very poor roads. There are number of speed breakers, by just placing such mechanism on road, we can tap so much energy [3], [4].

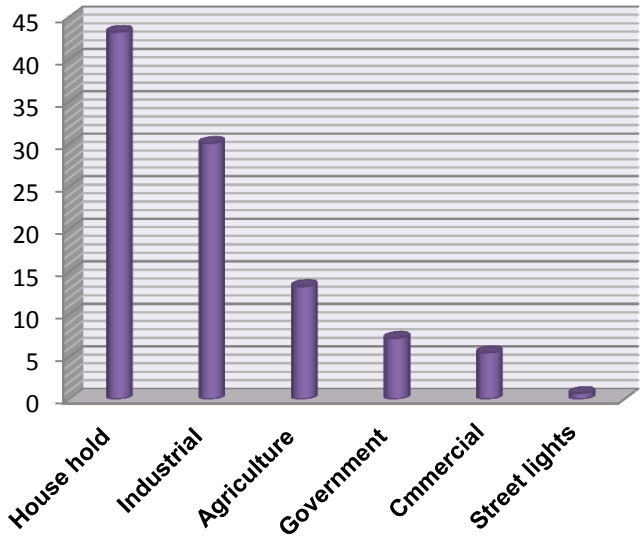

Fig. 2. Power Consumption Profile.

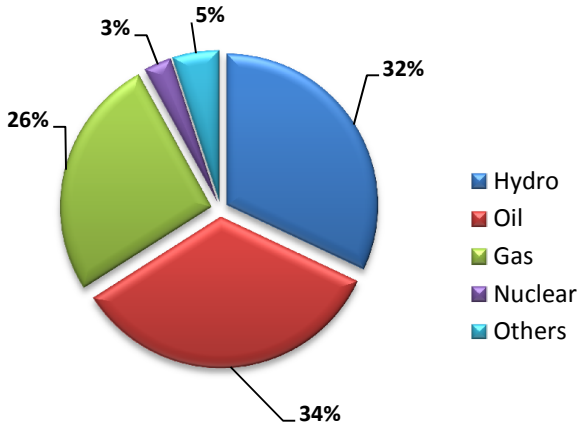

Fig. 3. Power Generation Contribution.

3 WORKING PRINCIPLE

When a vehicle moves over a speed breaker system it exerts a force on it as a result speed breaker moves down. This linear motion of system is converted to a rotary motion by using a rack and pinion mechanism which is placed in the bottom of speed breaker. The axis of the pinion is connected to a gear arrangement. This arrangement is made of two sprockets. One of them is larger in dimension and the other one is small in size. Both are connected by means of a chain, As the power is conveyed from the larger sprocket to the smaller sprocket, the larger sprocket rotates and relatively increases the speed of smaller sprocket. The speed that is available at the larger sprocket is relatively multiplied at the rotation of the smaller sprocket. A flywheel is mounted on the shaft, whose function is to regulate the fluctuation in the rotation and to make the speed uniform. So the shafts will rotate with certain rpm. As a result flywheel will rotate and this rotation is sufficient to rotate the rotor of a generator which causes the DC generator to convert mechanical energy into electrical energy [5]. Similar mechanism is performed on other side of speed breaker as shown in fig 4, and power is generated. Both generators are connected in parallel to increase the charging current. Therefore we can charge our batteries earlier.

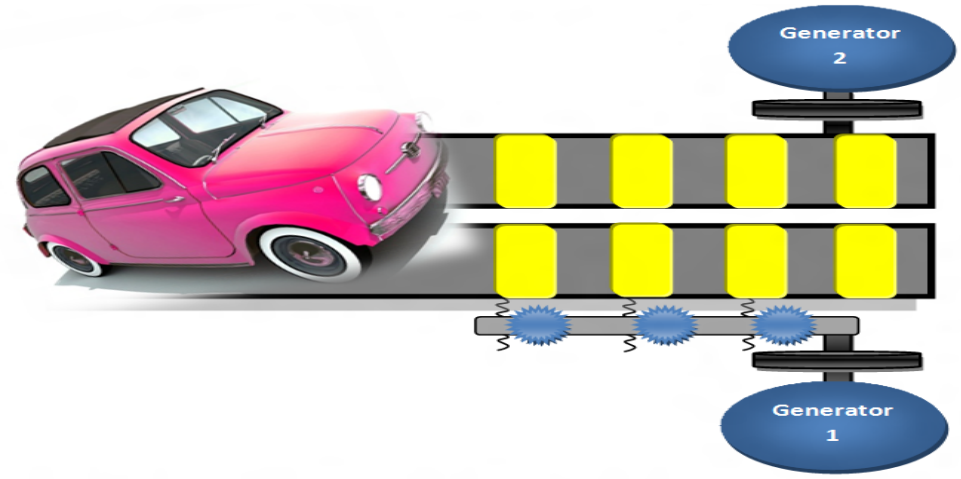

Fig. 4. Model of PGS

4 COMPONENTS DISCRIPTION

- Fly wheel: Store mechanical energy and then provide constant rpm.
- DC generator: Converts the mechanical energy to electrical energy, its output voltage is 12V.
- Rack and Pinion: Converts the linear motion into rotary motion
- Gears: It increases the shaft speed.
- Inverter: It converts 12V DC to 220V AC
- DC control charger: It controls the voltage of generator and regulates it.

5 BLOCK DIAGRAM

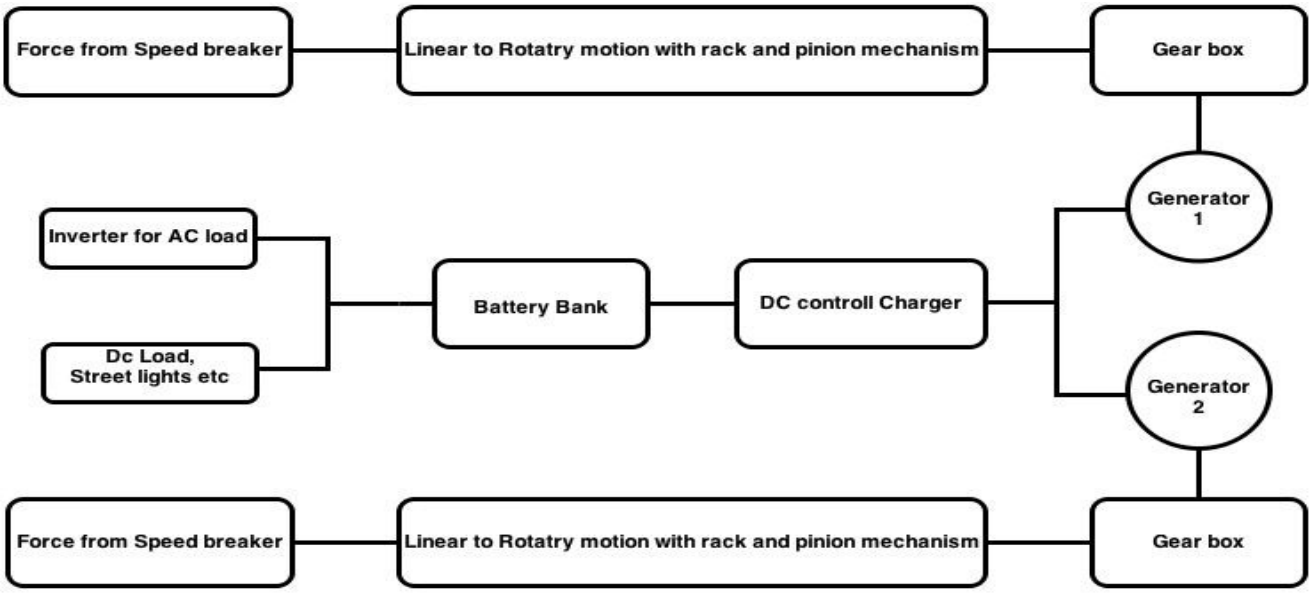

Fig. 5. Block diagram of PGS

6 OUTPUT POWER CALCULATION

Average Weight of a Vehicle = 700Kg

Height of speed brake =10 cm

- Work done=Force x Displacement …… (1)

W=F.d cos (Θ), where Θ= 0°, because force acted in the direction of displacement.

- Force= mass x gravitational force

Force=700 Kg x 9.81 =6867 N

Displacement covered by the speed breaker= 10cm /0.10 m

- Put the value of force and displacement in equation (1).

Output power=Work done/Sec

Output power= (6867 x 0.10)/60

Output power= 11.445 Watts

Power developed for 1 vehicle passing over the speed breaker is 11.445 watts; due to flywheel it delivers power for one minute continuously. So the Power developed for:

1 hr =686.7 watts

24 hours=16.480 KW

This power is sufficient to burn street lights in the roads in the night time [3] , [6] , [7].

7 EXPERIMENTAL RESULTS

The experimental results can be taken out by placing a power generating speed breaker on the road. When the vehicles move over the speed breaker voltage is generated and it depends on vehicle speed and vehicle weight [3] , [4] , [6]. Table 1 shows the relation between vehicle speed and the voltage generated. And similarly the relation between load and voltage at 10km/h speed of vehicle is shown in Table 2.

Table 1. Vehicle speed vs. Voltage generated

Speed of Vehicle (Km/h)	Voltage Generated (V)
5	11.5
10	8
15	7.14
20	6.28
25	5.65

Table 2. Vehicle load vs. Voltage generated

Vehicle Load (Kg)	Voltage Generated (V)
1000	13.8
900	12.8
800	12
700	11.81
600	11

8 ADVANTAGES

By using PGS (Power generating speed breaker) system on roads we can produce enough power [7] , [8], there are numerous advantages of this system such as;

- Eco friendly to environment.
- Simple Construction.
- Less area required for deployment.
- Easy and low cost maintains.
- No consumption of any fossil fuel. It is totally free power generation method.
- Power will be generated throughout the year.

9 APPLICATIONS

Power generation with speed breaker system can be used in most of the places such as; Highways, roadway speed breakers, tool plazas, parking lots, and traffic signals [9,10]. The power generated when the vehicles pass over the PGS, can be stored into the batteries and used to lighten the street lights, road signals, sign boards and bus stops during the night time [11] , [12] , [13].

10 CONCLUSION

As the population is exploding tremendously these days, the need for energy has also been increased. Countries like Pakistan cannot afford expenses on power generation through conventional sources like fossil fuels and coal because they are depleting fast. The presented model can serve as a best source to combat the daily energy needs as it is much economical, pollution free, efficient and easy to install without any use of conventional reservoirs. Increasing vehicles that are considered as a major problem of our country can be utilized in the capacity to generate sufficient amount of power and can help to boost the world's economy. In future, it will establish a great boon to the world, since it will save a lot of power generated from power plants.

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REFERENCES

[1] Mohsen Partodezfoli, Abbas Rezaey, Zahra Baniasad, Horieh Rezaey, "A Novel Speed-Breaker for Electrical Energy Generation Suitable for Elimination of Remote Parts of Power Systems where is Near to Roads", *Journal of Basic and Applied Scientific Research*, ISSN 2090-4304, 2012.

[2] Ashok Kumar Sharma1, Omkar Trivedi2, Umesh Amberiya2, Vikas Sharma2, "Development of speed breaker device for generation of compressed air on highways in remote areas", *International Journal of Recent Research and Review,* vol. 1, ISSN 2277 – 8322, March 2012.

[3] Aswathaman.v, Priyadharshini.m, "Every speed breaker is now a source of power" In the Proceedings of the 2011 *International Conference on Biology, Environment and Chemistry*, vol. 1.

[4] Mohammad Uzzal Hossain Joardder, Md. Mamun Kabir, Ranjoy Barua, "Production of power from speed breaker" In the Proceedings of the 2011 International Conference on Mechanical Engineering and Renewable Energy (ICMERE).

[5] Alok Kumar Singh, Deepak Singh, Madhawendra Kumar "Generation of Electricity through Speed Breaker Mechanism", *International Journal of Innovations in Engineering and Technology* (IJIET), vol. 2, ISSN 2319 – 1058, April 2013.

[6] Aniket Mishra, Pratik Kale, Atul Kamble, "Electricity Generation from Speed Breakers", *International Journal of Engineering and Science* (IJES), Vol. 2, 2319 – 1813 ISSN, 2013.

[7] Md.Saiful Islam1,Syed Khalid Rahman2,Jakeya sultana Jyoti3, " Generation of Electricity Using Road Transport Pressure", *International Journal of Engineering Science and Innovative Technology (IJESIT),* Vol. 2, ISSN: 2319-5967, Issue 3, May 2013.

[8] Amanpreet Kaur, Shivansh Kumar Singh, Rajneesh, Parwez, Shashank AP, EIE Dept, Galgotias College of Engineering and Technology, Gr. Noida, U.P1 Student, EIE Dept, Galgotias College of Engineering and Technology, Gr. Noida, U.P, "Power Generation Using Speed Breaker with Auto Street Light", *International Journal of Engineering Science and Innovative Technology (IJESIT),* Vol. 2, ISSN: 2319-5967, March 2013.

[9] Shakun Srivastava , Ankit asthana, "Produce electricity by the use of speed breakers", *Journal of Engineering Research and Studies*, Vol. 2, E-ISSN 0976-7916, April 2011.

[10] Selvaraj, R.S., Sivamadhavi, V., "Magnitude of Green House Effect and the contribution of Carbon di oxide," Recent Advances in Space Technology Services and Climate Change (RSTSCC), 13-15 Nov. 2010, no. 41 – 44, Chennai.

[11] Aswathaman.V, Priyadharshini.M, "Every speed breaker is now a source of power" International Conference on Biology,Environment and Chemistry IPCBEE, vol.1, 2011, Singapore.

[12] Nota, R., Barelds, R., "Engineering methods for road traffic and railway noise after validation and fine-tuning", Harmonies, 2005.

[13] Ankita, Meenu Bala, "Power Generation from Speed Breakers", *International Journal of Advance Research In Science and Engineering*, ISSN-2319-8354(E), 2013.

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Chemical composition of essential oils of *Artemisia campestris* and *Juniperus phoenicea* from Algeria

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ABSTRACT: The chemical composition of the essential oils obtained by hydrodistillation from *Artemisia campestris* L (family Asteraceae) and *Juniperus phoenicea* L (family Cupressaceae) collected in Djebel Amour (Sahara Atlas, Algeria). Aerial parts were also evaluated by gas chromatography (GC) and gas chromatography coupled to mass spectrometry (GC-MS). The analyses for leaves and fruits of *A. campestris* resulted in the identification of thirty-one compounds, representing 91.8 % of the total oil and the yields were 0.33% (v/dry weight). The main components were β-pinene and sabinene (25.6% and 17% respectively) followed by α-pinene (9.9%), limonene (6.6 %) and p-cymene (4.1%). forty-two compounds were identified in leaves and fruits of *J. phoenicea* representing 97% of the total oil composition. The yield of essential oil was 0.44 % and the major compound in aerial parts was α-pinene (75.8%) followed by δ-3- carene (3.4%), linalool (2.7%).

KEYWORDS: *Artemisia campestris, Juniperus phoenicea,* Essential oil, GC-MS, Algeria.

1 INTRODUCTION

The genus *Artemisia*, widespread over the world, growing wild over the Northern Hemisphere belongs to the *Asteraceae* family. Eleven species of *Artemisia* can be found in Algerian flora [1]. *Artemisia campestris* L. In Arab folk medicine, A. *campestris* have been used as febrifuge, vermifuge, anticancer, against digestive troubles, gastric ulcer, and menstrual pain [2, 3]. Juniperus berries are used as the only spice derived from conifers, particularly in European cuisine [4, 5]. This species is also a medicinal plant largely used in traditional medicine. Leaves' decoction is used to treat diarrhea, rheumatism, diabetes, against bronco- pulmonary disease and as diuretic. The mixture of leaves and berries of this plant is used as an oral hypoglycaemic agent [6, 7]. In the light of this work we have determined and comparative the chemical composition of essential oils isolated from leaves and fruits of *A. campestris* and J*. phoenicea* from Algeria.

2 MATERIAL AND METHODS

The leaves and fruits of A. *campestris* and J. *phoenicea* have been collected during April 2010 grow in the full steppe zone of Algeria named Djebel Amour region (Sahara Atlas).The essential oils of each collective sample were isolated from fresh plant material (30 g) by hydrodistillation, for 4 h, using a Clevenger-type apparatus according to the European Pharmacopoeia method (Council of Europe, 2007). Gas chromatographic analyses were performed using a Perkin Elmer Autosystem XL gas chromatograph equipped with two flame ionization detectors (FIDs) as reported by [8]. The GC-MS unit consisted on a Perkin Elmer Autosystem XL gas chromatograph, equipped with DB-1 fused-silica column (30 m x 0.25 mm i.d.,

film thickness 0.25 µm; J & W Scientific, Inc.), and interfaced with a Perkin-Elmer Turbomass mass spectrometer (software version 4.1, Perkin Elmer, Shelton, CT, USA) The conditions of the assay are those previously reported . The identity of the components was assigned by comparison of their retention indices, relative to C8-C17 n-alkanes, and GC-MS spectra with corresponding data of components of reference oils, laboratory synthesized components and commercially available standards from a home-made library.

3 RESULTS AND DISCUSSION

The chemical composition of essential oils of *Artemesia campestris* and *Juniperus Phoenicea* are presented in Table 1. More than 50% of the essential oil of A. campestris was constituted by β-pinene, sabinene and α-pinene, whereas in *J. phoenicea* oil only one component (α-pinene) constituted more than 75% of the oil (Table 1). The chemical composition of A. campestris oils from Europe, Africa and Asia has been reported and some variability has been found which can be attributed to the seasonal and climatic and geographical conditions among areas. α-pinene richness of Juniperus oil was already reported by other authors [9-11].

Table 1. Composition of the essential oils isolated from the aerial parts of A. campestris L and. J. phoenicea populations collected in Laghouat, Algeria

Components	RI	A. *campestris*	J. *phoenicea*
α-Pinene	**930**	**9,9**	**75,8**
Sabinene	**958**	**17**	t
β-Pinene	**963**	**25,6**	t
β-Myrcene	975	3,3	1,2
δ-3-Carene	**1000**		**3,4**
p-Cymene	1001	4,1	0,3
Limonene	**1009**	**6,6**	0,7
γ-Terpinene	1035	2,3	0,2
Linalool	1074	1,3	2,7
Terpinen-4-ol	1148	2	0,2
α-Terpineol	1159	1,1	0,5
Geraniol	1236	1,3	
Geranyl acetate	1370	1,3	
Germacrene-B	1533		0,5
Spathulenol	1551	2,5	
Geranyl isovalerate	1590	1,6	
β-Eudesmol	1620	3,6	
% of identification		91,8	97
Grouped components			
Monoterpene hydrocarbons		73,9	83,2
Oxygen-containing monoterpenes		10,6	8,9
Sesquiterpene hydrocarbons		1,2	3,2
Oxygen-containing sesquiterpenes		6,1	0,6
Others		t	1,1

RI: retention index relative to C9-C17 n-alcanes on the DB-1 colum ; t: trace (<0.05%).

4 CONCLUSION

The leaves and fruits oils obtained from *Artemesia campestris* and *Juniperus phoenicea* grown in Algeria was characterized by GC-MS, GC-FID and thirty-one volatile compounds were identified which made up 91.8% of the total essential oil of *A. campestris* and *forty-two* volatile compounds were identified which made up 97% of the total volatile products for *J. phoenicea*. k The essential oil yields of the studies were 0.33% and 0.44% for *A.campestris* and *J.phoenicea* respectively. The major constituent in aerial parts was α-pinene (75.8%).

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REFERENCES

[1] Quezel, P., Santa, S., 1963. Nouvelle Flore de l'Algérie et des régions désertiques méridionales (Tome II). Paris, Ed. CNRS.
[2] Ozenda, P. 2004. Flore et végétation du Sahara. 3ème édition, CNRS Editions, Paris.
[3] Djeridane, A., Yousfi, M., Nadjemi, B., Vidal, N., Lesgards, J.F., Stocker, P., 2007. Eur. Food Res. Technol. 224, 801-809.
[4] Medini, H., Elaissi, A., Khouja, M.L., Piras, A., Porcedda, S., Falconieri, D., Marongiu, B., Chemli, R., 2011. Nat. Prod. Res. 25, 1695-1706.
[5] Rameau J.C., Mansion D., Dumé G. & Gauberville C. (2008). Flore forestière française (guide écologique illustré), Région méditerranéenne. Institut pour le Développement Forestier. Volume 3, *Paris*
[6] Amer, M.M.A., Wasif, M.M., Abo-Aytta, A.M., 1994. J. Agric. Res. 21, 1077-1091.
[7] Medini H., Elaissi A., Chraief I., Bannour F., Farhat F., Ben Salah M., Khoudja M., Et Chemli R. (2007). Composition and variability of the essential oils of the leaves from Juniperus phoenicea L. from Tunisia*. Revue des region arides.* 1: 185-189**.**
[8] Albano, S.M., Lima, A.S., Miguel, M.G., Pedro, L.G., Barroso, J.G., Figueiredo, A.C., 2012. Rec. Nat. Prod. 6, 35-48.
[9] Aicha, N., Ines, S., Mohamed, B.S., Ines, B., Soumaya, K., Kamel, G., Mohamed, N., Imed, C., Mohamed, H., Leila, C.-G., 2008. J. Essent. Oil Res. 20, 471-477.
[10] Akrout, A., Chemli, R., Chreif, I., Hammami, M., 2001.. Flav. Fragr. J 16, 337-339.
[11] Belhattab, R., Boudjouref, M., Barroso, J.G., Pedro, L.P., Figueiredo, A.C., 2011. Adv. Environ. Biol. 5, 429-432.

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الأسس التصميمية والقيم الفكرية في عمارة المسكن اليمني القديم

[Design Basics and intellectual values in the architecture of old Yemen house]

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ABSTRACT: Our knowledge of an ancient architecture of Yemen during a period prior to sixth century AD is still not enough. It needs a lot of research and investigation. This research deals with the house in old Yemen during a period of the ancient Yemen kingdoms since the beginning of first millennium BC even appearance of Kingdom of Himyarite in the first three centuries AD. It aims to identify the design basics and intellectual values of the house. It deals with the house and palace of three kingdoms of old Yemen. They are Saba Kingdom, Qataban Kingdom and Hadramout Kingdom. They were studied and analyzed, and then draw general conclusions on the architecture, and draw a set of design basics and intellectual values of the architecture of old Yemen.

KEYWORDS: Ancient Architecture of Yemen, Yemen's History, Ancient Religion of Yemen, Tower House, Symbolism.

ملخص: لا تزال معرفتنا بالعمارة اليمنية القديمة لفترة ما قبل القرن السادس الميلادي - فترة ما قبل دخول الإسلام إلى اليمن – غير كافية، فهي بحاجة إلى الكثير من البحث والتقصي. يتناول البحث الحالي المسكن في اليمن القديم خلال فترة حكم الممالك اليمنية القديمة وذلك منذ بداية الألف الأول ق.م وحتى ظهور القوة الريدانية (مملكة حمير) في القرون الميلادية الثلاثة الأولى. ويهدف البحث إلى التعرف على الأسس التصميمية والقيم الفكرية للمسكن في تلك الفترة. لذا، فقد تناول البحث عمارة المسكن والقصر لثلاث ممالك يمنية قديمة هي: مملكة سبأ وقتبان وحضرموت، وذلك من خلال انتخاب نماذج معينة للمسكن والقصر، والقيام بدراستها وتحليلها، وتم استخلاص نتائج عامة عن العمارة في تلك الحقبة، واستخلاص مجموعة من الأسس التصميمية والقيم الفكرية لعمارة اليمن القديم خلال تلك الحقبة.

كلمات دلالية: العمارة اليمنية القديمة، تاريخ اليمن، الديانة اليمنية القديمة، المسكن البرجي، الرمزية.

1 المقدمة

صنع الإنسان على اختلاف العصور وتعاقب الأزمان في بقاع مختلفة من الأرض حضارات، تميزت كلٌ منها عن الأخرى، لتعكس روح عصرها ومكانها وبيئتها. ومنها الحضارة اليمنية التي تميزت بأصالتها واستمرارها، حيث تمتد جذورها إلى فترات تاريخية مبكرة، ومن أبرز سماتها الحضارية العمارة والعمران. وبرغم ذلك التميز إلا أنها ظلت بعيدة عن الضوء لفترات طويلة ولم تنل حظها من الدراسات المعمارية المتخصصة.

يتناول البحث الحالي المسكن اليمني القديم وذلك خلال فترة الألف الأول قبل الميلاد، وهي الفترة التي عرفت بفترة حكم دويلات المدن – الممالك اليمنية القديمة، وهي كذلك الفترة التاريخية التي ظهرت فيها الكتابة. وقد حكمت اليمن خلالها عدد من الممالك القديمة هي: مملكة سبأ ومملكة معين ومملكة قتبان ومملكة اوسان ومملكة حضرموت. وفي البداية سيتم استعراض الدراسات السابقة التي تناولت العمارة اليمنية القديمة والمسكن بشكل خاص، بهدف تحديد المشكلة البحثية وصياغة الأهداف البحثية.

تناولت عدد من الدراسات المعمارية المساكن اليمنية وخصوصاً المباني البرجية في صنعاء وشبام حضرموت (العمارة اليمنية التقليدية)، فيما لم تتطرق أيُّ دراسة معمارية تفصيلية للمباني السكنية لفترة ما قبل الإسلام (العمارة اليمنية القديمة). ومن تلك الدراسات دراسة الصليحي (Al-Suleihi, 1992) التي تناولت دراسة الواجهات المعمارية اليمنية؛ لمعرفة العلاقة بين الواجهات المعمارية لمباني مدينة صنعاء والشعر، وعمل نموذج يمكن بواسطته ترتيب العناصر والمبادئ الأساسية لتشكيل الواجهات المعمارية. وتناول فراندا (Varanda, 1994) موضوع التقليد والتغير في البيئة المشيدة خلال الفترة الزمنية قبيل ثورة 1962م وبعدها، وهي تغطي الفترة بين النظامين الملكي والجمهوري. وقام الشيباني وآخرون (2005) بتطبيق القيم والمضامين الإسلامية على المبادئ التخطيطية والتصميمية لطراز صنعاء القديم؛ بهدف قياس معاني الفكر الإسلامي، كما قام الباحثون بدراسة التشكيل المعماري؛ لاستخلاص القيم الروحية والمضامين التشكيلية في واجهات المباني السكنية. وتناول القادري (2006) عمارة الأبراج في وادي حضرموت، دراسة حالة المنزل البرجي التقليدي بمدينة شبام. وقدم المذحجي (2006) توصيف لخصائص التشكيل المعماري والعمراني لمدينة صنعاء القديمة. وتناولت سميرة جميل (جميل، 1999) الخصائص العمرانية لمدينة صنعاء القديمة والاستفادة منها في العمارة المعاصرة.

أما فترة ما قبل القرن السادس الميلادي، فقد تناولت بعض الدراسات العربية والأجنبية العمارة اليمنية القديمة، سواءً من الجانب التاريخي أو الأثري، ولكنها لم تخصص حيزاً كافياً لتناولها من الجوانب الفنية. فتناول بريان دو (Doe, 1971, 1983) جزئيات محددة من العمارة اليمنية القديمة في مؤلفين له، وتناول دي مغريه (De Maigret, 2002) جزئيات من العمران اليمني القديم - معابد ومدن ومدافن - خلال الفترات التاريخية في الألف الأول قبل الميلاد. وتناول عبد الله الشيبة (2000) في كتابه "دراسات في تاريخ اليمن القديم" دراسة نشوء المدينة اليمنية القديمة ومكوناتها. في حين تناول حنشور (2007) في رسالته خصائص العمارة اليمنية القديمة، بهدف إبراز أهم الخصائص المعمارية للمدينة اليمنية القديمة، ومدى التقدم الفكري والخبرة المعمارية والإنشائية التي وصل إليها المعمار اليمني القديم. كما تناول الأغبري (1994) في رسالته "التحصينات الدفاعية في المدن والحصون اليمنية القديمة". وعرضت عزة عقيل وجان بريتون (1996) نتائج أعمال البعثة الأثرية الفرنسية اليمنية في كتاب بعنوان "شبوة عاصمة حضرموت القديمة".

ومن الدراسات التي تطرقت في جزئيات معينة للمساكن والقصور اليمنية القديمة، ما قام به دي مغرية وروبن (2006) من أعمال التنقيبات الأثرية لمدينة تمنع عاصمة قتبان، والتي كشفت عن المساكن المحيطة بسوق المدينة، مما أتاح التعرف على المساكن اليمنية القديمة، وتمّ تحليل ثلاثة مباني سكنية حول السوق المركزي لمدينة تمنع. وتمكنت بعض الدراسات من التعرف على التفاصيل الخاصة بعدد الأدوار ووظائف الغرف (Loreto, 2012). وتناول دي مغرية (De Maigret, 2005c) بعض الملاحظات عن المسكن العربي الجنوبي (اليمن) من خلال المقارنة بين نماذج لمساقط المعابد والمساكن والمقابر ومقارنتها بنماذج مشابهة لحضارات مجاورة في نفس الفترة الزمنية. وتناول سنييه (1996) القصر الملكي في شبوة وعمل تصور تخيلي للقصر، كما ناقش الغامدي (1995) "عمارة المسكن وتخطيطه في جنوب شبه الجزيرة العربية في عصر ممالكها القديمة على ضوء المكتشفات الأثرية". وتناول بروتون (1998) "المسكن في مدينة شبوة بين الأصالة وتقاليد المناطق المجاورة". وتناول بريتون (1992) "البيت الشاهق والبيت ذو الفناء في اليمن القديم والمعاصر".

يتضح من ذلك، أن أغلب الدراسات التي تناولت العمارة اليمنية القديمة كانت عبارة عن دراسات وتقارير للتنقيبات الأثرية، كان الهدف منها التوثيق للعمارة اليمنية القديمة، ولم يتم تناول العمارة اليمنية القديمة – فترة ما قبل دخول الإسلام - من منظور معماري، حيث تركزت الدراسات والبحوث المعمارية على دراسة العمارة اليمنية في الفترة التي تلت دخول الإسلام إلى اليمن وخصوصاً في الفترة المتأخرة.

1-1 مشكلة البحث

إن إشكالية فقر العمارة اليمنية المعاصرة، وتغلب المفاهيم والأفكار المعاصرة على المفاهيم الفكرية والثقافة السائدة، أوجد عمارة يمنية حديثة ابتعدت عن إنسانيتها وقيمها الروحية الكامنة في بنيتها المكانية. ويرجع ذلك إلى عدم معرفة ممارسي العمارة والنخبة بالأسس التصميمية والقيم الفكرية لمفردات العمارة اليمنية القديمة، وكذلك عدم توفر بحوث معمارية متخصصة تطرقت لموضوع العمارة اليمنية القديمة. والحقيقة، إن العمارة اليمنية القديمة - أي قبل دخول الإسلام إلى اليمن- لم تحظ بالاهتمام اللازم من قبل المعماريين، بالإضافة إلى أن الدراسات المعمارية التي تطرقت إلى دراسة العمارة اليمنية القديمة اهتمت بالبعد التاريخي الذي لا يتجاوز فترة دخول الإسلام إلى اليمن – القرن السادس الميلادي، ولم نجد أي دراسة معمارية متخصصة تناولت العمارة اليمنية القديمة لفترة ما قبل الإسلام من جوانبها الفنية، وهو ما يشير إلى وجود فجوات وتجاهل لعمارة اليمن القديم من المنظور المعماري.

1-2 الأهداف

يهدف البحث إلى تسليط الضوء على العمارة اليمنية القديمة وبالخصوص المسكن اليمني القديم خلال فترة الألف الأول قبل الميلاد، وذلك بهدف إظهار واستخلاص قيم وأسس التصميم للمسكن اليمني القديم. كما يهدف إلى إبراز حضارة اليمن القديم في المجال المعماري استكمالاً لما قدمته بعض الدراسات الأثرية والتاريخية، كمحاولة منه إخراج عمارة اليمن القديم إلى النور.

1-3 منهجية البحث

اتبع البحث المنهج التحليلي والتاريخي من خلال دراسة نماذج منتخبة للمسكن والقصر من كل مملكة يمنية قديمة. فتم اعتماد المنهج التاريخي للتأكد من تحديد المراحل المتعاقبة للتطور المعماري الذي شهده اليمن خلال تلك الفترة، والمنهج التحليلي لمناقشة النماذج التي تم انتخابها. هذا بالإضافة إلى استخدام المنهج الوصفي والمقارن في جزئيات تستدعي ذلك. هذا وسيتم أولاً البحث عن الجذور الفكرية والتصميمية للمسكن اليمني بشكل عام، ثم انتخاب نماذج معينة لتحليلها والخروج بنتائج عامة.

2 جذور المسكن اليمني القديم

عرّف اليمنيون المسكن في نقوش المسند بمصطلح (بيت)، وهو نفس الاسم الذي أُطلق على المعبد (بيت الإله)، وقد وصف البيت اليمني القديم فقيل إن أبوابه وجدرانه وسقوفه كانت من العاج والأحجار الكريمة، وغلفت أعمدته بالصفائح الذهبية والفضية (بافقيه، 1989). وجاء القصر في نقوش المسند بلفظ "صرحت، صرحة" والصرح بيت واحد يُبنى منفرداً طويلاً في السماء وهو القصر أو كل بناء مرتفع (علي ج8، 1993).

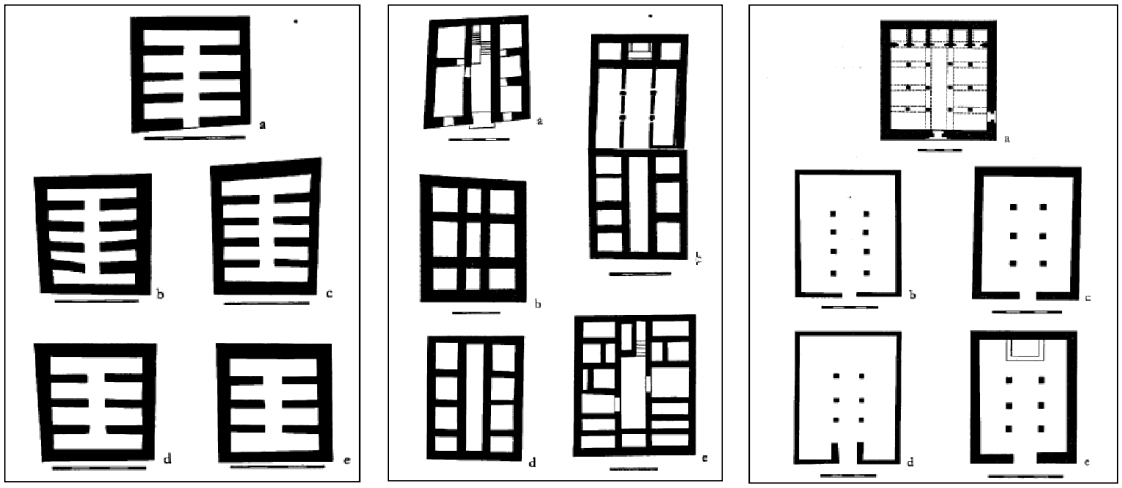
وقد حرص اليمنيون على توكيل حماية مساكنهم العامة والخاصة إلى الآلهة (الحسني، 2012)، فمن تقاليدهم أن يدون صاحب البيت أوصاف بيته وعهد الملك الذي بني البيت في عهده واسم الإله الراعي، ثم يوضع الحجر الذي كتب عليه ضمن البناء كنوع من الزخرفة، ففي نقش (يمن 11) أن "نبط عم زادن من آل معاهر... بنى قصره شبعان وسواه وحفر أساسه، ووقفه باسم الآلهة وعلاه وذلك ضمن سور المدينة قانية ومن أساس القصر حتى قمته"، وفي نقش (Doe 7) أن "بني رأبم آلهن بن ذرا كرب.. بيته (وثعن) من قاعة استقبال (طابق أرضي)، وطابقين عاليين وجدارين من الأساس إلى القمة" (الجرو، 2003).

كما زودتنا نقوش المسند بأسماء العناصر الفضائية للمسكن، فجاء اسم المدخل "مور"، والصالة الأمامية "صولت"، وصالة الاستقبال أو الجلوس في المسكن "محرب" وهي تقابل محراب المعبد، والمطبخ "بسل"، وتسمى الطوابق العلوية "علوهم" أو "علوه" والطابق الأرضي "خطب" أو "سفلة" (الغامدي،

1995)، وجاء اسم الحجرة الأمامية "ذقن"، وقاعة الاستقبال أو المجلس "مسود"، وقاعة الولائم أو الاحتفالات "مألمت"، والسلالم الحجرية والخشبية "أحلين"، والنافذة والشباك "خلف"، والمنور "مصبح"، والأدوار أو الطوابق "بحور"، وسطح البيت "مريم"، وفناء المنزل "فنو" (البريهي، 2000).

وقد أثبتت التنقيبات والأبحاث الأثرية أن المسكن متعدد الطوابق (المسكن البرجي) كان نمطاً رئيسياً عند عرب الجنوب (اليمن) منذ بداية الألف الأول ق.م، وأن التطور الرأسي للبيت إحتاج إلى تخصص حرفي إلى جانب الموارد المالية، لذا يعتقد ظهوره أولاً في المدن (بريتون، 1992). يؤكد ذلك ما كشفت عنه البعثة الأثرية الإيطالية في يلا الدريب عن مبنى متعدد الطوابق، يرجع بنائه إلى بداية الألف الأول ق.م، كما أظهرت الحفريات التي نفذت في ريبون على وجود النمط البرجي منذ القرن الثامن ق.م (بروتون، 1998). ومن ثمّ فإن قصر غمدان الشهير ما هو إلا ثمرة جهد لمراحل تطورية على مستوى الفكر المعماري والإنشائي، فقد بُني القصر في القرن الأول للميلاد واستمر حتى خلافة عثمان بن عفان، وقد قال الربيع بن ضبيع الفزاري فيه "وغمدان إذ غمدان لا قصر مثله... زهاء وتشييداً يحاكي الكوكبا" (الحوالي، 1982).

والملاحظ، أن مسقط المسكن ما هو إلا تكرار لمسقط المعبد؛ وذلك نتيجة للتشابه الكبير بينهما (الشكل 1). ولقد قارن البروفيسور دي مغرية بين مساقط المعابد والمساكن والمقابر، فوجدها تتشابه من ناحية الشكل والتفاصيل مع بعض الحالات التي استبدلت فيها الأعمدة في صالة المعبد بقواطع في المسكن والقبر، ممّا يوحي بوجود نموذجاً معمارياً واحداً تمّ تحويره على حسب الوظائف (De Maigret, 2005c). هذا، واعتبر دي مغرية مسقط المعبد مستوحى من مسقط المسكن، ولكننا نختلف معه ونرى العكس من ذلك، إذ أن مسقط المسكن مستوحى من المعبد؛ كون المعبد بيت الإله، ومن ثمّ فإن هذا النموذج الذي طبق في المقابر والمعابد والمساكن هو دليل على وجود رؤى ومفاهيم دينية مرتبطة بتصور معين يحملها هذا النموذج تتعلق بقصر الإله في السماء. وعليه، فتطبيقه أولاً جاء على المعبد؛ كونه يمثل نسخة طبق الأصل لنموذج بدئي، ويدعم هذا الرأي تأكيد أحد الباحثين عند حديثه عن أصالة تخطيط المعبد اليمني وامتداده ليشمل العمارة المدنية، حيث قارن وشبه تخطيط قصر شبوة ومساكن في ريبون ومشغة بتخطيط المعبد اليمني القديم (العريقي، 2002).



أ- نماذج لمساقط معابد ب- نماذج لمساقط مساكن جـ- نماذج لمساقط مقابر

الشكل 1: نماذج لمساقط المعابد والمساكن والمقابر اليمنية القديمة (De Maigret 2005c)

إن هذا النموذج لم يتكرر أو يشابه أيّ مساقط لمبانٍ سكنية مشابهة للحضارات المجاورة وذلك خلال فترة ظهوره. فقد أثبتت الدراسات الأثرية والنقشية أن تصميم المسكن الكلاسيكي في المدن الإغريقية، كان عبارة عن وحدات مستطيلة مغلقة من الخارج، وتفتح الأبواب والنوافذ على فناء داخلي (الشكل 2). واختلف نموذج تصميم المسكن الكنعاني (الشكل 3)، والذي كان عبارة عن مسقط له فناء وسطي، وجاء مسقط المسكن الفلسطيني الذي يعود إلى فترة بداية الألف الأول ق.م، والذي يُسمى المسكن ذو الأعمدة قريب الشبه بمسقط المعبد اليمني ذي الصالة المعمدة، وهو عبارة عن مسكن يحمل سقفه صفان من الأعمدة الحجرية، والذي يمثل نموذجاً فلسطينياً (Schloen, 2001).

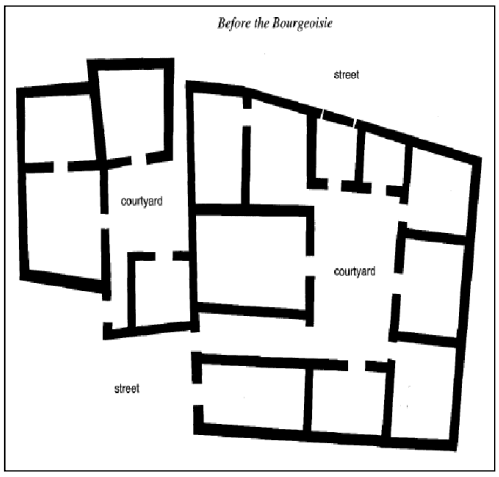
وقد عمد دي مغرية بمقارنته بالمسكن اليمني، ولكن كما سنرى لاحقاً فإن المسكن اليمني لم يستخدم الأعمدة في مسقط المسكن، بل كان الدور الأرضي والأدوار الأخرى عبارة عن جدران تقسم المسقط إلى غرف تستخدم كأماكن خزن وخدمات أخرى. وعلى الرغم من تشابه المسقط في طريقة تقسيمه إلى صالة وسطية تفتح عليها الغرف المجاورة، فإن الاختلاف واضح، حيث يحتوي المسكن اليمني على ممر وسطي يربط الباب مع الدرج الحجري الذي يقع نهاية الممر، فيما لا يحتوي المسكن الفلسطيني على درج يقع نهاية المحور، بل ينتهي بغرف مستطيلة، تأخذ الضلع الخلفي للمسكن بالكامل، وتنفتح على الصالة الوسطية، كما أن الصالة الوسطية ذات عرض كبير مما يطرح احتمالية أنها عبارة عن فناء وسطي مفتوح على السماء.

واما من ناحية الشكل الخارجي للنمط البرجي في اليمن القديم، فيمكن تكوين فكرة عنه من خلال المقارنة مع المسلات الأكسومية (الشكل 4)؛ كون الأسس المعمارية للثقافة الأثيوبية خلال الألف الأول ق.م قد استقت مبادئها من ثقافة جنوب الجزيرة العربية (اليمن)، فكان الشكل المعماري للمسلات مستوحى من الأشكال المعمارية الأكسومية واليمنية القديمة، فيرى عبد الله الشيبة أن هذه المسلات تمثل مرحلة متطورة للصخور التي كانت تنصب عمودياً (الشيبه، 2000)، وهي تُعبر عن "بيت الإله" أو إله الشمس السبئي أو عدد السماوات، وقد جاءت من جزءين هما: المنصة والنصب (المسلة)، حيث المنصة في الأسفل تحاكي قاعدة المذبح (المبخرة أو المائدة المقدسة) في وظيفتها، وقسمت الواجهة إلى طبقات (أدوار) بكلّ منها تجويفات أو نوافذ وهمية، ويفصل بين الطبقات إفريز أفقي من الدوائر (Van Beek, 1967).

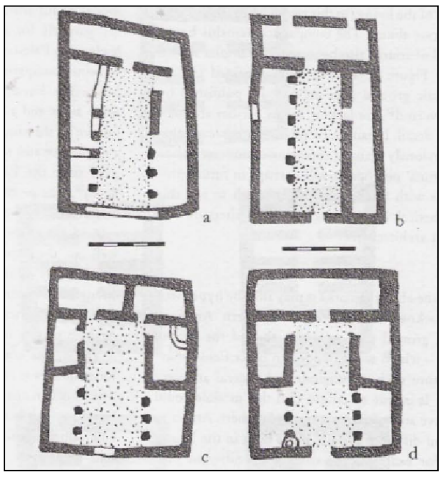
والغاية من المنصات هي أن تكون بمثابة الوظيفة التي يقوم بها المذبح (المائدة المقدسة) كمكان لإسالة دماء الأضاحي أو مكان للتقدمات الخاصة بالقرابين (Van Beek, 1967). ويعتقد الشيبة أن هذه المسلات ترمز إلى المساكن البرجية متعددة الطوابق، فهي تحاكي تماماً البيوت البرجية التي مازلنا نراها في صنعاء وشبام حضرموت، كما أن زخارفها الجانبية تحاكي فنّ البناء العربي الجنوبي القديم - اليمن قديماً (الشيبه، 2000).

ومن الرسوم الصخرية للقصور يتضح أن البناء كان برجياً، ويظهر من واجهته أنها شبيهة بالمباني البرجية التقليدية؛ فهو عبارة عن كتلة تتدرج ارتفاعاتها لتنتهي بكتلة المفرج، كما تظهر الواجهة غنية بتشكيلاتها وزخارفها، حيث النوافذ المتعددة والأحزمة الأفقية التي تفصل الأدوار، وكذلك البروزات في جميع أركان

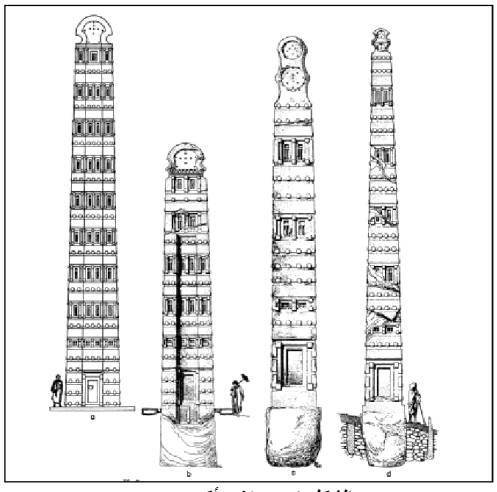
المبنى. وتظهر غرفة في قمة المبنى تشابه غرفة المفرج في مساكن صنعاء القديمة، ويتضح ذلك من الرسوم الصخرية للقصور مثل رسم ريمة حميد (الشكل 5)، علاوة على وصف غرفة الملك في قصر غمدان.



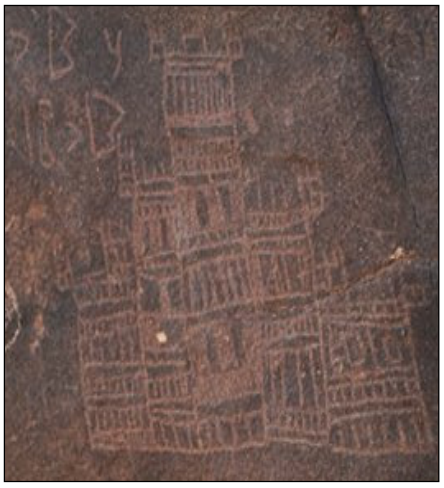
الشكل 2: مسقط لمسكن إغريقي
(Schloen 2001)



الشكل 3: نماذج من المساكن الفلسطينية
(De Maigret 2005c)



الشكل 4: مسلات أكسوم
(Van Beek 1967)



الشكل 5: الرسم الصخري للقصر الذي كشف عنه في ريمة حُميد إلى الجنوب الشرقي من مدينة صنعاء (الانترنت)

3 الدراسة التحليلية

لاجراء الدراسة تم انتخاب نماذج للمساكن والقصور لثلاث من الممالك اليمنية القديمة، هي:

3-1 المسكن في مملكة سبأ

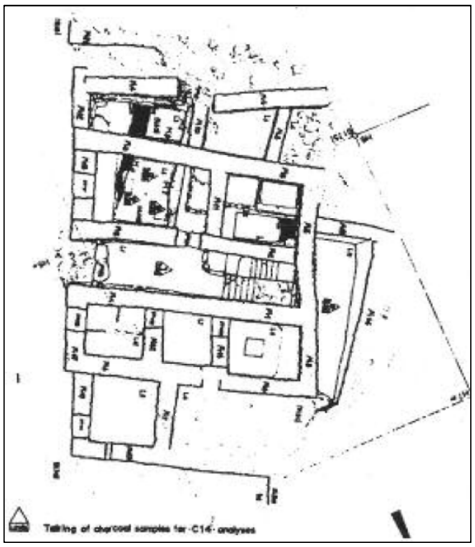
تعتبر مملكة سبأ أهم مملكة في جنوب الجزيرة العربية (اليمن)، وقد تشكلت المملكة باندماج ثلاث قبائل لتشكل ما عرف بقبيلة سبأ، والتي اتخذت من مدينة مأرب، وصرواح مناطق استقرار لها. وقد ازدهرت مملكة سبأ لمدة 13 قرناً بدءاً في القرن العاشر ق.م، وأقدم نقش ذكرت فيه يعود إلى القرن الثامن ق.م، واستمرت إلى القرن الثالث الميلادي (حنشور، 2005). وبلغت مملكة سبأ درجة كبيرة في عهد كرب إل وتر، حيث بُنيت المباني الدينية الضخمة، مثل معبد أوام، ومعبد بران في مأرب، ومعبد إلمقة وعول صروح في صرواح، ومعبد معربم في المساجد، وفي القرن السابع ق.م تم إنشاء سد مأرب بمخارجه الضخمة، وقد اتخذت المملكة مدينة مأرب عاصمة لها، حيث ذكرت في النقوش "هجرن\ مرب أو مريب" (الشيبه، 2000).

سيتم دراسة مسكن في مدينة يلا الدريب، وقصر صرواح في مدينة صرواح، كون معالمهما واضحة.

أ- مسكن في يلا الدريب

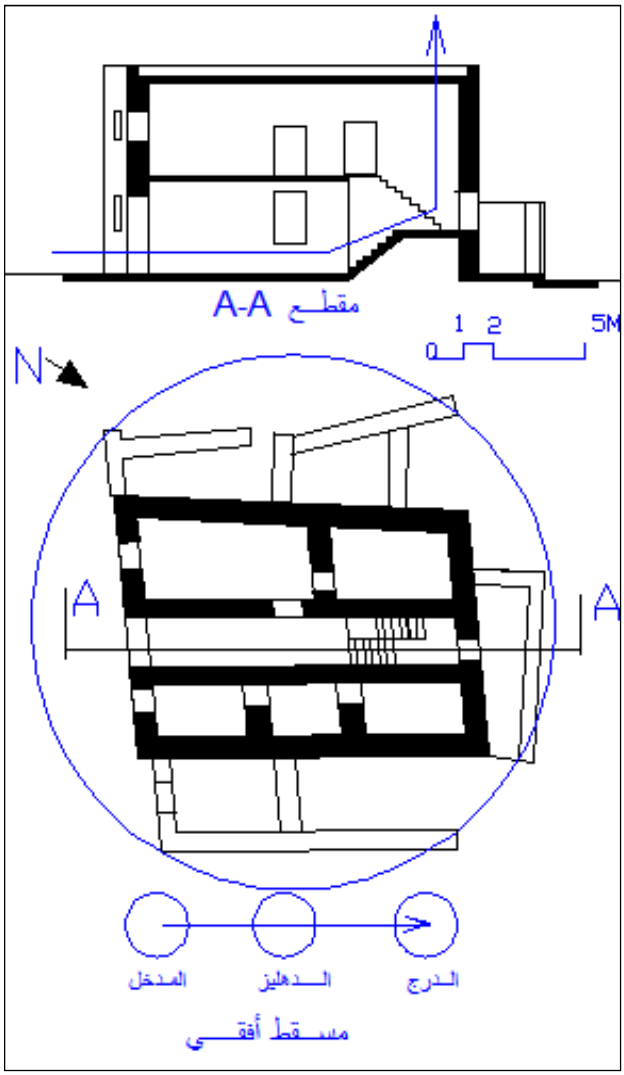
تقع مدينة يلا الدريب في وادي "يلا"، على بعد 30 كم إلى الجنوب الغربي من مدينة مأرب، وتمثل مدينة يلا الدريب نموذجاً للمدن السبئية المبكرة، حيث وجدت على تل طبيعي يرتفع عن مستوى الوادي، ويظهر من تخطيطها صغر حجمها. وقد اثبتت الدراسات الأثرية ان تاريخ أقدم طبقة للمسكن محل الدراسة ترجع إلى النصف الثاني من الألف الثاني ق.م، وأحدث طبقة إلى النصف الأول من الألف الأول ق.م (دي مغرية وروبان، 1999). ويقع المسكن في الجهة الشمالية للمدينة العليا، بحيث يفتح بابه على شارع يقع بين المسكن وبين سور المدينة، فيما تطل واجهة المبنى الخلفية على الساحة الوسطية للمدينة العليا، ويتكون المبنى من قسم مربع الزوايا، مع بعض الأقسام التي أضيفت على جانبيه، ويتناظر البناء في الواجهة على جانبي الباب ذي المصراعين يقود إلى الدهليز (الصالة)، وعلى جانبي الباب في الواجهة نافذتان (دي مغرية وروبان، 1999) (الشكل 6)، وتتجه الواجهة الرئيسية للمبنى باتجاه الجنوب الشرقي، وأركان المبنى متجهة إلى الجهات الأصلية.

صُمم مسقط المسكن بشكل مستطيل، يقسم الدور الأرضي ممر وسطي يصل بين الباب وسلم ذي اتجاهين يقود إلى الطابق الثاني. ويلاحظ من تصميم المبنى عدم ضبط زوايا أركانه عند التأسيس، أما التنظيم الوظيفي للمبنى، فقد استخدم الطابق الأرضي كغرف لخزن المحاصيل ومجمعات للمياه، حيث وجد أحواض من بلاطات حجرية، كما أن ارتفاع مدخل القسم الشمالي مرتفع مما تطلب درجاً خشبياً لبلوغه (دي مغرية وروبان، 1999). واستُخدم الطابق العلوي للساكنين، وهو يتكون من صالة (ممر) مستطيلة وغرف على جانبيها. هذا وبُنيت جدران المبنى بشكل مزدوج من أحجار صغيرة جُلبت من الجبال القريبة من الموقع، أما التسقيف فهو عبارة عن عوارض خشبية مُدّت في الاتجاه القصير لبحور الفضاءات، حيث وجدت آثار الحُفر التي كانت تثبت عليها العوارض على جدران الممر. أما الواجهة الرئيسية فإنها تتشكل من مدخل ونوافذ مستطيلة، فالمدخل عبارة عن باب بعرض الممر، والنوافذ مستطيلة الشكل وجدت منها اثنتان في جدار الواجهة الرئيسية على جانبي المدخل (الشكل 7).



الشكل 6: مسقط لمسكن يلا (ديمجريت 1999)

الشكل 7: منظر عام لمسكن يلا (الباحث)



الشكل 8: مسقط ومقطع تخيلي للمسكن (الباحث)

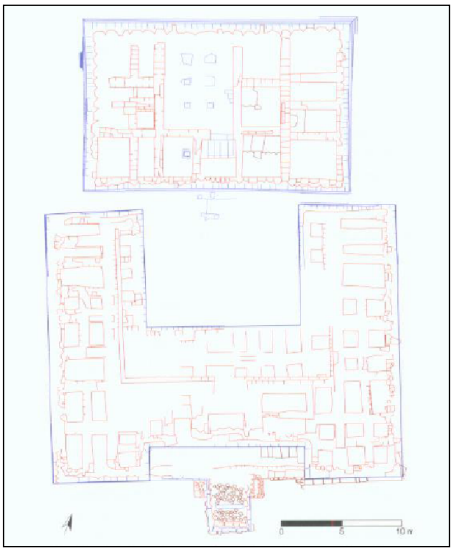
ب- قصر صرواح (المبنى الإداري)

تقع مدينة صرواح على سفح جبل يبعد 40 كم غرب مدينة مأرب، وعلى مساحة تتجاوز 6 هكتارات، وجاءت متماشية مع طبوغرافية الموقع الذي أُقيمت عليه، وتم تخطيطها داخلياً بشكل شبكي للشوارع التي تربط أجزاء المدينة شرق - غرب، وشمال – جنوب. وللمدينة شارع رئيسي يقسمها إلى قسمين شرقاً وغرباً. ويقع معبد إلمقه (وعول صرواح) في الركن الجنوبي الشرقي من المدينة، وفي منتصف الجهة الشمالية يوجد القصر أو مبنى إداري.

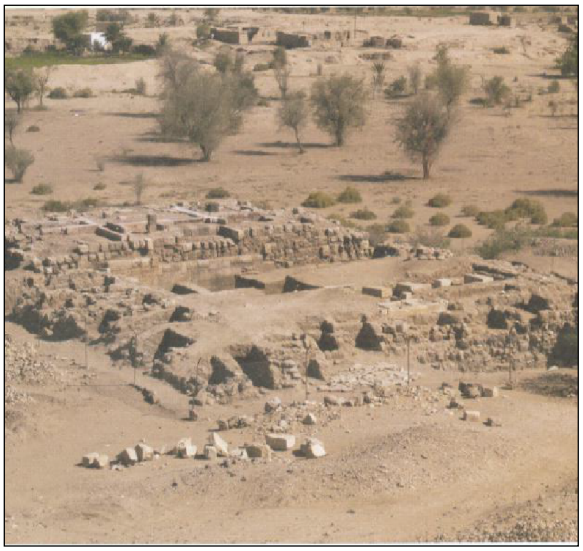
وقد تمّ توقيع مبنى القصر (المبنى الإداري) بتوجيه اركانه إلى الجهات الأصلية مع ميل بسيط باتجاه. ومسقط المبنى على شكل وحدتين معماريتين إحداهما مستطيلة في الجهة الشمال، والأخرى على شكل حرف U في الجهة الجنوب، وتمّ رفع المبنى الشمالي على منصة ارتفاعها 12 م، ويوجد أمامه ساحة تشكلت من المبنى الجنوبي ذي الأروقة من ثلاث جهات هي الجنوب، والشرق، والغرب (الأشكال 9، 10).

يتم الدخول إلى المبنى الجنوبي من خلال درج (سلم) يؤدي إلى المدخل الذي تتقدمه صالة خارجية، ويتم الدخول إلى المبنى الشمالي على صالة معمدة بستة أعمدة، وتتوزع الغرف على جانبيها. وتصميم المبنى ونظامه الإنشائي يشير إلى ان المبنى الشمالي كان متعددة الطوابق وكان خاص بالملك كسكن له وللأسرة، اما المبنى الجنوبي فكان عبارة عن دور أو دورين فقط، وكان خاص بأستقبال الزوار واماكن لسكن الحراسة. ومن جانب آخر، فقد صُمم قطاع المبنى بمناسيب مختلفة يصل إليها عبر (سلالم) أدرج حجرية، فيتغير المنسوب الخارجي عن منسوب المدخل الجنوبي وعن منسوب الفناء الداخلي، كما يتغير منسوب الفناء الداخلي عن منسوب المبنى الشمالي.

وقد بُني المبنى بتقنية هيكلية خشبية وطين مع قاعدة حجرية، وتمّ تغطية الواجهات بألواح حجرية مزينة، وبُنيت الجدران بأسلوب البناء المتدرج، الذي تتراجع فيه المداميك العليا عن التي تحتها (الشكل 11). ويحمل تصميم المبنى عدداً من المعاني، منها أن المبنى يقع على نهاية المحور، الذي يربط المعبد في الجنوب وينتهي بالقصر في الشمال، فيبدو المبنى مسيطراً على المدينة، وجاء مسقط المبنى من مستطيلات كنمطٍ سائدٍ، والبناء كان متدرجاً يرمز إلى الصعود الروحاني. كما تم توجيه المبنى لتتجه أركانه إلى الجهات الأصلية فيشير بذلك إلى جهات الدنيا الأربعة (الشكل 12).

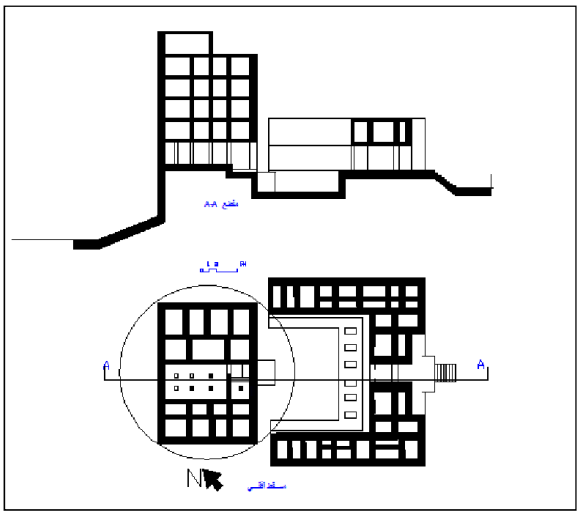


الشكل 9: مسقط للمبنى (Japp 2012)



الشكل 10: منظور عام للمبنى (Japp 2012)

الشكل 11: تقنية البناء في المبنى الشمالي (الباحث)



الشكل 12: مسقط ومقطع تخيلي للمبنى (الباحث)

3-2 المسكن في مملكة قتبان

اختلف الباحثون في تحديد بداية التكوين السياسي لمملكة قتبان، فمنهم مَنْ يرى أنها ترجع إلى نهاية الألف الثانية ق.م، ومنهم مَنْ يرى أنها في بداية الألف الأول ق.م، أما عن نهايتها فكان أثر حريقٍ مدمرٍ قام به ملوك سبأ وذو ريدان في القرن الثاني الميلادي (حنشور، 2005). أما حدود مملكة قتبان فهي تمتد إلى الشمال الغربي حتى حدود مدينة ذمار، وإلى الجنوب حتى حدود مدينة عدن ومضيق باب المندب. وكانت عاصمة المملكة هي مدينة تمنع (هجر كحلان حالياً), والتي تحتل موقعاً متميزاً يسيطر على مخرج وادي بيحان إلى صحراء صهيد، وعلى هضبة ترتفع 20م على مستوى الوادي (دي مغرية وروبان، 2006).

أظهرت التنقيبات الأثرية في مدينة تمنع مجموعة من المساكن، وهي المساكن القريبة من البوابة الجنوبية والمساكن المحيطة بالسوق، والتي يرجع تاريخ بنائها إلى القرن الثالث ق.م، وقد دمرت في القرن الثاني الميلادي (Loreto, 2012). وقد تمّ إنشاء مساكن المدينة سواء التي تقع في الجنوب، أو التي تقع حول السوق بمساقط مستطيلة على قواعد حجرية ضخمة سمك جدارها يتراوح بين 80 و100سم، ولها مدخل واحد مرتفع عن مستوى الأرض، يتم الصعود إليه عبر درج خارجي يؤدي إلى مستوى المدخل الذي يشكل بداية الممر الوسطي، والذي ينظم التنظيم الفراغي للمسكن حوله، وينتهي هذا الممر بسلم حجري يؤدي إلى الأدوار العليا وفضاء الاستقبال في الطابق الأخير. وقد أكدت النقوش بأن فضاء الاستقبال "المسود" كان في الطابق الأخير وأنه مكون من غرفتين إحداهما تسمى "صرحة" والأخرى تسمى "صالة" (بروتون، 1998).

ومن خلال دراسة تمت على احد المباني اتّضح أن الدور الأرضي استُخدم كفضاء معيشي، حيث قُسم إلى سلسلة من الغرف تتعامد جدرانها على الممر المركزي، واستخدمت هذه الغرف لأغراض الطبخ والخزن، وقد دلّت المخلفات الأثرية التي وجدت فيها أن هذه المباني السكنية صُممت كمبانٍ متعددة الأدوار من

طابقين أو ثلاثة طوابق، وبُنيت جميع المساكن على قاعدة حجرية يتراوح ارتفاعها بين 2.5- 4م، ولا تحتوي على نوافذ، وهذه القواعد تعتبر أساساً للهيكل الخشبي المحشو بالطين لجدران الأدوار العليا، كما بُنيت الجدران الداخلية مرتفعة عن الجدار الخارجي، حيث استُخدمت هذه الغرف كمخازن تجارية (Loreto, 2012).

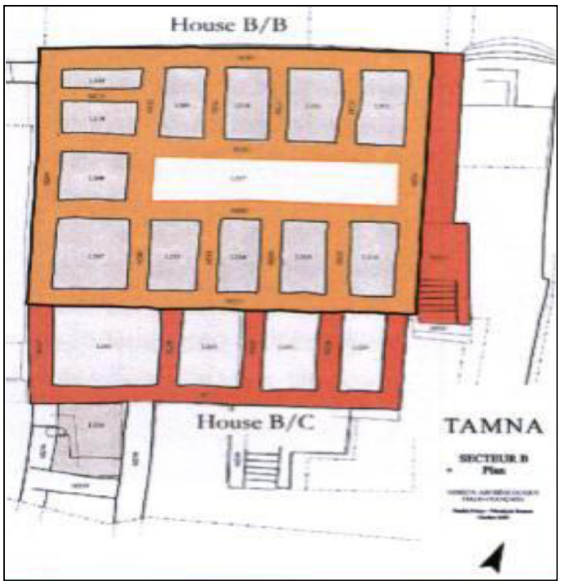
لقد بُنيت المباني حول السوق خلال الفترة الواقعة بين القرنين الرابع والثالث ق.م حسب عينات الكربون 14 على العوارض الخشبية (دي مغرية وروبان، 2006)، حيث بُنيت من الطين والهياكل الخشبية، وتمّ تكسية الجدران بألواح حجرية زخرفية منها ما وجد في البيت B/H (Loreto, 2008): زخارف النوافذ الكاذبة التي تتشكل من مستطيلات متدرجة ومتراجعة في مساحتها للداخل، وزخارف عبارة عن ألواح حجرية تتشكل الزخرفة من خطين عموديين ويعلوهما عدد من الخطوط الأفقية، ويتم معالجة حجر بناء الواجهات الخارجية بصقل حوافاها وترك وسطها خشناً.

أ- مسكن تمنع المبنى B\B

يقع المسكن تحت الدراسة والذي سمي في النقوش (بيت ياعود) في الجهة الجنوبية من سوق تمنع ضمن سلسلتين من المباني الخاصة أحداهما في الشرق والأخرى في الجنوب مكونه مع بعضها ساحة بزاوية قائمة هي ساحة السوق، هذا وتتخلل المساكن أزقة ضيقة سدت لمنع المرور إلى السوق، إلا عبر شارع واحد واسع (دي مغرية وروبان، 2006). وصمم المسكن بمسقط مستطيل، وتوجية أركانه إلى الجهات الأصلية، ويحيط بالمسكن من الشمال الشرقي والجنوب الغربي شوارع ضيقة تتفرع من ساحة السوق، فيما ألصق المبنى B\C عليه من الجهة الجنوبية الشرقية (الشكل 13).

لقد صُمم مسقط المسكن بأبعاد 9.60*7.80م، له دهليز مركزي (صالة) تتوزع عليه الغرف من الجانبين، وله مدخل واحد في الجهة الشمالية الشرقية يتم الصعود إلى مستواه بواسطة درج حجري (سلم) على جانب الجدار (الشكل 14)، وينتهي بصحن أمام الباب يتم الانتقال من خلاله إلى الدهليز، الذي يكون سطحه مبلطاً بصفائح، وهذا الدهليز يؤدي في عمقه إلى درج (سلم) يرتكز على الغرفة الوسطية الواقعة في عمق الدهليز والذي يؤدي إلى الطابق العلوي (دي مغرية وروبان، 2006)، ويُفتح على الدهليز عدد من الغرف المستطيلة تمتاز بعرضها الصغير وسماكة جدرانها (الشكل 15).

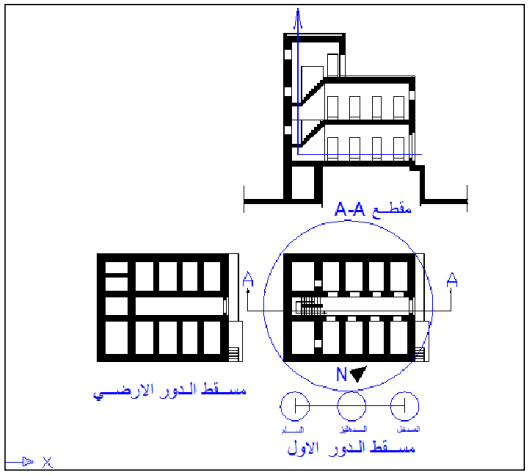
والحقيقة، ان سماكة القواطع الكبيرة كانت لأغراض إنشائية؛ وذلك لحمل جدران الأدوار العليا وسهولة التسقيف، فالمبنى يتكون من طابقين علويين، وسقف مستوٍ، ونوافذ مربعة ومستطيلة (Loreto, 2011). وقد بُني المسكن على قاعدة حجرية ضخمة من أحجار جرانيت كبيرة الحجم إلى ارتفاع أكثر من 3م، وأُلصق على جداره الجنوبي المبنى B\C، ثم بُنيت الأدوار العليا بواسطة الهياكل الخشبية والطين، وتمّ تكسية الجدران الخارجية بألواح من الحجر المصقول، وزُخرفت الواجهة بعدد من أنواع الزخارف (دي مغرية وروبان، 2006).



الشكل 13: المسكن B\B في سوق مدينة تمنع (دي مغريه وروبن 2006)

الشكل 14: الدرج الصاعد إلى المدخل (الباحث)

الشكل 15: الغرف والقواطع الفاصلة للمسكن (الباحث)



الشكل 16: مساقط ومقطع تخيلي للمسكن B\B في تمنع (الباحث)

ب- قصر تمنع – المبنى الكبير (TTI)

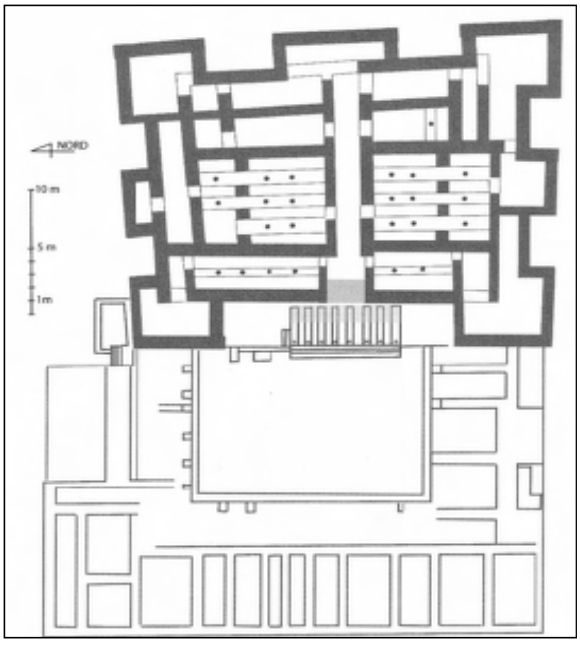
ينبغي التنويه إلى أن المبنى الكبير (TTI) في مدينة تمنع يعود إلى القرن الثامن أو السابع ق.م، وقد مرَّ بناؤه بعدة مراحل: المرحلة الأولى في القرن الثامن أو السابع ق.م، حيث بَنِيت الجدران السفلية، والمرحلة الثانية في القرن السادس ق.م، حيث بُنِيت جدران البناء، والمرحلة الثالثة في القرن الرابع ق.م، حيث بُنِيت الساحة والدرج، والمرحلة الرابعة في القرن الأول ق.م حيث بُنِيت الحجرات والغرف الغربية التي كانت تستخدم كمستودعات، وقد ظهرت التأثيرات الهلينسية في هذه المرحلة (الجرو، 2003). هذا واختلف الباحثون حول نوعية المبنى هل هو قصر أم معبد؟ حيث اعتبره الإنجليزي (دو) معبد عثتر، في حين اعتبرته البعثة الأثرية الفرنسية، التي عملت في شبوه عاصمة حضرموت القصر الملكي حريب، بينما اعتبره الحسني معبد الإله عم ذو دونم (الحسني، 2012).

لقد تم توجية المبنى باتجاه الجهات الأصلية مع ميل بسيط يجعل من محور البناية الرئيسي يتجه بزاوية 99 من الشمال باتجاه الشرق. ومحور المبنى الرئيسي – أي محور المدخل مع العمق الداخلي للمبنى- باتجاه الغرب إلى الشرق، ثم تحول المدخل باتجاه الشمال نظراً لإضافة البناية الغربية (ب)، كي تتماشى مع التخطيط العام للمدينة، وربما لارتباطها بالسوق أو الميدان أو غيره (الشكل 17).

وقد مر بناءه بعدة مراحل: المرحلة الأولى هو البناية الشرقية (أ) وصُممت على نمط المعابد السبئية، وهذا واضح من خلال المدخل الرئيسي والذي يميز مداخل المعابد اليمنية القديمة. وصُمم جدار المبنى على شكل بروزات – ناتىء وغائر – بالاسلوب الذي صُممت على نمطه أسوار المدن اليمنية القديمة (الشكل 18). هذا ويكون الدخول إلى الفناء عبر مدرجين (سلالم) في الشمال والجنوب، حيث الدرج الشمالي أكبر وبعرض 9.5م. وصُمم قطاع المبنى بمناسيب مختلفة يصل إليها عبر (سلالم) أدرج حجرية، فيتغير المنسوب الخارجي عن منسوب الفناء الداخلي، كما يتغير منسوب الفناء الداخلي عن منسوب أرضية المبنى الرئيسي.

ويتم الدخول إلى المبنى الرئيسي الواقع في الجهة الشرقية من خلال مدخل في الجهة الغربية يتقدمه مظلة بارزه تحملها ثمانية أعمدة لاتزال قواعدها المستطيلة في مكانها. ويتكون المسقط الأفقي للمبنى الرئيسي (أ) من شبكة من الجدران المتقاربة والتي تمثّل أساسات لجدران الطوابق العلوية. ومن كمية الكتل المتراكمة على السطح، علاوة علي الدراسات الأثرية التي أجريت عليه يؤكد الباحثين انه مبنى متعدد الطوابق ذا ارتفاعاً كبيراً شبيه بقصر "شقر" الذي سيتم مناقشته لاحقاً. اما المبنى الغربي (ب) فله فناء وسطي ينخفض بمقدار متر عن مستوى المبنى الشرقي، ويحيط به أروقة تحملها أعمدة من ثلاث جهات، ويوجد في الجهة الغربية سلسلة من الغرف كانت مستودعات ومخازن، هذا ويتم تصريف مياه الأمطار الساقطة على الفناء عبر قناة تؤدي إلى حوض حجري خارج المبنى لتجميع المياه (دي مغرية وروبان، 2006).

ومن جانب آخر، فقد زخرف البناء بالكوات الجدارية – النوافذ الوهمية – وبألواح حجرية عليها رموز الهلال والقرص، ورموز اخرى كالكف (اليد) ورسم للخنجر (العريقي، 2002). كما استخدمت النسب الذهبية في تخطيط المبنى وأجزاءه، حيث أثبتت الدراسات السابقة أن تصميم الفناء كان باعتماد نسبة محددة بلغت هذه النسبة في طول وعرض الفناء 3:4، واستخدمت نصف عرض البوابة كوحدة قياس (Doe, 1983).



الشكل 17: مسقط أفقي للمبنى (Breton 2009)

الشكل 18: الدخلات والخرجات في الجدار الخارجي (الباحث)

3-3 المسكن في مملكة حضرموت

تعتبر حضرموت المملكة اليمنية القديمة التي لا تزال محافظة على اسمها حتى وقتنا الحاضر. وأقدم ذكر لمملكة حضرموت يعود إلى عصر الملك كرب إل وتر بن ذمار علي (حنشور، 2005)، حيث كانت تابعة لمملكة سبأ، وفي القرن الرابع قبل الميلاد كونت دولة مستقلة (الأغبري، 1994)، وكانت نهاية مملكة حضرموت في بداية القرن الرابع الميلادي على يد جيوش الملك شمر يهرعش ملك سبأ وذو ريدان.

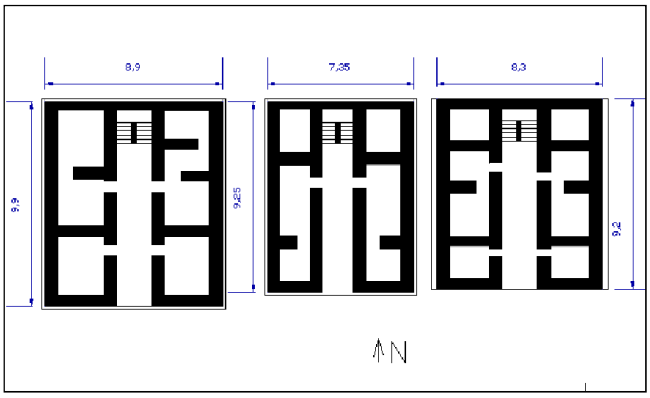
واتخذت المملكة مدينة شبوة عاصمة لها، والتي تقع في وادي عرمة ووادي المعشار، كما تحتل المدينة موقعاً متميزاً عند ملتقى الطرق التي تربط المدن المحيطة وطرق التجارة (حنشور، 2007). هذا وقد تمّ الكشف على عددٍ من المباني السكنية في مدن مختلفة من حضرموت منها: شبوة، وريبون، وسونة، ومشغة. وسيتم اختيار نماذج محددة، وهي مساكن مدينة مشغة كنموذج للمسكن العادي، وقصر شقر في العاصمة شبوة كنموذج للقصر في المملكة الحضرمية.

أ- مساكن مشغة

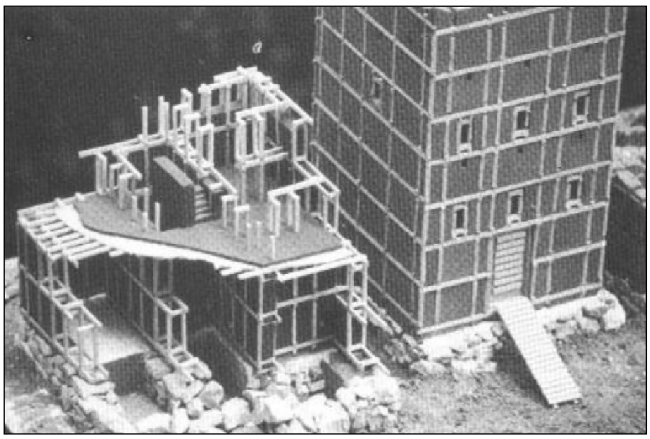
تقع مدينة مشغة في وادي عدم أحد الروافد الجنوبية لوادي حضرموت، وتتخذ المساكن التي تمّ الكشف عنها في المدينة مساقط على الشكل المستطيل، حيث يتكون مسقطها الأفقي من رواق مركزي بالاتجاه الطولي للمسكن، يربط البوابة الوحيدة للمسكن مع السلم الحجري في الجهة المقابلة وتتوزع على جانبيه الغرف، ويفصل بين المساكن شوارع ضيقة (الشكل 19).

وقد صُمم لكل مسكن بوابة كبيرة بعرض الرواق، فيما تُفتح جميع أبواب غرف المسكن على الرواق، ويكون مستوى عتبتها مرتفعة بمقدار 1.5م عن مستوى أرضية الرواق، وهذا يشير إلى ان الدور الأرضي كان عبارة عن أماكن خزن، وأما الجهة المقابلة على نهاية الممر، فيوجد سلم يؤدي إلى الأدوار العليا، حيث يبلغ عرض الدرجات 22 سم، 24 سم، أو 28 سم، 30 سم (حنشور، 2005).

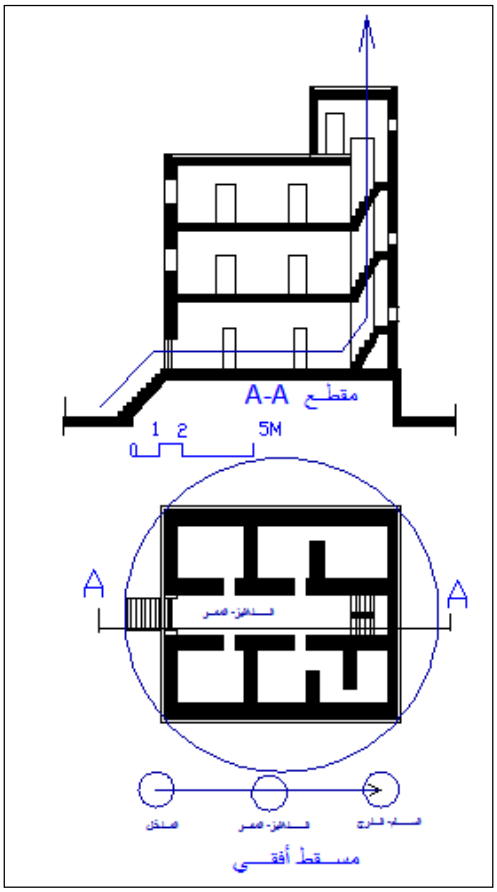
أما النظام الإنشائي المتبع في هذه المساكن، فهو عبارة عن قاعدة حجرية ترتفع عن مستوى الأرض بأكثر من مترين تكون قاعدة لجدران البناء الذي يركب عليه العوارض الخشبية الأفقية والعمودية، مكونة هيكلاً يتم بناء اللبن النيئ بداخله (الشكل 20)، وتكون أبعاد الهيكل الخشبي عمودياً، فكلّ 1,40 م يوجد عوارض أفقية، وتغلف الواجهة الخارجية للبناء بصفائح حجرية (حنشور، 2005). هذا وزُخرف بناء الجدران بزخارف ورسومات ملونة، وخصوصاً الممرات والسلالم المبنية بالبلاط الحجري (الجرو، 1998).



الشكل 19: مساقط أفقية لمساكن مشغة (الباحث)



الشكل 20: تصور تخيلي وإعادة تركيب للمساكن ونظامها الإنشائي (حنشور 2005)



الشكل 21: مسقط ومقطع تخيلي لأحد المساكن (الباحث)

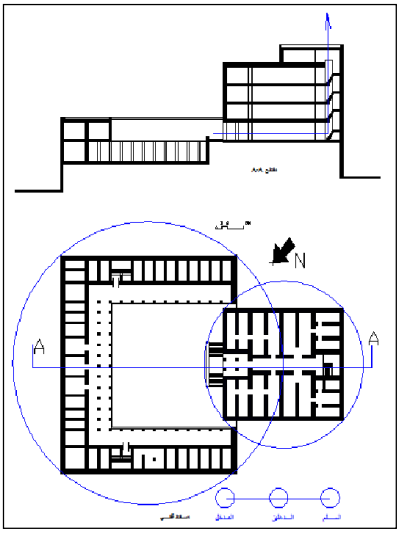
ب- قصر شقر في شبوة

قصر شقر - كما جاء اسمه في النقوش المسندية وعلى العملات الحضرمية - هو قصر المملكة الحضرمية الرئيسي، والقصر يقع على الجانب الأيمن من المدخل الشمالي الغربي لمدينة شبوة عاصمة المملكة. وقد صُمم القصر من جزءين (الأشكال 22، 23)؛ جزء رئيسي برجي (متعدد الطوابق) أبعاده 19.80*22.30 م، وجزء ذو فناء أبعاده 38.5* 32.5 م، ويُحمل رواقه أعمدة، والجزء الرئيسي مستطيل الشكل له بوابة واحدة تفتح على الفناء (سنيبه، 1996)، كما توجد بركة ماء في مواجهة الجهة الغربية للمبنى الرئيسي بأبعاد 7.8 * 2.6 م (الجرو، 2003).

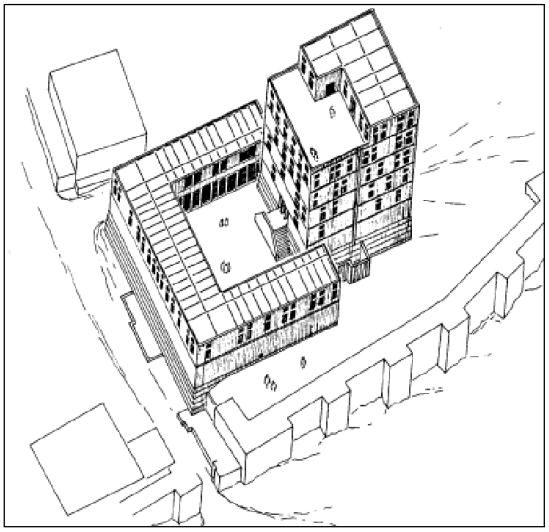
بُني المبنى الرئيسي (متعدد الطوابق) على قاعدة حجرية مرتفعة يصل أرتفاعها 6.5م، ثم بُني فوقها بنظام هيكلي من هياكل خشبية وطين. هذا ويرتفع المبنى عن الفناء بمقدار 3.8 م، وقد بُني الجدار بالأسلوب المتدرج، حيث يتراجع المدماك العلوي عن السفلي، وتمّ صقل حواف الأحجار، وبُني الجدار مزدوجاً تربط بين وجهيه جدران عرضية بسمك 1.1م (سنيبه، 1996). والحقيقة، ان بناء قاعدة حجرية متدرجة بتقنية تراجع المداميك للخلف مع الأرتفاع لتشير إلى الجبال المقدسة، وإلى الصعود الروحاني إلى السماء.

وتمّ تكسية جدران القصر المبني بالهياكل الخشبية والطين بواسطة الأحجار الزخرفية وبأساليب متعددة، تمثلت أعمال التزيين في النوافذ الوهمية التي غُطيت بها الجدران، وزُينت بها المقاعد الحجرية، وهناك أفاريز من روؤس الوعول، وكذلك زخارف هندسية متكررة مع أشكال نجمية، كانت تحيط بالنوافذ الخشبية، والأعمدة المثمنة الشكل التي تعلوها ألواح خشبية مزينة بصفين من المسننات (ادوان، 1996).

هذا وقد تأثر نمط بناء القصر بمؤثرات خارجية وخصوصاً في الأعمال الفنية والتشكيلية، فهناك تأثيرات خارجية هلينسية على الأعمدة الحجرية؛ ففيها عناقيد العنب والحيوان الخرافي، وظهرت الأقواس والقطع العاجية التي تشابه بعض الأعمال القبطية، كما أن الأعمدة التي كانت تحمل أروقة الفناء عبارة عن أعمدة ثُمانية الأضلاع، مقطوعة من حجرٍ واحدٍ تحمل تيجاناً منشورية وأسفل كل عمود ميزاب حجري ينتهي برأس ثور، يعتبر تأثيراً محلياً وليس له علاقة بالفنون اليونانية والرومانية، أما زخرفة الأعمدة بأوراق الكروم فيظهر عليها التأثير الهلينسي، وتيجانها مزخرفة بحيوان خرافي بأجنحة ورأس أسد يظهر عليه التأثير البارثي (فيل، 1996).



الشكل 22: مسقط ومقطع تخيلي للقصر (الباحث)



الشكل 23: منظور تخيلي للقصر (سنبيه 1996)

4 مناقشة مكونات وعناصر المسكن اليمني القديم

بشكل عام، فقد مثّل النمط البرجي نمطاً سائداً في هذه الفترة، وجاء محققاً للمتطلبات الأمنية والوظيفية والاقتصادية والرمزية. هذا وسيتم مناقشة مكونات وعناصر المسكن والقصر كالتالي:

4-1 أسلوب وتقنية البناء

تطورت تقنية وأساليب البناء الملائمة للنمط البرجي متعدد الطوابق؛ لما لهذا النمط من مميزات الأمن والأمان، وذلك وفق نظام دفاعي قوي. إذ بُنيت الجدران الخارجية من الأسفل بالحجر الصلد، وبسماكة كبيرة، وخلت الأدوار السفلية من الفتحات والنوافذ، حيث استُخدمت كأماكن وفراغات للحيوانات والخزن فقط. وقد بُنيت جدران المسكن من الأسفل بشكلٍ متدرج، ومن كتلٍ حجريةٍ كبيرةٍ ترتفع عن الأرض بعدة أمتار، ثم يُبنى الجدار من الأعلى بواسطة هيكل خشبي يُحشى بالطين، ثم تغلف بواسطة ألواح حجرية مزخرفة. وكان التسقيف باستخدام العوارض الخشبية التي توضع على الجدران وفي الاتجاة القصير للفضاء وذلك على مسافات محددة، ثم تفرش قطع خشبية صغيرة بشكل عمودي فوقها، ثم توضع فوقها طبقة من الطين والقش.

4-2 التنظيم الفضائي

جاء التنظيم الفضائي لجميع المساكن اليمنية القديمة متشابهاً، حيث تحتوي جميعها على ممرٍ وسطي، يخترق المسقط ليربط البوابة بالسلم، وتتوزع على جانبيه الغرف. وعادة يكون الدور الأرضي عبارة عن عدد من الغرف تُستخدم كأماكن وفراغات للخزن وللحيوانات، فيما تُستخدم الأدوار العليا للسكن. ويتميز القصر عن المسكن بوجود مبنيين؛ أحدهما برجي، والآخر أمامي يحتوي على ساحة بأروقة، ويحتوي الدور الأرضي على بئر للماء وذلك لتزويد المبنى بالمياة الضرورية. وحيث أن الدين يؤثر على شكل المبنى ومسقطه والتنظيمات الفراغية والتوجيه، بل حتى إن الدين يؤثر على قرار اختيار شكل المسقط إما دائرياً أو مربعاً أو غيره (Rapoport, 1969)؛ لأن الحنين العميق لدى الإنسان المتدين يكمن في العيش في مكان يشابه سكن الآلهة، وبذلك يصبح عالمه الصغير، الذي يسكن فيه مشابهاً لعالم الآلهة الكبير - الكون (إلياد، 1988). فعمد الإنسان اليمن إلى تبني شكل مسقط المعبد، واتخاذه كنموذج مثالي يُبني على نمطه مسكنه، حتى يصبح المكان الذي يعيش فيه يمتاز بالقداسة والطهارة، وبتبني مسقط المعبد كنموذج للمسكن يسبغ عليه صفة القداسة، فالارتباط بالنماذج المقدسة يجعل الماديات من الفعل البشري عملاً انطولوجياً خصوصاً اعمار الأماكن، حيث يتحول فيها كلّ عنصرٍ من عناصرها إلى عنصرٍ يحمل وظيفة رمزية، إضافة إلى وظيفته النفعية.

4-3 البوابة (المدخل)

بُنيت المساكن على قاعدة حجرية يصل ارتفاعها أحياناً إلى 4م، ويكون هذا المنسوب هو مستوى المدخل. كما صُممت البوابة على المحور الرئيسي للواجهة بحيث تفتح على عرض الرواق، ويتم الوصول إلى مستواها عبر سلم حجري (درج)، جاء ليشير إلى دور البوابة كحدّ فاصلٍ، يفصل بين الخارج (العام) والداخل (الخاص)، والوصول إليها عبر درج يرمز إلى دوره في الصعود الروحي إلى السماء. ومن جانب آخر، فقد ذُكر الباب في نقوش المسند بلفظ "خلف"، ويتكون الباب من مصراع أو مصراعين (علي ج8، 1993)، أما المدخل فهو عبارة عن باب له أكتاف جانبية، ويعلوه عتبة مستقيمة أو أفريز (بركات، 1986). وللباب عتبة "معقم" وعلى هذه العتبة يدون تاريخ البناء وعهد الملك والإله الحامي من أجل حماية البيت وساكنيه، ومنها نقش يدون بناء قصر (يفد) في مدينة شبوة وحماية الإله سين (الحسني 2006). ونقش عُثر عليه في حنو الزرير يعود إلى نهاية القرن الرابع ق.م، ببناء بيت ميفعم وتمّ توكيل حماية البيت إلى الآلهة عم وأنبي وذات رحبان، وهذا النقش كان على عتبة وضِعت على باب البيت (الحسني، 2012). كما استخدموا التمائم على أبواب المنشآت أو تحفظ في المنازل بغرض الحماية (سالم، 2011)، ويتم وضع تماثيل من زوج من الأسود على جانبي البوابة؛ لحماية المدخل وطرد الكائنات الشريرة (عقيل، 2010).

4-4 صالة التوزيع (الدهليز)

تُعد الصالة (الدهليز) محور الحركة الرئيسي، والذي يقسم مسقط المسكن إلى جزءين تتوزع الغرف على جانبيه، حيث يقع المدخل في بدايته، وعلى النهاية الأخرى يوجد سلم (درج حجري) ينقل الحركة إلى الأدوار العليا. وبالمقارنة لمسقط المعبد والبيت، فان المحور الوهمي الذي يربط البوابة بقدس الأقداس في المعبد جسد كصالة توزيع في المسكن. ويقوم الدهليز بوظيفة تهيئة الحركة ونقلها من الخارج إلى الداخل، كما يعزز الدهليز الخصوصية للمسكن ويمارس نوعاً من الفصل، وذلك بعزل المدخل عن العمق الداخلي للمسكن (الدرج والطوابق العليا المخصصة للأسرة)، ويكون ذلك من خلال تصميمه كممر طويلٍ ومسقوفٍ لا ينفتح مع الخارج إلى من جهة الباب، الذي يكون عادة بدون نوافذ، ممّا يجعل الدهليز مظلماً كدلالة على الحماية، ويعزز فكرة الدفاع عن المركز (الملكية الخاصة بأهل الدار) بعدم كسر حرمته.

4-5 السلم - الدرج

يوجد السلم في نهاية الصالة (الدهليز) على الضلع الخلفي المقابل للمدخل، ووظيفة السلم في المسكن نقل وربط الحركة بين المدخل وجميع الأدوار في المسكن. وقد جاء السلم (الدرج) كتصميمٍ ثابتٍ في نهاية الرواق، حيث يتكون من درجات حجرية حول عمود حجري، وتحمل الدرجات على القطب من جهة وعلى جدار بيت الدرج من الجهة المقابلة. والسلّم هو العنصر العمودي الأهم في المبنى السكني، وهو عموده الإنشائي، ويبنى السلم بالأحجار بعكس عناصر المبنى الأخرى، كما أن السلم يمثل المحور الرأسي المتجسد للرؤى العقائدية للسلم، الذي يربط السماء بالأرض ويربط الإنسان بالإله، والسلم في المسكن وعلى مستوى المسقط يحتل موقع المذبح في المسقط للمعبد، والذي يكون مكان المركز (المقدس).

4-6 الواجهات

اتسمت واجهات المساكن بنمطٍ وأسلوب معين يتفق مع النمط البرجي، بحيث يكون الدور الأرضي بدون نوافذ؛ وذلك لأغراض أمنية ووظيفية وإنشائية، وتبدأ النوافذ بالظهور في الدور الأول، وتكون النوافذ ضيقة وتتسع في الأدوار الأخيرة للمبنى. هذا، وزُينت القصور بالحجر بأنواعه المختلفة، والفضة، والعقيق، والفسيفساء، والجزع، والجوهر، فقد كتب المؤرخين أن الزخارف كانت مكملة للبناء داخلياً وخارجياً، وكانت نوعية الزخرفة من زهور الزئبق وسائر الزهور وأنواع الزركشة (السروري، 2002). وتميزت واجهات المباني بالزخارف والأبواب والنوافذ واللهوج والأفاريز، وكان يكمل البناء ويزخرف بالصدف وسنّ العاج والذهب والأحجار الكريمة (الحوالي، 1982). وكان اليمنيون يضعون بلاطة أو لوحة على واجهة المنزل، يكتبون عليها عبارات مختلفة ربما لجلب الحظ أو للحماية، ويبنى الجدار بتدرج في المداميك العليا عن السفلى بشكل هرمي، ممّا يجعل جدار الواجهة يظهر بشكلٍ مائل، كما تبنى الجدران من الأسفل بالأحجار الضخمة؛ لتشكل قاعدة يقوم عليها المبنى. وبشكل عام فإن الواجهة تتكون من عناصر رئيسية هي:

أ- الفتحات والنوافذ

اختلفت عدد ومساحة النوافذ بحسب موقعها في الأدوار، ووظيفة الفراغ الذي تخدمه، بحيث يزداد عددها وتتسع مساحتها كلما ارتفع البناء، فالدور الأرضي خالٍ من النوافذ، وتكون النوافذ صغيرة في الدور الأول ويزداد اتساعها كلما ارتفع البناء، وتكون النوافذ منسجمة مع الوظائف، وتبلغ ذروة اتساعها في الأدوار الأخيرة. ولقد تشكلت الفتحات من نافذ ومصمت (وهمي) في ثنائية تحكم نظامها، وهذه الثنائية تعبر عن الثنائية القطبية من روح وجسد، وعالم مرئي وغير مرئي، فالمصمت جاء ليشير إلى الروح، بينما يشير النافذ للجسد، ويُعبر النافذ عن العالم المرئي، ويُعبر المصمت عن العالم غير المرئي.

ب- التشكيلات الزخرفية

جاءت العناصر الزخرفية إما على شكل عناصر هيكلية كالأحزمة التي تنهي البناء، وهي عبارة عن أفاريز مسننة تطوق المبنى بالكامل، أو على شكل إفريز مجسم لصفوف الوعول (عقيل، 2010)، كما كان يعتلي المبنى بروزات، أو ينتهي السطح بوضع تماثيل رمزية غالباً ما تكون على هيئة ثور (حنشور، 2007). واستُخدمت المزاريب (الميازيب) الحجرية بكثرة، والتي تنتهي برأس ثور؛ وذلك لتصريف مياه الأمطار من الأسطح، ويتم تأطير الواجهة بواسطة أفاريز تفصل كلّ دور، كما تم معالجة جميع أحجار البناء بطريقة الصقل الناعم لحواف الحجر، وتنقر وسط الحجر نقراً خشناً، وكون المباني كانت تبنى بالهياكل الخشبية والطين، لذلك كانتْ تغلف الواجهة وتزخرف بألواح حجرية.

5 الاستنتاجات النهائية

سعى البحث الحالي إلى البحث عن عمارة يمنية قديمة، فكان الهدف الرئيسي إبراز تلك العمارة وإظهارها إلى حيز الوجود. كما حاول البحث بقدر المستطاع استخراج الأسس التصميمية والقيم الإنسانية الكامنة وراء تلك العمارة. وبناءً عليه، تناول البحث المسكن والقصر في اليمن القديم وذلك خلال فترة حكم دويلات المدن - الممالك اليمنية القديمة في الألف الأول ق.م، وتم استخلاص عدد من الاستنتاجات النهائية وهي كالتالي:

- أثرت البيئة والمناخ على عمران تلك الفترة، فتم اختيار الموقع تبعاً للمناخ الملائم، كما أثرت جيولوجيا الموقع على نوع البناء وأسلوبه من أحجار متواجدة في الموقع، ونوع الخشب المتوفر في الموقع.
- تمَّ تطوير نظام إنشائي قوي في أسلوب بناء للجدران يتسم بتدرج وتناقص في سماكة الجدران كلما ارتفع البناء، وتمَّ توظيف بناء هيكلي خشبي مع الطين، أنتج نمطاً بنائياً برجياً.
- صُمم المسكن وفقاً لنظام يستجيب للنواحي الدفاعي، فينبى على قاعدة حجرية، ويكون الدور الأرضي مبني بأحجار كبيرة الحجم وبسمك كبير للجدران، ويكون بدون نوافذ.
- يتشابه التنظيم الفضائي لجميع المساكن، حيث تتشكل جميعها من ممر وسطي يخترق مسقط المسكن ليربط البوابة بالدرج (السلم)، وتتوزع على جانبيه الغرف. وعادةً يكون الدور الأرضي عبارة عن غرف تستخدم للخزن وللحيوانات، وتستخدم الأدوار العليا للسكن.
- يتكون التنظيم الفضائي للمسكن اليمني القديم من ثلاثة أقسام رئيسية هي: القسم الخدمي (الخزن وأماكن للحيوانات) في الدور الأرضي، والقسم العام (استقبال الضيوف والزائرين) في الدور العلوي - الأخير، القسم الخاص (أماكن العائلة والنساء) في الأدوار الوسطية.
- وجود نمطية في بناء المساكن والقصور، حيث يتكون المسكن من مبنى منفرد يكون مسقطه مستطيلاً، ويتكون القصر من بناءين أحدهما برجي مستطيل المسقط يشبه المسكن، والآخر مبنى على شكل حرف U له أروقة.
- إن أول نموذج لمسقط المسكن البرجي كان مستطيلاً يخترقه ممر تتوزع الغرف على جانبيه، وينتهي الممر بسلم حجري يؤدي إلى الأدوار العليا، جاء هذا المسقط كنموذج تمَّ تكراره من مسقط المعبد، فالممر الوسطي للمسكن جسد الممر الوهمي الذي يربط البوابة بالمذبح، فيما جسد السلم المذبح (قدس الأقداس) الذي يمثل المركز، ومنه يمتد المحور العمودي الذي يربط الأرض بالسماء.

- عمد المعماري اليمني إلى تبني النماذج المرجعية المثلى؛ بهدف ترسيخ وتخليد النتاج المعماري. فقد تبني شكل مسقط المعبد، واتخاذه كنموذج مثالي يبني على نمطه مسكنه؛ حتى يصبح المكان الذي يعيش فيه يمتاز بالقداسة والطهارة، فالارتباط بالنماذج المقدسة يجعل الماديات من الفعل البشري عملاً انطولوجياً.
- تميز تخطيط المسكن والقصر اليمني بخصائص معينة، حيث تناظر المسقط والفضاءات حول ممر مركزي، وبتوجيه أركان المبنى إلى الجهات الأصلية. كما تميز التوزيع الفضائي بالنمط الرأسي حيث توزع الأقسام الوظيفية رأسياً في ادوار (طوابق) لتحقيق الخصوصية.

6 التوصيات

يُعد هذا البحث خطوة في اتجاه فهم تراث اليمن الحضاري وهي خطوة تحتاج إلى خطوات أخرى. ومن ناحية اخرى، فان العمارة اليمنية القديمة عبر مراحلها التاريخية تمثل عمارة يمنية متجذرة نابعة من بيئتها المحلية، وهي تشكل مصدراً ومرجعاً لممارسي العمارة، يمكنهم من خلالها استثمار مراجع فكرية وأسس تصميميه في اعمالهم الحديثة.

ويوصي البحث بضرورة الاهتمام والحفاظ على المباني اليمنية القديمة؛ كونها تمثل إرثاً تاريخياً أصيلاً يتطلب المحافظة عليه وحمايته من العبث والإهمال، ويتطلب تكاتف الجهود الرسمية والشعبية، ويجب توثيقها علمياً حسب القواعد والأصول العلمية المتبعة في التوثيق، من خلال المسح والتسجيل، والتصنيف، والبحث العلمي.

شكر وتنويه

اعبر عن جزيل امتناني وشكري لأبناء محافظتي شبوة ومأرب لحسن ضيافتهما لي وتسهيل الصعاب اثناء الدراسة الميدانية. كما اعبر عن جزيل امتناني وتقديري للإخوة: الدكتور صلاح الحسيني، والدكتور احمد حنشور، والدكتور جمال الحسني، والدكتور خلدون نعمان لما قاموا بتزويدي بالمراجع المطلوبة للبحث، والأخوة: عبد الإله محمد عامر، علي عبدربه علي النهمي، عبد العزيز محمد خولاني، عادل محمد الدحيدح، علي حفظ الله النهمي لمرافقتي ومساعدتي أثناء الدراسة الميدانية. وينبغي التنويه إلى ان البحث جزء مستل من رسالة الدكتوراه للباحث أحمد عبدربه علي النهمي، قسم الهندسة المعمارية، كلية الهندسة، جامعة القاهرة.

المراجع العربية

1. ادوان (ريمي)، "النحت والرسوم في قصر شبوة الملكي": شبوة عاصمة حضرموت القديمة: نتائج أعمال البعثة الأثرية الفرنسية اليمنية، أعداد عزة علي عقيل وجان بريتون، صنعاء، 1996.

2. الأغبري (فهمي)، التحصينات الدفاعية في اليمن القديم، رسالة ماجستير (غير منشورة)، كلية الآداب - جامعة بغداد، 1994.

3. البريهي (إبراهيم بن ناصر)، الحرف والصناعات في ضوء نقوش المسند الجنوبي، وزارة المعارف - وكالة الآثار والمتاحف، المملكة العربية السعودية، 2000.

4. الجرو (أسمهان)، دراسات في التاريخ الحضاري لليمن القديم، دار الكتاب الحديث، عدن، 2003.

5. الجرو (أسمهان)، "الفكر الديني عند عرب جنوب شبه الجزيرة العربية: الألف الأول قبل الميلاد وحتى القرن الرابع الميلادي"، *مجلة أبحاث اليرموك*، المجلد 14، العدد 1، ص 219-250، 1998.

6. الحسني (جمال) الإله سين في ديانة حضرموت القديمة: دراسة من خلال النقوش والآثار، رسالة ماجستير (غير منشورة)، كلية الآداب - جامعة عدن، 2006.

7. الحسني (جمال) الإله عم وآلهة قتبان (٧٠٠ق.م – ١٧٠م)، رسالة دكتوراه (غير منشورة)، كلية الآداب - جامعة طنطا، 2012.

8. الحوالي (محمد الأكوع)، اليمن الخضراء مهد الحضارة، ط2، مكتبة الجيل الجديد، اليمن، 1982.

9. السروري (عبد الجليل)، "المحات من فن العمارة والبناء في اليمن القديم"، *مجلة الإكليل*، العدد 26، ص 86- 99، 2002.

10. الشيباني (عبد الرقيب طاهر) وآخرون، أسس التصميم المعماري والتخطيط الحضري في العصور الإسلامية المختلفة: دراسة تحليلية على العاصمة صنعاء، إعداد وتنفيذ مركز الطاهر للاستشارات الهندسية، منظمة العواصم والمدن الإسلامية، جدة، 2005.

11. الشيبه (عبد الله حسن)، دراسات في تاريخ اليمن القديم، مكتبة الوعي الثوري، تعز، 2000.

12. العريقي (منير)، الفن المعماري والفكر الديني في اليمن القديم من600/1500 ق.م، مكتبة مدبولي، القاهرة، 2002.

13. الغامدي (عبد الكريم)، "عمارة المسكن وتخطيطه في جنوب شبه الجزيرة العربية في عصر ممالكها القديمة على ضوء المكتشفات الأثرية"، *مجلة جامعة الملك* عبد العزيز- الآداب والعلوم الإنسانية، المجلد 8، ص 125-163، 1995.

14. القادري (عبد الناصر)، عمارة الأبراج في وادي حضرموت، دراسة حالة المنزل البرجي التقليدي بمدينة شبام، رسالة دكتوراه (غير منشورة)، كلية الهندسة - جامعة القاهرة، 2006.

15. المذحجي (محمد)، "توصيف لخصائص التشكيل العمراني لمدينة صنعاء القديمة"، *مجلة تقنية البناء*، العدد 9، ص 74-89، 2006.

16. إلياد (ميرسيا)، المقدس والمدنس، ترجمة عبد الهادي عباس، دار دمشق للطباعة والنشر والتوزيع، دمشق، 1988.

17. بافقية (محمد)، "المحات من أعمال الصيانة والترميم في اليمن القديم"، *مجلة دراسات يمنية*، العدد 36، ص 52-67، 1989.

18. بركات (أبو العيون)، "الوعل في الحضارة اليمنية القديمة"، *مجلة اليمن الجديد - وزارة الثقافة والإعلام بصنعاء*، العدد 12، السنة 15، ص 35- 52، 1986.

19. بروتون، جان فرانسوا. "المسكن في مدينة شبوة بين الأصالة وتقاليد المناطق المجاورة"، (حفريات شبوة الجزء الثالث: العمارة وتقنيات البناء)، 1998، خلاصة مترجمة من كتاب (fouilles de shabwa iii).

20. بريتون (جان فرنسوا)، "البيت الشاهق والبيت ذو الفناء في اليمن القديم والمعاصر"، *مجلة دراسات يمنية، العدد 45*، ص263-264، 1992.

21. جميل، سميرة جمال. الخصائص العمرانية لمدينة صنعاء القديمة والاستفادة منها في العمارة المعاصرة، رسالة دكتوراه (غير منشورة)، كلية الهندسة - جامعة القاهرة، 1999.

22. حنشور (أحمد)، الخصائص المعمارية للمدينة اليمنية القديمة، رسالة دكتوراه (غير منشورة)، كلية الآداب - جامعة عدن، 2007.

23. حنشور (أحمد)، نشوء وتطور العمارة اليمنية القديمة، دراسة أثرية تاريخية، 2005.

24. دي مغريه (ألساندرو)، وروبن (كريستيان)، تمنع العاصمة القديمة لقتبان، البعثة الإيطالية للآثار في الجمهورية اليمنية، ترجمة مالك الوسطي، المركز اليمني الايطالي للبحوث الأثرية، بحث رقم 3، 2006.

25. دي مغرية (الساندرو) وروبان (كريستيان)، التنقيبات الإيطالية في يلا (اليمن الشمالي سابقاً): معطيات جديدة حول التسلسل الزمني للحضارة العربية الجنوبية قبل الإسلام، ترجمة منير عربش، المركز الفرنسي للدراسات اليمنية، 1999.

26. سالم (هالة)، "التمائم في اليمن القديم"، *مجلة الجمعية التاريخية السعودية*، العدد 24، السنة 12، ص 7-42، 2011.

27. سنييه (جاك)، "القصر الملكي لشبوة: الهندسة المعمارية، تقنية البناء، تصور شكل القصر": شبوة عاصمة حضرموت القديمة: نتائج أعمال البعثة الأثرية الفرنسية اليمنية، إعداد عزة عقيل وجان بريتون، صنعاء، 1996.

28. عقيل (عزة) وبريتون (جان)، شبوة عاصمة حضرموت القديمة: نتائج أعمال البعثة الأثرية الفرنسية اليمنية، صنعاء، 1996.

29. عقيل (عزة علي)، البرونز في اليمن القديم: الجزء الأول التقنية التماثيل الزينة المعمارية، الصندوق الاجتماعي للتنمية، صنعاء، 2010.

30. علي (جواد)، المفصل في تاريخ العرب قبل الإسلام، ج8، ط2، جامعة بغداد، 1993.

31. فيل (أرنست)، "ملاحظات وإضافات عن زخارف القصر الملكي": شبوة عاصمة حضرموت القديمة: نتائج أعمال البعثة الأثرية الفرنسية اليمنية، إعداد عزة عقيل وجان بريتون، صنعاء، 1996.

REFERENCES

[1] Al-Suleihi, S.T., The Lyrical Facades of Sanaa, Master of Architecture, Department of Architecture, Massachusetts Institute of Technology, 1992.
[2] Breton, J.F., Fouilles de Shabwa iv, shabwa et son context architectural et artistique, CEFAS – SANAA, 2009.
[3] De Maigret, A., "Some reflection on the South Arabian bayt", *ABADY*, 10, pp. 101–109, 2005c.
[4] De Maigret, A., Arabia Felix: An Exploration of the Archaeological History of Yemen, Stacey International, London, 2002.
[5] Doe, B., Southern Arabia, Thames and Hudson, London, 1971.
[6] Doe, B., Monuments of South Arabia, the Oleander Press and the Falco Press, Italy, 1983.
[7] Japp, S., Der sogenannte verwaltungsbau in Sirwāh: vertreter eines besonderen bautypus in sudarabien, *ZORA5*, pp. 296-319, 2012.
[8] Loreto, R., "The House B/E. A Contextual Analysis of A workshop Inside The "Market Square" in Tamna, *Newsletter di Archeologia CISA*, 3 /1, pp. 229-264, 2012.
[9] Loreto, R., "South Arabian inscriptions from domestic buildings from Tamna and the archaeological evidence", *Journal of Arabian Archaeology and Epigraphy*, 22/1, pp. 59–96, 2011.
[10] Loreto, R., "Architectural decorations from the private buildings in the Market Square at Tamna", *Journal of Arabian Archaeology and Epigraphy*, 19/1, pp. 22 –47, 2008.
[11] Rapoport, A., House Form and Culture, London: Printice Hall Inc. 1969.
[12] Schloen, D., House of the Father as Fact: Patrimonialism in Ugarit and the Ancient Near East, Eisenbrauns, Indiana, 2001.
[13] Van Beek, G., "Monuments of Axum in the Light of South Arabian Archeology", *Journal of the American Oriental Society*, 87/2, pp. 113 -122, 1967.
[14] Varanda, F., Tradition and Change in the Built Space of Yemen, Ph.D dissertation, University of Durham, 1994.

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Une nouvelle stratégie de régulation intelligente d'un moteur à réluctance variable

[A new intelligent control strategy of a variable reluctance motor]

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ABSTRACT: The use of systems with variable reluctance is nowadays very replied in the industrial fields. Despite this enormous expansion, they present limitations to fill at their controls. It is for this reason that the study of such a system is a of reflection and research that we have considered important to delve deeply into. Our study then summarizes the conception of an approach that aims to facilitate the control of variable reluctance system.
The proposed approach is based on an intelligent software sensor, reducing the overall cost of the control system and promoting the simultaneous processing of a large number of information received from the actuator. Apart from this, the integration of an evolutionary intelligent regulator will retrieve the optimal useful output.

KEYWORDS: Variable reluctance motor, neural Network, smart sensor, intelligent evolutionary regulator.

RESUME: L'utilisation des systèmes à réluctance variable est de nos jours, très répondue dans la vie des industries. Malgré cette énorme expansion, ces derniers présentent des limites à combler au niveau de leurs contrôles. C'est pour cette raison, que l'étude des tels systèmes constitue un sujet de réflexion et de recherche dont nous avons pris en considération. Notre étude se résume alors dans la conception d'une approche permettant de faciliter le contrôle de tels systèmes.
Une telle approche proposée se base sur un capteur logiciel intelligent, réduisant le coût global du système de contrôle et favorisant le traitement simultané d'un nombre important d'informations reçus depuis l'actionneur. D'autant plus l'intégration d'un régulateur intelligent permettra de récupérer la sortie utile optimale.

MOTS-CLEFS: Moteur à réluctance variable, Réseau de neurones, capteur intelligent, régulateur évolutionnaire intelligent.

1 INTRODUCTION

Les actionneurs électromagnétiques représentent un nombre important d'applications dans tous les domaines de la vie, particulièrement dans le domaine des machines de production où ils sont utilisés notamment pour la commande de position ou de vitesse. Parmi ces dispositifs, nous citons en premier lieu les moteurs pas à pas linéaires qui sont d'une grande importance et qui ont attiré fortement l'attention des chercheurs [1-2]. Ils offrent par exemple une alternative aux dispositifs pneumatiques ou hydrauliques dans plusieurs domaines impliquant des vitesses plus au moins importantes ou de grandes précisions de commande de mouvement. Ces dispositifs peuvent avoir des densités de forces magnétiques assez élevées, de

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bonnes propriétés dynamiques ainsi que de faibles pertes. Ils sont utilisés dans les systèmes d'entrainement de hautes performances et dans des applications comme les servomoteurs. Parmi ces actionneurs, on trouve les machines à réluctance variable (MRV) qui sont des transducteurs électromécaniques qui assurent la conversion des impulsions électriques en mouvement de translation [3] [4]. Ils sont des actionneurs incrémentaux fonctionnant par des déplacements élémentaires successifs entre des positions d'arrêt qui sont des états d'équilibre. Leur précision de positionnement est liée à la précision d'arrêt sur un pas. Elle est devenue un candidat important pour différentes applications telles que les automobiles, la production de l'énergie électrique et le domaine de l'aérospatial [5], [6], [7]. Cet intérêt qui s'est éveillé pour la machine à réluctance variable est dû à la robustesse de son rotor, à la simplicité de sa conception et à sa capacité à fonctionner en mode dégradé avec un défaut dans une de ses phases [5].

Par contre, ses défauts majeurs sont les ondulations de force et le bruit acoustique qu'elles produisent. Plusieurs recherches se font actuellement pour réduire ces inconvénients. Des informations de position de rotor jouent un rôle critique dans le contrôle de la MRV. De façon classique, les capteurs de position distincts, sont utilisés pour obtenir ces informations. Les capteurs de position ajoutent à la complexité et le coût du système de contrôle et de réduire sa fiabilité et souplesse.

Afin de pallier les inconvénients des capteurs de position, cet article proposé étudie un système de commande sans capteur de position qui répond aux besoins d'une application de l'actionneur électrique En effet, Il traite la conception et l'optimisation de la régulation d'une machine à réluctance variable.

Dans un souci de mieux se servir avec ce système, on a pensé à intégrer des éléments intelligents s'articulant autour de réseaux neuroniques afin d'assurer une régulation optimale et précise du processus dont on veut industrialiser et dont la section suivante est consacré à sa modélisation.

2 MODÉLISATION DU SYSTÈME ADOPTE

2.1 STRUCTURE GLOBALE DU SYSTÈME

Le prototype de moteur linéaire à réluctance variable utilisé dans cette étude est présent sur la figure 1. Il s'agit d'une machine électrique composée d'une partie mobile appelée translateur capable de se déplacer de façon incrémental. Ce translateur possède 8 dents de rotor et 4 dents de stator et porte 4 phases, chaque phase est constituée par une bobine, Le stator de la LSRM comporte des pôles constitués de pièces polaires associées à des enroulements inducteurs. La partie mobile est un ensemble de feuilletage de matériau ferromagnétique, il n'y a ni aimant permanent ni enroulements [8].

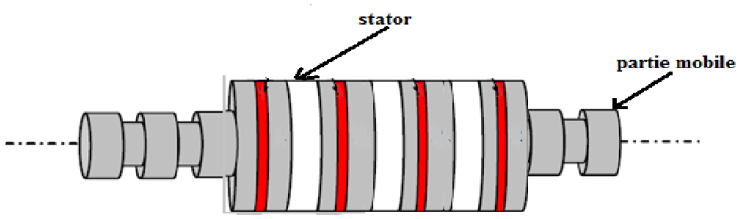
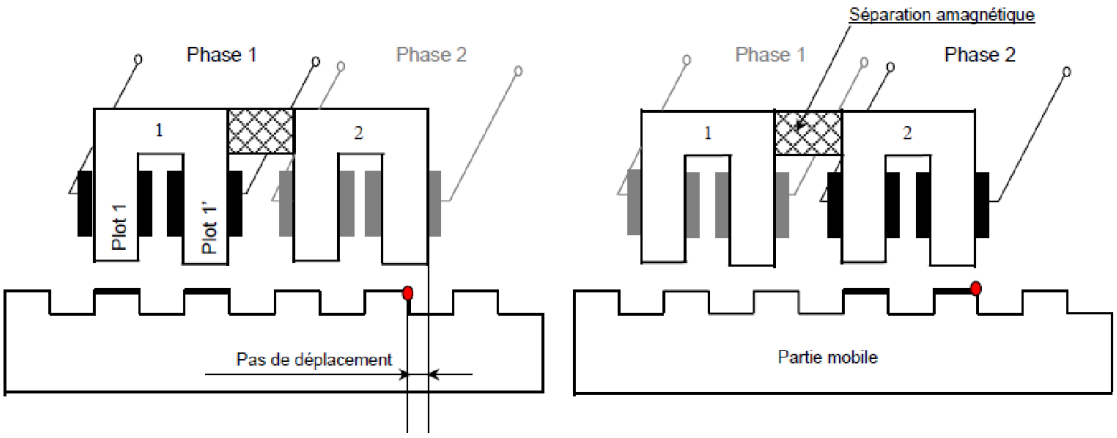


Fig. 1. Moteur linéaire à réluctance variable

La figure 1 montre un prototype de moteur linéaire à réluctance variable mentionné ci-dessus.

Son principe de fonctionnement se base sur le phénomène de l'attraction du fer par les électroaimants. En effet, lorsque deux pôles opposés du stator sont excités, deux pôles du rotor s'alignent avec eux, mais un autre ensemble de pôles est hors alignement. L'alimentation d'une autre paire de pôles du stator amène encore une fois les pôles du rotor à l'alignement. De la même façon, et en commutant séquentiellement le courant dans les enroulements du stator, le rotor se déplace. La figure 2 montre un exemple de fonctionnement [9].



a) phase 1 alimentée *b) phase 2 alimentée*

Fig. 2. Principe de fonctionnement d'un moteur à réluctance variable

Sur la figure 2.(a), la partie mobile est alignée avec les dents du module 1. Ensuite, sur la figure2.(b) la partie mobile vient aligner ses dents avec celles du module 2.

2.2 PRODUCTION DE LA FORCE DANS LA MACHINE À RÉLUCTANCE VARIABLE

La production de la force dans une machine à réluctance variable s'explique par le principe élémentaire de la conversion électromécanique dans un solénoïde de N tours (figure 3). L'excitation de la bobine par un courant électrique (i) crée un flux magnétique (φ).

Dans la figure 3.(a) si le courant d'excitation (i) est assez élevé, l'armature mobile se déplacera vers la culasse. La caractéristique du flux en fonction de la force magnétomotrice (fmm) pour deux valeurs X1 et X2 (X1> X2) de l'entrefer est montré dans la figure 3.(b).

Cette caractéristique est linéaire pour X1 parce que la réluctance de l'entrefer est dominante, cela engendre un plus petit flux dans le circuit magnétique [10].

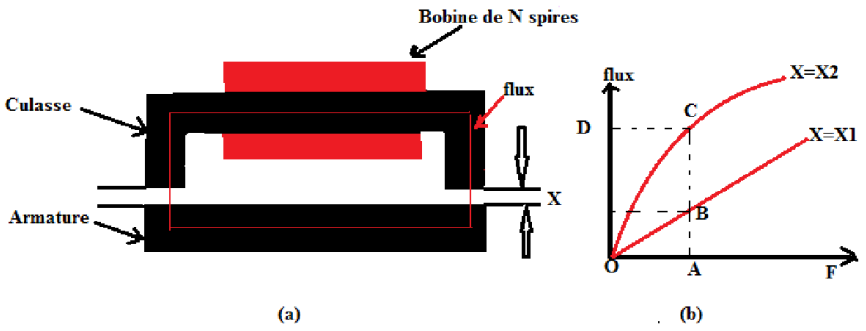


Fig. 3. Un solénoïde et sa caractéristique

L'expression de l'énergie électrique est donnée par l'expression suivante.

$$W_e = \int i.e.dt = \int i.N\frac{d\varphi}{dt}.dt = \int N.i.dt = \int F.d\varphi \quad (1)$$

Où e est la force électromotrice induite.

Par définition l'énergie d'entrée W_e est égale à la somme de l'énergie magnétique emmagasinée dans la bobine W_f et l'énergie convertie en énergie mécanique W_m :

$$W_e = W_f + W_m \quad (2)$$

À l'instant où l'armature est encore à la position X1, l'énergie emmagasinée est égale à l'énergie d'entrée donnée dans l'équation (2). Cela correspond à la surface OBEO dans la figure 3 (b).

Le complément de cette énergie est la co-énergie, elle est donnée par la surface OBAO dans la même figure. Son expression mathématique est $\int \varphi dF$. De la même façon, pour la position X2 de l'armature, l'énergie du champ correspond à la surface OCDO et la co-énergie est donnée par la surface OCAO. D'une manière variationnelle, nous pouvons écrire l'équation (2) de la façon suivante :

$$\delta W_e = \delta W_f + \delta W_m \quad (3)$$

Pour une excitation constante Fi donnée par le point A dans la figure 1.4 (b), les expressions des différentes énergies deviennent :

$$\partial W_e = F1 d\varphi = \int_{\varphi 1}^{\varphi 1} F1(\varphi 2 - \varphi 1) = S(BCDEB) \quad (4)$$

$$\delta w_f|_{X=X2} - \delta w_f|_{X=X1} = S(OCDO) - S(OBEO) \quad (5)$$

L'utilisation des équations (3) à (5) donne l'expression de la variation de l'énergie mécanique :

$$\delta W_e = \delta W_f + \delta W_m = S(OBCO) \quad (6)$$

Cette surface représente la différence entre les deux courbes pour une force magnétomotrice donnée. Dans le cas des machines linéaires, l'évolution de l'énergie mécanique en termes de force électromagnétique et de la variation de la position de la partie mobile est donnée par la relation suivante.

$$\delta w_m = F_e \partial\theta \quad (7)$$

La force électromagnétique est donné par :

$$F_e = \frac{\delta w_m}{\partial\theta} \quad (8)$$

Dans le cas d'une excitation constante, l'augmentation de l'énergie mécanique est égale au taux de variation de la co-énergie w_f Donc l'évolution de l'énergie mécanique s'écrit de la forme suivante :

$$\delta w_m = \delta w_f \quad (9)$$

$$w_f = \int N.\varphi.di = \int L(x,i).i.di \quad (10)$$

Si l'inductance varie linéairement avec la position du rotor pour un courant donné, ce qui en général n'est pas le cas en pratique, le couple peut s'écrire sous la forme suivante :

$$F_e = \frac{\partial w_f}{\partial x} = \frac{i^2}{2}\frac{dL(x,i)}{dx} \quad (11)$$

2.3 MODÈLE MATHÉMATIQUE DE LA MACHINE

2.3.1 ÉQUATIONS ÉLECTRIQUES

En négligeant l'inductance mutuelle entre les phases du stator, la tension induite aux bornes d'une phase A, B, C ou D, notée k, d'un moteur linéaire à réluctance variable, est donnée par l'expression suivante [11]:

$$V_k = R_s i_k + \frac{d\varphi(x,i)}{dt} = R_s i_k + \frac{dL(x,i)}{dt} \quad (12)$$

Avec R_s est la résistance d'une seule phase. L'équation (12) peut s'écrire sous la forme suivante :

$$V_k = R_s i_k + L_k(x,i)\frac{di_k}{dt} + \frac{dL_k(x,i)}{dt} v_m i_k \quad (13)$$

Où $v_m = \frac{dx}{dt}$ qui représente la vitesse de déplacement

L'inductance $\mathbf{L_k(x, i)}$ est une fonction périodique de x, de période spatiale λ. Elle oscille autour d'une valeur moyenne, son développement en série d'harmoniques est donnée par :

$$L_k(x) = L_0 + \sum_{k=1}^{\infty} L_k \cos(k \frac{2\pi x}{\lambda}) \quad (14)$$

Pour le cas des moteurs à quatre phases, les bobines statoriques sont électriquement déphasées de $\frac{\pi}{2}$.

Lors du déplacement de la partie mobile. L'inductance $\mathrm{L_k(x)}$ oscille autour d'une valeur moyenne. C'est une force périodique de x dont la période spatiale est égale à λ .fig 4 [12].

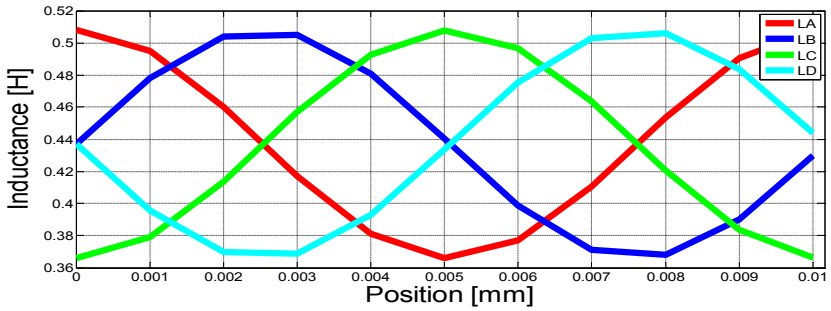


Fig. 4. Evolution de l'inductance en fonction de la position du mobile

2.3.2 ÉQUATION MÉCANIQUE DU MOUVEMENT

Le mouvement, sur un pas, d'un moteur à réluctance variable est régi par une équation différentielle du second ordre :

$$m\frac{dx^2}{dt} = F_A(x) + F_B(x) + F_C(x) + F_D(x) - \xi\frac{dx}{dt} - F_0 signe\left(\frac{dx}{dt}\right) - F_c \quad (15)$$

avec :

- $\mathrm{F_k(x)}$ (k= a, b, c, d): la force de poussée (N),
- ξ : Le coefficient de frottement visqueux (Nsm-1),
- $\mathrm{F_0}$: Le frottement visqueux (N)
- m : La masse de mobile (kg),
- $\mathrm{F_c}$: La force de charge (N).

Avec les expressions des forces dans chaque phase est comme suit :

$$F_A(x) = (-\frac{\pi L_1}{\lambda})sin(\frac{2\pi x}{\lambda})i_A^2 \quad (16)$$

$$F_B(x) = (-\frac{\pi L_1}{\lambda})sin(\frac{2\pi x}{\lambda} - \frac{\pi}{2})i_B^2 \quad (17)$$

$$F_C(x) = (-\frac{\pi L_1}{\lambda})sin(\frac{2\pi x}{\lambda} - \pi)i_C^2 \quad (18)$$

$$F_D(x) = (-\frac{\pi L_1}{\lambda})sin(\frac{2\pi x}{\lambda} - \frac{3\pi}{2})i_C^2 \quad (19)$$

Avec comme vecteurs d'état$\overline{\mathrm{X}} = [\mathrm{i_k}, \mathrm{x}, \mathrm{v_x}]$, avec k= a, b, c, d. Le modèle dynamique peut être mis sous la forme suivante [13] :

$$\begin{cases} \frac{\mathrm{di_k}}{\mathrm{dt}} = \frac{1}{\mathrm{L_k(x)}}(\mathrm{V_k} - \mathrm{Ri_k} - \frac{\mathrm{dL_k(x)}}{\mathrm{dx}}\mathrm{i_k v_k}) \\ \frac{\mathrm{dx}}{\mathrm{dt}} = \mathrm{v_x} \\ \frac{\mathrm{dv_x}}{\mathrm{dt}} = \frac{1}{\mathrm{M}}(\mathrm{F_x} - \mathrm{Dv_x} - \mathrm{F_{sec}sign(v_x)}) \end{cases} \quad (20)$$

3 COMMANDE ADOPTE D'UNE MACHINE LINEAIRE A RELUCTANCE VARIABLE

Le model dynamique ci-dessus était pilote par une machine linéaire à réluctance variable, dotée d'une vitesse et d'une force non linéaires pouvant induire une certaine imprécision sur la fonctionnalité attendue. Pour palier à cette problématique on a pensé à remplacer les deux éléments actifs de la boucle de commande du système par des dispositifs intelligents multivariables de ce fait, l'ancien capteur analogique unidimensionnel pouvant convertir un seul paramètres de retour du système par un réseau neuronique multivariable (multi-paramètres) qui tient en considération plusieurs paramètres a la fois et qui réside dans l'intégration d'une carte de KHONEN dont l'abréviation est 'SOM' pour Self Organizing Map. A recevoir les déférents paramètres de sorties de ce système au même temps et offrant a chaque itération (cycle d'apprentissage non supervise). Ce meilleure sortie dite BMU (Best Matching Unit) vers un comparateur passif traduisant l'écart a un régulateur non conventionnel mais de nature intelligent et évolutionnaire aussi sous l'effet d'un algorithme génétique assurant l'élaboration de gène (chromosome) la plus adaptée a la commande de notre système ce ci étant décrit par « survie au meilleur individu ». Ce dernier étant sélectionné par une fonction coût dite « Fitness » appropriée à notre système ce chromosome qui génère le nouveau régulateur évolutionnaire est constitué d'un vecteur de données caractérisant les paramètres venant d'être comparés, ce vecteur sera véhiculé vers l'actionneur du système afin d'affecter le déplacement de l'armature mobile située à l'intérieur du moteur à réluctance variable, cette idée étant modélisée par le synoptique suivant.

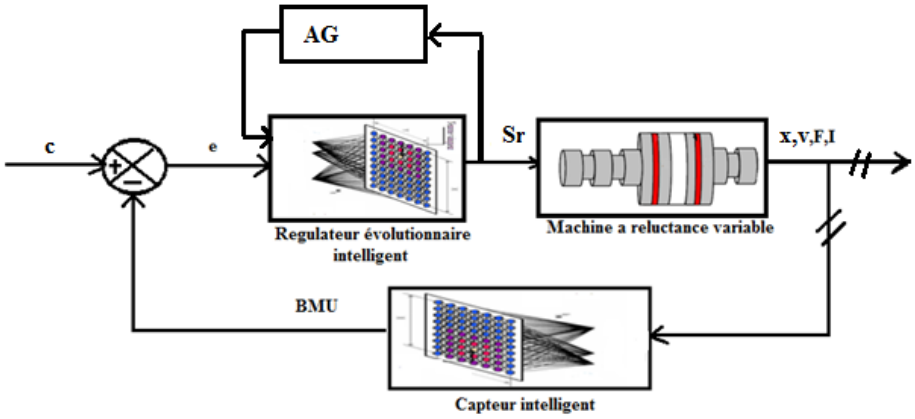


Fig. 5. Principe de commande intelligente d'une machine à réluctance variable

3.1 ALGORITHME DE FONCTIONNEMENT DU CAPTEUR INTELLIGENT ADOPTE

Le capteur intelligent est constitué d'un réseau de neurones auto-organisateur à une seule couche dont le vecteur de données d'entrée, qui présente les paramètres de sortie actionneur, s'applique à chaque neurone comme le montre la figure 6 [14]. Il s'agit de la carte de Kohnen désignée en anglais par SOM pour « Self Organizing Map ». Après l'admission d'un vecteur d'entrée $\overline{X}$, chaque neurone va recevoir tous les composants du vecteur $\overline{X}$ suite à leur convolution, (multiplication) autrement dit après leurs filtrage par les poids synoptiques de chaque canal d'interconnexion. Au cours de la phase d'apprentissage, on aura dans chaque itération (cycle d'apprentissage) un seul neurone qui représente mieux le signal d'entrée (vecteur d'entrée) ; c'est le neurone ayant les aspects géométriques les plus proches en terme de distance euclidienne aux motifs du vecteur d'entrée. Ce neurone sera appelé : Neurone vainqueur désigné par le terme BMU.

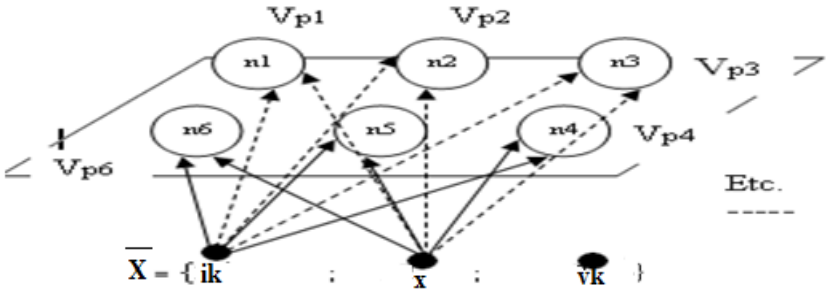


Fig. 6. Représentation de SOM

La figure 7 représente un résumé sur le principe de l'algorithme de capteur intelligent adopté au moyen d'un diagramme qui met en ouvre la logique de son fonctionnement.

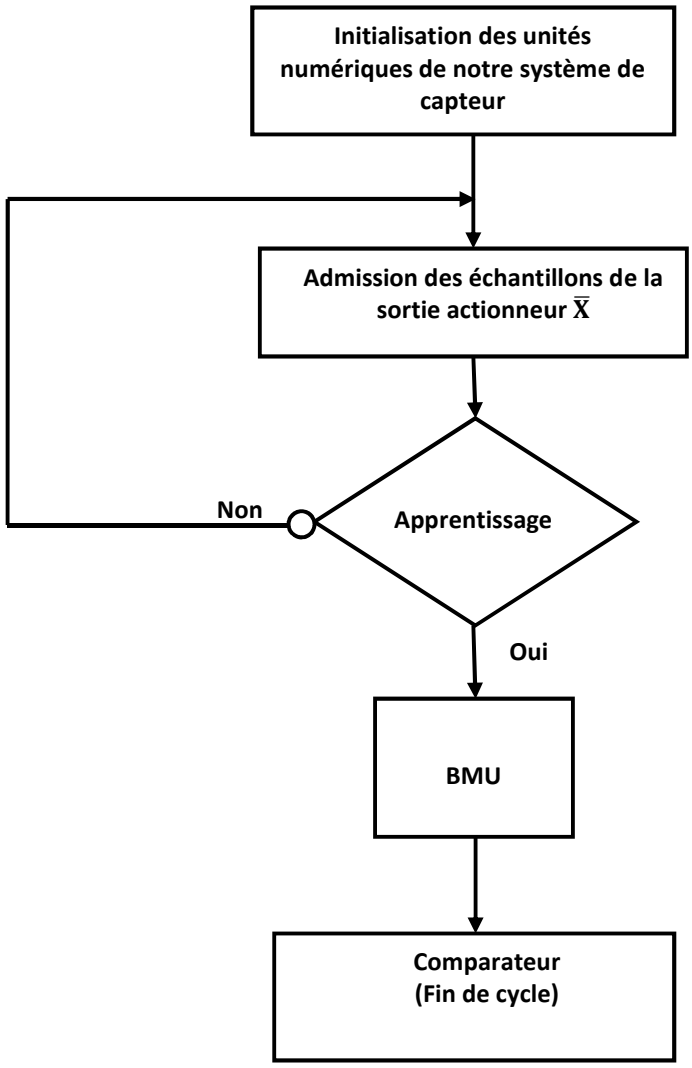


Fig. 7. Diagramme de fonctionnement du capteur intelligent adopte

3.2 ALGORITHME DE FONCTIONNEMENT DU REGULATEUR EVOLUTIONNAIRE INTELLIGENT ADOPTE

Notre régulateur évolutionnaire intelligent prend appui aussi sur l'application du même réseau neuronique (la carte SOM) qui constitue maintenant un très bon outil de diversification des populations de part l'élaboration à chaque itération d'un individu constitué par le BMU. Cette diversification des individus d'une population offre l'avantage pour l'algorithme Génétique (AG) évolutionnaire d'appliquer à une étendue beaucoup plus importante que notre espace de recherche pour se converger finalement vers une solution optimale qui se rapproche vraisemblablement à la solution attendue ; un signal constant assure la stabilité et la linéarité de l'actionneur. Cet algorithme évolutionnaire adopté est guidé par une fonction coût appropriée dite « Fitness » ; C'est la fonction de régulation. La figure 8 représente un résumé sur le principe de l'algorithme de régulateur évolutionnaire intelligent adopté au moyen d'un diagramme qui met en ouvre la logique de son fonctionnement.

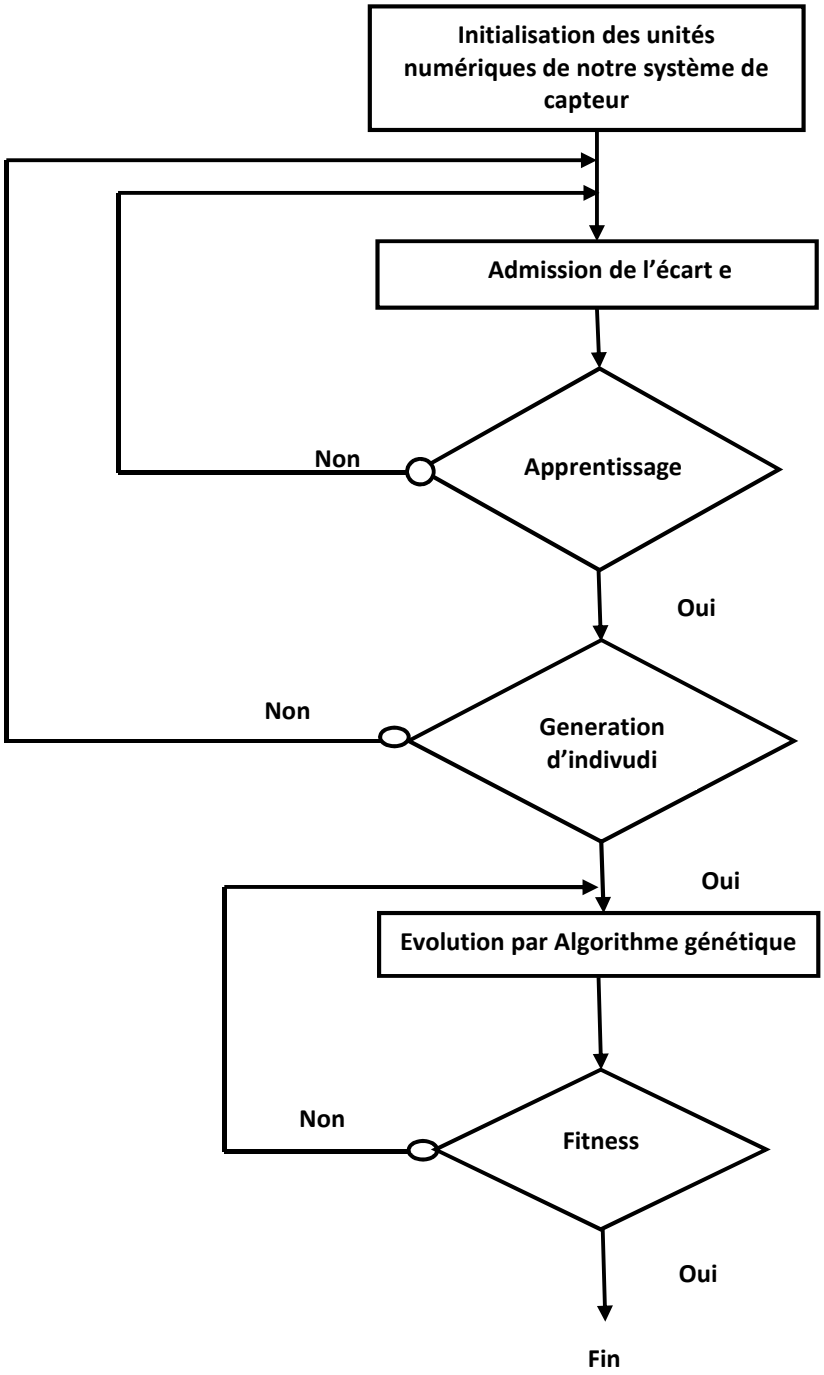


Fig. 8. Diagramme de fonctionnement régulateur évolutionnaire intelligent

4 CONCLUSION

Notre étude de la nouvelle approche de la conception d'un régulateur et d'un capteur intélligents pourra palier à des limites de performance caractérisant les plus parts des systèmes à réluctance variable. Notre étude actuelle couvre la partie conception et étude et nous envisageons à une étape ultérieure passer à l'implémentation et la simulation en vue d'intégrer la solution en toute simplicité.

REFERENCES

[1] Wadhah Missaoui, Lilia EL Amraoui, Frederic Gillon, Mohamed Benrejeb and Pascal Brochet, "Performance Comparison of Three and Four-Phase Linear Tubular Stepping Motors", in Proc. ICEM06, Greece, paper No.467, 2006.

[2] T. Wildi, Gilbert Sybille, ''Electrotechnique'', 4ème Edition, Edition De Boeck et Larcier, 2005.

[3] G.Grellet, G.Clerc, "Actionneurs électriques, principes/modèles/commande", Collection Electrotechnique, Edition EYROLLES, Paris, 2000.

[4] M.Jufer, "Electromécanique", Editions Georgi Dunod, Traité d'Electricité, d'Electronique et d'Electrotechnique, 1979.

[5] R. Krishnan, "Switched Réluctance Motor Drives", CRC Press, 2001.

[6] T.Wildi, "Électrotechnique", Les presses de l'université Laval, 2008.

[7] J. M. Kokernak, D. A. Torrey, and M. Kaplan, "A switched réluctance starter/alternator for hybrid electric vehicles," Proc. PCIM'99, 1999, pp. 74-80.

[8] Z. Mustapha. "Modélisation Numérique du Couplage Electromagnétique'', Mécanique dans les Structures Linéaires Tubulaires, Thèse de doctorat en électrotechnique, 2013.

[9] L.Elamraoui, ''Conception électromécanique d'une gamme d'actionneurs linéaires tubulaires à réluctance variable", Thèse de Doctorat, Université des Sciences et Technologies de Lille, Ecole Générale de Lille, Ecole Nationale d'Ingénieurs de Tunis, 2002.

[10] M. CHAKIR, CONCEPTION ET OPTIMISATION DE LA PERFORMANCE D'UNE GÉNÉRATRICE À RÉLUCTANCE VARIABLE

[11] KHIDIR.J, ''Alimentation et commande d'un actionneur linéaire triphasé à flux transversal'', Thèse de doctorat, Université scientifique et de technologie de Lille, 1992.

[12] W.Amri, A. B.Amor, ''Nonlinear dynamic simulation model of Réluctance Linear Motor'', International Conference in Control, Engineering & Information Technology, 2013.

[13] M.R.DE CASTRO, ''Analyse des modes chaotiques dans un moteur linéaire à réluctance variable en vue de control'', Thèse de doctorat, Université de Reims, Champagne-Ardenne, 2010.

[14] M.S. SALHI, ''Hybridation des modèles auto-organisateurs récurrents RSOM et AG''. Thèse de doctorat, ENIT, UNIVERSITE DE TUNIS EL MANAR, 2012.

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Contrast Enhancement of Gray Image using proposed mask in Discrete Cosine Transform Domain

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ABSTRACT: In this paper contrast of gray image is enhanced using proposed mask in discrete cosine transform and discrete wavelet transform domain. In this technique the image is converted into DCT and DWT domain and respective coefficients are modified using proposed mask for its domain then the enhanced image is reconstructed using inverse transform. The discrete cosine transform outperforms with better image quality and highest PSNR value. We compare this approach with enhancement based on the discrete wavelet transform.

KEYWORDS: Discrete cosine transform, Discrete wavelet transform.

1 INTRODUCTION

Image Contrast Enhancement is an important in enhancing images quality where features are hardly detectable by eye. It improves the visual quality of an image. In satellite, medical field the contrast enhancement techniques are used to enhance the images brightness and contrast. Histogram equalization is one of spatial domain method for enhancement of images. In Transform domain approach the discrete wavelet transform and discrete cosine transform approach consists of first transforming the image using the transform. Then the coefficients are modified by multipling by constant at scale. Finally, the enhanced image is obtained by taking the inverse transform from the modified coefficients.

2 OVERVIEW OF DWT AND DCT

In this paper,mask in discrete cosine transform domain for enhancing the gray image has been proposed and compared with discrete wavelet transform.

2.1 DISCRETE WAVELET TRANSFORM

The discrete wavelet transform separates the image in two wavelet coefficients that are the approximate and detail. Approximate coefficients are high scale, low frequency components and the detail coefficients are low scale,high frequency components of an image. These are modified by scaling. Finally the enhanced image is obtained by taking the inverse wavelet transform from the modified wavelet coefficients. The following chart describes the basic decomposition steps for images:

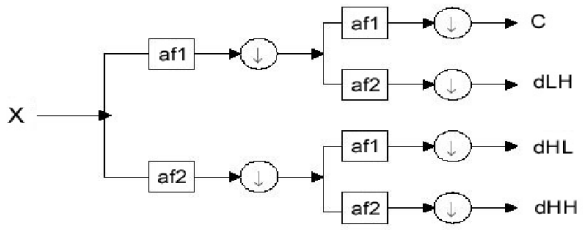

Fig. No.1. Decomposition of image

2.2 DISCRETE COSINE TRANSFORM

The DCT separate the image into three parts. It segments an image in to non overlapping block and applies DCT to each block. After transform it gives three frequency sub-bands: low frequency sub-band, mid-frequency sub-band and high frequency sub-band. Much of the image information lies at low-frequencies sub-band which contains the most important visual parts of the image as shown in fig. No.4.,mid frequency consisits small information of an image and the high frequency components of the image and it is noise.

m	m	m	m	m	m	m	m
m	m	m	m	m	m	m	n
m	m	m	m	m	m	n	n
m	m	m	m	m	n	n	n
m	m	m	m	n	n	n	n
m	m	m	n	n	n	n	0
m	m	n	n	n	n	0	0
m	n	n	n	n	0	0	0

*Fig. no.2 DCT 8*8 scaling mask*

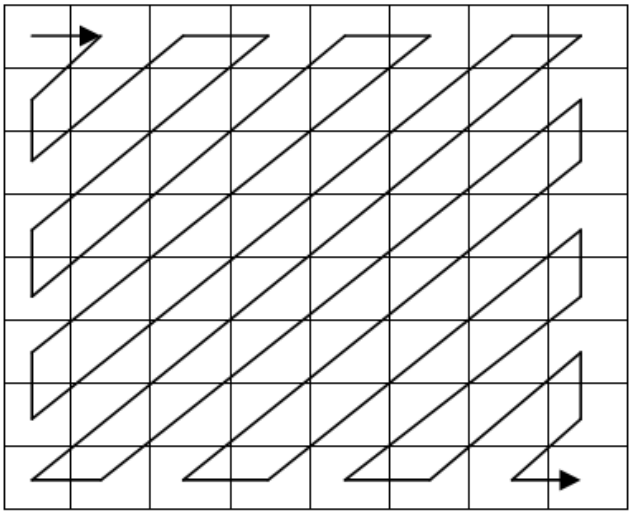

Fig.No.3 zigzag ordering of DCT coefficients

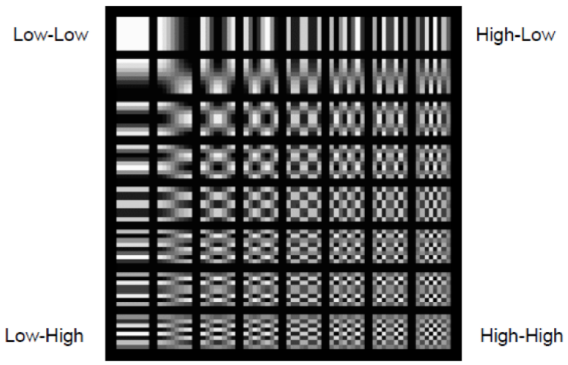

Fig.no.4 DCT Coefficients

3 PROPOSED METHODOLOGY

In this paper, a mask based on discrete cosine transform and discrete wavelet transform has been proposed and compared for enhancing the contrast of gray images. Discrete cosine transform is applied to separate the features of an image. The DCT converts the spatial domain into frequency domain represented by its DCT coefficients. DCT separates higher, mid and lower frequency components .The important information is in low frequency DCT coefficients. Hence low frequency is separated from high frequency coefficients by making high frequency components zero and by scaling low and mid frequencies DCT coefficients are modified. For obtaining enhanced image from modified coefficients inverse DCT is used. Assume A is a gray image and E is an enhanced image.

The following are the steps for proposed technique.

Step1: Read a gray image A.

Step2: Divide the input image into 8×8 non-overlapping sub blocks.

Step3: Apply DCT to each sub block.

Step4: Using proposed mask each sub block DCT coefficients are modified.

Step5: By applying inverse DCT reconstruct the enhanced image E from modified DCT coefficients.

4 RESULTS AND DISCUSSION

For obtaining better result different scaling factors are analyzed and best scaling factors are used to enhance the image.

4.1 DISCRETE COSINE TRANSFORM O/P

Table No.1 DCT Scaling factor analysis

Lena.jpg	Scaling Factor		For noiseless image		For noisy image	
Sr.no.	m	n	PSNR	Contrast	PSNR	Contrast
1	0.7000	0.8040	24.1805	0.1660	24.3919	0.7229
2	0.8000	0.8080	24.5534	0.2025	24.7919	0.8022
3	0.9000	0.8120	26.2177	0.2406	26.5022	0.8911
4	1.0000	0.8160	51.6302	0.2937	33.6584	1.0030
5	1.1000	0.8200	75.4320	0.3304	42.0890	1.1002
6	**1.2000**	**0.8240**	**93.2853**	**0.3595**	**47.9023**	**1.1794**
7	1.3000	0.8280	Inf	0.3829	51.9566	1.2449

4.2 DISCRETE WAVELET TRANSFORM O/P:

Fig. No.5 DWT Output for lena.jpg

LL*m	LH*n
HL*p	HH*q

Fig.No.6 DWT scaling factor mask

Table No. 2 DWT scaling factor analysis

Lena.jpg	Scaling Factor				For noiseless image	
Sr. no.	m	n	p	q	PSNR	Contrast
1	1.0100	0.7080	1.0100	0.0100	43.1187	0.2856
2	1.0200	0.7160	1.0200	0.0200	44.4010	0.2915
3	1.0300	0.7240	1.0300	0.0300	45.6292	0.2954
4	1.0400	0.7320	1.0400	0.0400	46.8408	0.2987
5	1.0500	0.7400	1.0500	0.0500	48.0922	0.3025
6	1.0600	0.7480	1.0600	0.0600	49.3582	0.3052
7	1.0700	0.7560	1.0700	0.0700	50.6504	0.3095
8	1.0800	0.7640	1.0800	0.0800	52.0282	0.3114
9	1.0900	0.7720	1.0900	0.0900	53.4572	0.3150
10	1.1000	0.7800	1.1000	0.1000	54.9756	0.3216
11	1.1100	0.7880	1.1100	0.1100	56.5583	0.3279
12	1.1200	0.7960	1.1200	0.1200	58.2372	0.3338
13	1.1300	0.8040	1.1300	0.1300	59.9137	0.3384
14	1.1400	0.8120	1.1400	0.1400	61.7487	0.3398
15	1.1500	0.8200	1.1500	0.1500	63.6949	0.3403
16	1.1600	0.8280	1.1600	0.1600	65.5842	0.3431
17	**1.1700**	**0.8360**	**1.1700**	**0.1700**	**67.7647**	**0.3440**
18	1.1800	0.8440	1.1800	0.1800	69.5470	0.3453
19	1.1900	0.8520	1.1900	0.1900	71.3960	0.3466
20	1.2000	0.8600	1.2000	0.2000	73.7188	0.3499

Some other results are as below.

From above results we conclude that for enhancement of gray image discrete cosine transform outperforms better than discrete wavelet transform . Using discrete cosine transform obtained highest PSNR value is 93 dB. The image quality is better than discrete wavelet transform

REFERENCES:

[1] IEEE image processing 2001; 10 (3):367-82.Transform-based image enhancement algorithms with performance measure by Agaian s s, Panetta K, Grigoryan AM.

[2] The 2nd International Conference From Scientific Computing to Computational Engineering 2nd IC-SCCE Athens, 5-8 July, 2006 Madoukas Theodore1, Athanasiadis Emmanouil2, Bougioukos Panagiotis2, Kalatzis Ioannis1, Dimitropoulos Nikos3 and Cavouras Dionisis1 ,"Performance Evaluation of A-trous Wavelet based Filters for enhancing Digital Mammography Images".

[3] The International Journal of Computer Applications (0975 – 8887) Volume 35– No.7, December 2011 a paper was published on "Satellite Image Contrast Enhancement using Multiwavelets and Singular Value Decomposition (SVD)".

[4] The World Academy of Science, Engineering and Technology 79, 2011 ,"Enhancement of Low Contrast Satellite Images using Discrete Cosine Transform and Singular Value Decomposition "by A. K. Bhandari, A. Kumar and P. K. Padhy.

[5] The International Journal of Computer Applications (0975 – 8887) Volume 35– No.7, December 2011 a paper was presented by Sulochana S and Vidhya R on Satellite Image Contrast Enhancement using Multiwavelets and Singular Value Decomposition (SVD).

[6] The Optica Applicata, Vol. XLI, No. 1, 2011 " Comparison of wavelet, Gabor and curvelet transform for face recognition" by Jtulong Zhang, Yinghui Wang, Zhyui Zhang, Chunli Xia Computer Science and Engineering School, Xian University of Technology, Xi'an, 710048, P.R. China.

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Generation of Electricity Using Cow Urine

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ABSTRACT: For healthy environment and sustainable economic growth we need clean and efficient electric power generation systems. The natural sources of renewable energy available to human are: the solar, tidal, wind, bio-gas and biomass etc. This paper introduces a new renewable source of energy; energy from cow urine that can produce electricity by electrolytic conductions. The alkaline nature of fresh cow urine acts as a good electrolyte liquid. The system works like a conventional battery system. However, a discharged battery needs to recharge by electricity in order to reactivate it. On the other hand, cow urine based system needs only to replace old urine by fresh urine to activate the system again. As no electricity is required for charging the system, the daily available fresh urine from a dairy farm could be a possible source of renewable energy. In order to understand the feasibility of the source, we built a car battery size prototype that can hold approximate five liter of fresh urine as electrolyte. We used similar and equal number of electrode that a typical car battery does. We measured the performance of the source with loads and observed its outputs. The details of the system and its performances have been described in this paper.

KEYWORDS: Cow urine, Renewable energy, Green technology, Sustainable growth.

1 INTRODUCTION

Global demand for energy has risen inexorably in the last 150 years in step with industrial development and population growth. Hunger for energy is predicted to continue to rise, by at least 50% by 2030 [1]. Developing country like Bangladesh is seeking a tremendous scarcity of electricity generation and it is of incredible importance to cope up with the overwhelming demand of electricity. So if we devise self-sustainable energy production via simple yet recyclable way that would be helpful to reduce the inevitable scarcity. As natural resources can be utilized in a more efficient manner, we planned to utilize cow urine as an alternative source of electricity generation to lighting the domestic animal farm & other purposes. We can build some urine based plant to facilitate backup power system which will help the rural people immensely. The natural sources of energy available to man include; the sun, fossil fuels, flowing water energy available to man include; the sun, fossil fuels, flowing water and wind. Therefore, to make the decision on which of the aforementioned sources to use, a careful process of consideration has to take place. These considerations include: Availability, Extraction costs and feasibility, Conversion costs, Efficiency, Sustainability, and Economic implications. Research efforts for developing alternative sources of energy for electricity generation, has heightened [2-3]. The most desirable source would be one that is non-pollutant, available in abundance, and renewable, and can be harnessed at an acceptable cost in both large-scale and small-scale systems. The most promising source satisfying all these requirements is cow urine, a natural energy source. Process generation of electricity from cow urine shown fig-1

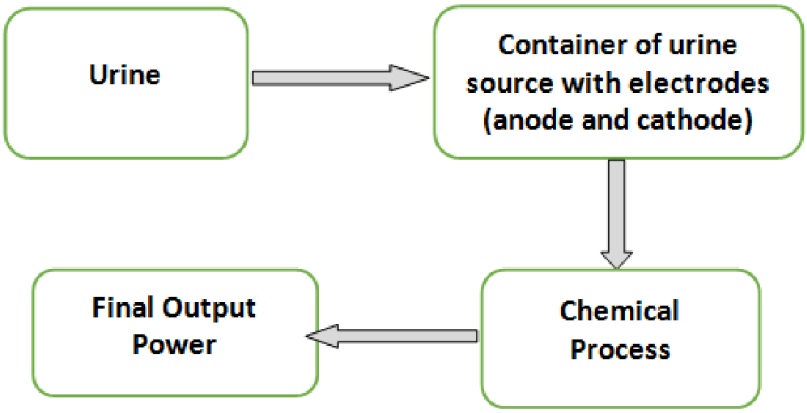

Fig.1. Block Diagram of proceeding of alternative source mechanism

2 WORKING PRINCIPLE

An anode is an electrode through which electric current flows into a polarized electrical device. The direction of electric current is, by convention, opposite to the direction of electron flow. In other words, the electrons flow from the anode into, for example, an electrical circuit. A commonly used mnemonic is ACID (Anode Current into Device). [4]

A cathode is an electrode through which electric current flows out of a polarized electrical device. The direction of electric current is, by convention, opposite to the direction of electron flow thus, electrons are considered to flow toward the cathode electrode while current flows away from it. This convention is sometimes remembered using the mnemonic CCD (cathode current departs).

The chemical reactions in this source cause a build-up of electrons at the anode. This results in an electrical difference between the anode and the cathode. We can think of this difference as an unstable build-up of the electrons. The electron wants to rearrange them to get rid of this difference. But they do this in a certain way. Electrons repel each other and try to go to a place with fewer electrons. In this system, the only place to go is to the cathode. But, the electrolyte keeps the electrons from going straight from the anode to the cathode within the battery. When the circuit is closed (a wire connects the cathode and the anode) the electrons will be able to get to the cathode. This is one way of describing how electrical potential causes electrons to flow through the circuit. However, these electrochemical processes change the chemicals in anode and cathode to make them stop supplying electrons. So there is a limited amount of power available in output. When we recharge a battery, we change the direction of the flow of electrons using another power source, such as solar panels. The electrochemical processes happen in reverse, and the anode and cathode are restored to their original state and can again provide full power. Fig 2 shows the configuration of electrodes.

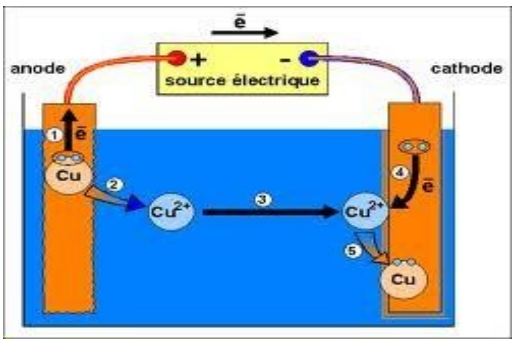

Fig.2. Diagram of a system which act as electrolyte

3 CHEMICAL PROCESS

The source we made from cow urine through is mostly evaluated by chemical composition of urine**.** Actually, from chemical composition we perceived that when copper and zinc plates come in contact with uric acid movement of electrons begins, generating electricity.

3.1 URIC ACID

Uric acid is a heterocyclic compound of carbon, nitrogen, oxygen, and hydrogen with the formula $C_5H_4N_4O_3$. It forms ions and salts known as urates and acid urates such as ammonium acid urate [5]. Chemical Bond of Uric acid is given below:

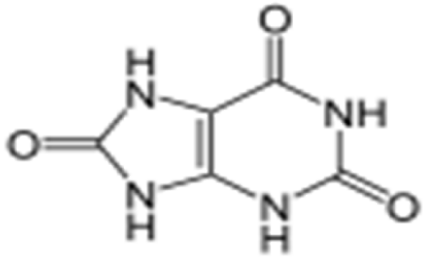

Fig. 3. Bond of uric acid ($C_5H_4N_4O_3$)

3.2 CHEMICAL CONCEPT OF ELECTRICITY GENERATION

Uric acid is a hetero cyclic compound of carbon, nitrogen, and hydrogen with the formulated of $C_5H_4N_4O_3$. [6] Copper with the presence of water will be reacted with Uric acid. Then oxidation reaction will be happened as a result uric acid will be oxidized by Cu and produced Cu urate. This is basically a salt solution and can be made ionic bond then this bond will be contacted with zinc plate. So, from this reaction it can be realized that, when copper and zinc plates come in contact with uric acid movement of electrons begins, generating electricity.

4 METHOD & MATERIALS USED IN URINE BASED POWER GENERATION SYSTEM

For the purpose of the renewable energy we collected several amount (liters) of urine for the primary test& put two different plastic pots containing half liter each& connect those using wires & electrodes; we measure the voltage as 1.1V to max 6.2V using multimeter where connecting proves into the different poles of the electrodes. The electrodes are made of zinc & copper respectively which acts as a battery cell. Connecting wires to the electrodes we found low voltage from urine after a while. We also connected two metal pins to the solution as cow's urine so that electron can flow from zinc plates to copper plates as a close loop system. Several affords we did in order to bring more urine so that we can get more voltage that we found before. It is anticipated that the more volume of urine we tested the more voltage we got. For the second time testing with 2 liters of cow's urine provide comparatively high in output. There are some remarks that we noticed that while using metal pins for the close loop system, the electrolysis process starts with few delay. The fresh urine might provide much more voltage as 1V for certain cases. It is found that while the flow of electron occurs through the electrodes & those pins as well, the gradual decay of metal pin happens. As a result there needs a change of metal pins testing with four or five experiments for better output. Besides, connection of the wires must be good enough to get the desire output. Observing the preliminary test, we think off the basic circuit diagram about how the process working. The equivalent circuit design of our system is given below in Fig. 4

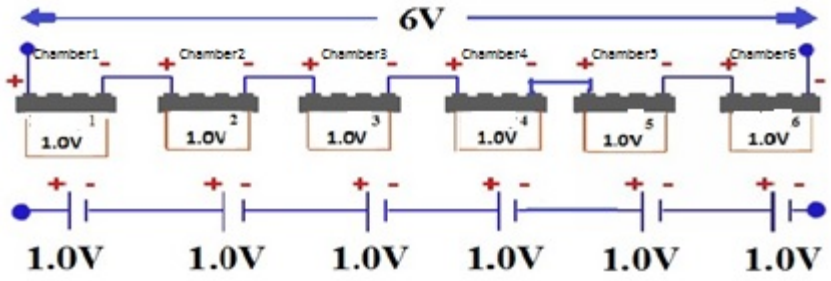

Fig. 4. Equivalent circuit diagram of urine based power generation system

According to our own system that works individually as a battery cell for each slot of container of a battery. In practical, situation every cell gives approximately about 1V & they connected as a series combination fig 5(a) which sum up three slots provides 3V & six slots provides 6V. The power varies according to the series combination of the battery & the current varies because of the condition of electrodes as well as urine. Total four loads (LEDs) are connected parallel to close the whole loop of the battery Fig 5(a) Continuous dissipation of energy cause the cow urine power tends to almost zero Fig 5(b) & Fig 5 (c).

Fig. 5. (a) Practical set up of the System for Three Slot

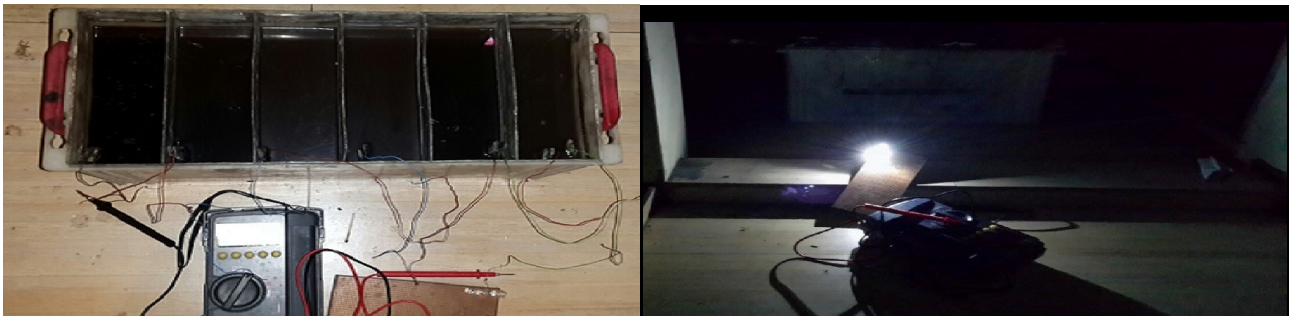

Fig. 5. (b), (c) Practical setup of System for Six Slot

5 EXPERIMENTAL RESULT & ANALYSIS

In this research, the cell technology is experimented with different terms which included volume of urine, voltage, current and power with respect to time which inscribed in different table with graph. Variations of load are applied so that the behavior of the system can be well understood. Several observations are taken. According to (table) it is clear that the system dissipate energy due to continuous connection of load. The experiment is performed with six segments where volume of urine changed from three liters to six liters & electrodes are kept unchanged.

In our research we examined different measurement with volume, voltage, current and power with respect to time which inscribed in different table with graph. In this project we have taken various data from various observations.

Table 1. Experiential data of the implementation for 4 liters of urine and data were taken 24 hours interval.

Observation	Time(Hour)	Volume(ltr)	Voltage(V)	Current(I)	Power(W)
1	24	4ltr	4.26V	287 mA	1.222W
2	72	4ltr	4.15V	228 mA	0.946W
3	96	4ltr	4.13V	221 mA	0.912W
4	144	4ltr	4.11V	217 mA	0.891W

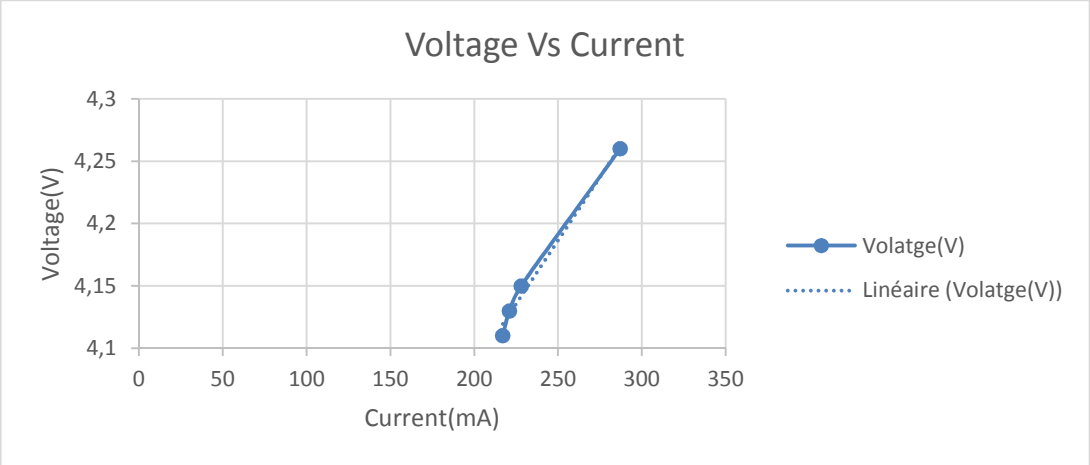

Fig. 6. Four liters of urine & new electrodes with load connected decreases the voltage & current

Table 2. Experiential data of the implementation of 5 liters of urine and load was connected continuously to check the system strength

Observation	Time (Hour)	Volume (ltr)	Voltage (V)	Current (I)	Power (P)
1	24	5ltr	6.00V	187 mA	1.122W
2	48	5ltr	5.62V	150 mA	0.843W
3	96	5ltr	5.32V	112 mA	0.595W
4	144	5ltr	5.16V	47 mA	0.242W

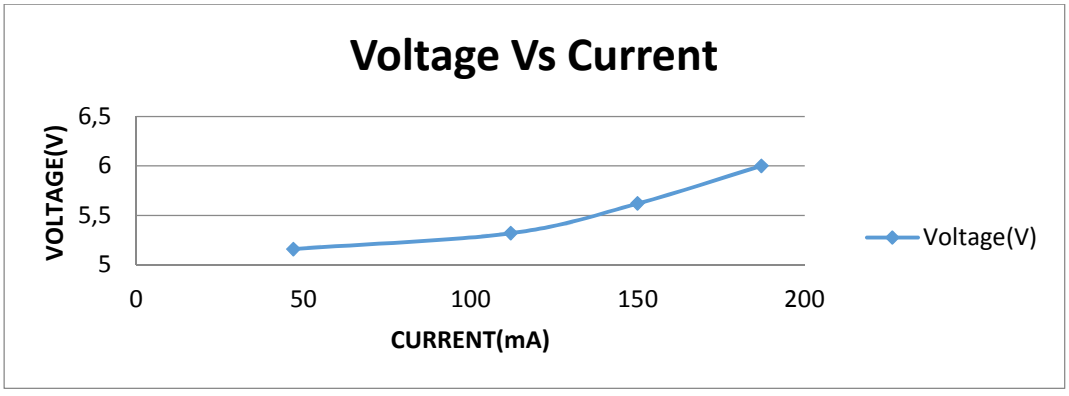

Fig. 7. V-I curve for Five liters of urine (Power is increased with respect to increase of urine quantity and it is observed that increasing the liters of urine can able to produce more energy)

Similarly several experiments are performed with different interval of time to understand the system response for every week. The power vs hour curve gives a brief idea of the system. From above experimental data it is clear that increasing

volume of urine can increase the voltage but with respect to time it will be downward because of decaying of electrodes and continuous dissipated of power. In figure 8 illustrated different experiment which shows the output power vs hour and also shows the behavior of movement. Different characteristics of different experiment curve shown in figure 8.

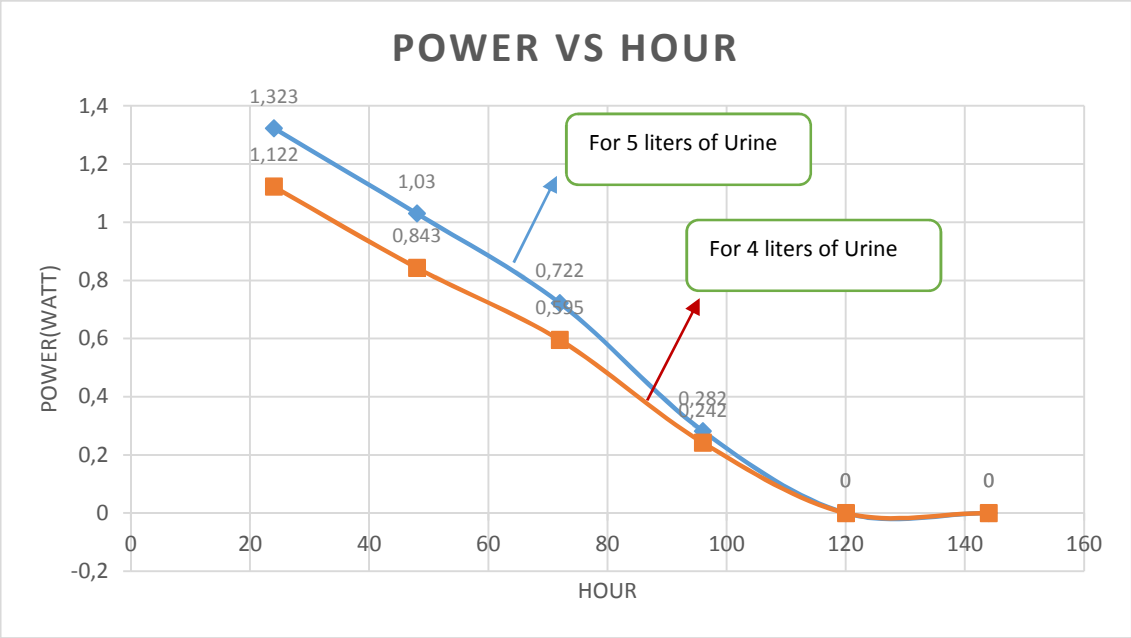

Fig. 8. Different volume of urine & unchanged electrodes with load connected where decreases power with respect to time. (From above graph it can be optimized that when urine will give sufficient amount of energy, then again chamber need to be filled with fresh urine so that it can produce energy likewise)

From the power vs hour graph, it can be conclude that is every battery cell technology has different factors & performance parameters depending on operating power, its chemistry & legibility. It's obvious that every time for every experiment fresh urine & fresh electrodes provides max output power depending on the volume of urine.Continuous flow of electrons & electrode decays causes the system to decreses current which is proportional to voltage. As a result power decreses with respect time gradually which is very ovious in practical cell technology system .It is clearly indicates that cow urine can be the alternative renewable source for generating electricity.From experimental data and analysis shows that higher quantity of urine and best quality of electrodes can produce higher and strong output which strength will be the best as well as longibity will be higher.

6 CONCLUSION

From the experiment we have demonstrated a small cow urine based power generation system. The performance of the system is satisfactory. Here, to understand the feasibility of the system needs to build a longer scale of the system & test it for a longer period of time. Moreover options, processes and systems may vary to use cow's urine based plant for households as well. In our researches we only worked with very smaller quantity of urine which only 5 liters and electrodes were old and we got almost 1.5 watt. Our aim is to work with large quantity of urine as well as larger size of own design electrodes to establish a power plant which will be able to mitigate the demand to a substantial extent in future. In order to prosper and thrive, energy consumption must be proportional to its supply and storage capacity while currently we are suffering. Hence any kind of alternative like this will make a significant change to that situation. So we expect our local government to make an active effort to invest and endorse in such research activities.

REFERENCES

[1] http://news.bbc.co.uk/2/shared/spl/hi/sci_nat/06/global_energy/html/intr oduction.stm

[2] Bilcan, A., Le Corre, O. and Delebarre, A "A Hydrogen Fuel Cell Uses

[3] Cow Manure" (2003) Thermal efficiency and environmental performances of a biogas-diesel stationary engine. *Environ. Technol.* vol. 24 (9):pp.1165-1173.
http://www.answers.com/search/Biocatalysts; Accessed on January 06, 2014.

[4] Elliot, H. H., Klass, D., Energy from Biomass and Wastes VIII/Symposium. 1984. Accessed on February 02, 2014.

[5] http://en.wikipedia.org/wiki/Electrode *Wikipedia: The Free Encyclopedia.* Accessed on March 18, 2014.

[6] Delaney, G. M., Bennetto, H. P., Mason, J. R., Roller, S. D., Stirling, J. L. and Thurston, C. F. "Cow Manure adds to Arsenic Epidemic" (1984) Performance of fuel-cells containing selected microorganism mediator substrate combinations. *J. Chem. Technol. Biotechnol. B- Biotechnology* vol. 34(1): pp.13-27. Accessed on February 12, 2014.

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The Modified Jones and Yoon Models in Detecting Earnings Management in Palestine Exchange (PEX)

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ABSTRACT: This study attempts to find out if the Modified Jones (1995) and Yoon et al., (2006) models are effective in detecting earnings management in an emerging economy as Palestine. The study also compares the Modified Jones (1995) model with the Yoon et al., (2006) model. That is to give an overview of the best model in detecting earnings management practiced by listed companies in the PEX. The study results shows that the Yoon et al., (2006) model is better than the Modified Jones (1995) model in detecting earnings management in the Palestinian's context, and the Modified Jones (1995) model is very poor. Additionally, the results proves that the effectiveness of the Yoon et al., (2006) model is also weak compared to other studies done in other countries (Yoon and Miller, 2006; Yoon et al., 2006; Islam et al., 2011). Consequently, developing new models is vital to be used in detecting earnings management in Palestinian's context.

KEYWORDS: earnings management, discretionary and non-discretionary accruals, effectiveness, efficacy, the explanatory power

1 INTRODUCTION

Financial reporting should provide useful information to enable investors and creditors and other users in making rational investment, credit and other decisions. The main aim of financial reporting is information about company's position provided by measures of earnings and its components. An understanding of earnings management is vital to accountants, auditors and other financial statements users. Because it provides better understanding of the usefulness of net income, both for reporting to investors and for contracting. Net income is one of the issues that cause a reduction in risk imposed on managers. Hence, managers have a strong interest in accounting policy choice. Since companies' managers can use accounting policies from a set of policies reported by Generally Accepted Accounting Principles (GAAP), since mangers are expected to use policies that maximize their own interests. This is called earnings management.

Most the models used to detect earnings management have been developed and applied in the US and European countries and few other countries. The most commonly used model is the Modified Jones (1995) model. Prior research reported that the Modified Jones (1995) model is effective in detecting earnings management in mostly developed economies (Dechow et al., 1995). Recently an empirical research revealed that the Modified Jones (1995) model was not effective in detecting earnings management in the context of Korea and Bangladesh (Yoon and Miller, 2002; Yoon et al., 2006; Islam et al., 2011). It is therefore possible that the Modified Jones model (1995) is not effective also to other countries as Palestine in today's context. Yoon et al., (2006) developed a model to detect earnings management for Korean firms. He found that the model works effectively and better than the Jones model modified in 1995. Therefore, in this paper, we investigate the effectiveness of the Modified Jones (1995) model in PEX. And we second employ the Yoon et al., model developed in 2006. We want to find out if the two models detect earnings management as well as they did in the US and other countries. We also compare the Modified Jones (1995) model with the Yoon et al., (2006) model. Our aim here is to give an overview of the best model in detecting earnings management practiced by Palestinian listed companies.

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We conduct this study to shed light on whether earnings management is practiced in industrial and service Palestinian listed companies. In addition, our study provides empirical evidence about the effectiveness of the existing Modified Jones (1995) and Yoon et al., (2006) models to the Palestinian context. To the best of our knowledge, only a very limited number of studies focused on emerging markets in general, and on Palestine in particular. We provide further evidence about the predictive power of the two models for emerging markets and, more specifically for Palestine. To the best of our knowledge, this is the first study that uses multiple regression analysis to test the effectiveness of both models for listed companies in Palestine. Finally, our results can help financial statements' users such as investors, creditors, practitioners, academics to get an overview about the efficacy of the two models in the Palestinian environment. It may also contribute to the earnings management literature in Palestine.

The remainder of this paper includes six other sections. In the next section, we provide a brief literature review. In section three, we present an overview of Palestine Exchange (PEX). In section four, we develop the study problem. In section five, we describe data and methodology. In section six, we discuss the results. In the final section, we report our conclusions.

2 LITERATURE REVIEW

Over the past few decades, earnings management has become a concern throughout the world. Earnings management occurs when managers use judgment in financial reporting and in organizing transactions to modify the financial reports. Managers' aims are here to either mislead some investors about the financial position of a company or to influence contractual outcomes that rely on accounting information (Healy and Wahlen, 1999). GAAP reported that managers may choose among accounting policies that influence reported income differently (Islam, 2011).

Some studies were carried out in the US and European countries to study management's choices of accounting methods, while other studies has focused on accrual management. For example, Cormier and Magnan (1996) supported the economic and financial theory assumption that managers make accounting choices to maximize their interests. Schipper (1989) reported that earnings management is a purposeful intervention in the financial reporting process with the purpose of obtaining some personal gains. As DuCharme et al. (2000) reported that earnings management techniques available to managers are divided into three categories: (1) choice of accounting methods, (2) acceleration of deferral of revenues and expenses and, (3) revision of accounting estimates.

It could be managers believe that they are acting in the firm's best interest. Therefore, they can accelerate the recognition of certain revenues and defer the recognition of some expenses. Additionally, Cormier and Magnan (1996) reported that managers are by nature, rational and opportunistic in the pursuit of their personal interests. These interests are determined by the terms set out in contracts between managers and the company, in addition to in contracts among the firm and other external parties such as creditors, lenders, governments and regulators. A lot of these contracts are based on some incentives. Therefore, regulators and investors have raised concerns that certain management incentives could lead to earnings management, decreasing the informativeness of financial reporting and contributing to recent business scandals (Levitt 1998; Knowledge at Wharton 2003). For example, senior managers often get incentives based on accounting income; and debt often has contracts that state minimum working capital amounts, make maximum debt-to-equity ratios (Islam, 2011).

Previous studies addressed the reasons that prompt managers to choose accounting policies. Such policies include capitalizing versus expensing interest payments, using accelerated depreciation rather than the straight-line method, and determining on whether to capitalize research and development costs.

In general, some studies support the assumption that managers make accounting choices to maximize their personal interests and well-being. Dechow and Skinner (2000) highlight capital market incentives that encourages earnings management. Cheng and Warfield (2005) find equity incentives, in the form of stock-based compensation and stock ownership, lead to earnings management because in such situations manager have more incentives to carry out earnings management to inflate the value of these shares to be sold in future. Bartov and Mohanram (2004) find that private information used by senior executives to time abnormally large stock option awards involve earnings management in order to increase cash payout from these awards, hence, proposing that such stock option awards need to be supervised by the directors. Baker et al. (2003) find that through downward earnings management managers decrease earnings in order to inflate the value of stock option grants. Roychowdhury (2006) finds evidence that firms use multiple real earnings management tools in order to meet certain financial reporting benchmarks to avoid reporting annual losses.

Research examined whether managers use accruals (the difference between net earnings and cash flow) to achieve their interests (Yoon et al., 2006). Other research in financial economics, for example, Bertrand and Schoar (2003) find that managers have a significant impact on the firm's investment, financing and operating decisions and firm's position. However,

accruals are a smart tool for managers to manage earnings because they usually do not need disclosure and often will not be tested by auditor.

It is worth referring that, it is not possible to observe earnings management directly. Therefore, studies have investigated two ways for earnings management, the choice of accounting methods and the management of accruals. Previous research on accruals focused largely for the fiscal year of the firms. DuCharme et al. (2000) reported that accruals models are preferred because this approach captures the income management techniques used to avoid detection by financial statements users. Accruals not only reflect the choice of accounting methods but also the effect of recognition timing for revenues and expenses, asset write-downs and changes in accounting estimates.

Previous research in their attempt to study accruals use two methods: Healy (1985) and DeAngelo (1986) use total accruals as a proxy for earnings management while Jones (1991), Dechow, Sloan and Sweeney (1995), Teoh et al. (1998a) and Teoh et al. (1998b) use discretionary accruals as a measure of earnings management.

The discrimination between discretionary and non-discretionary components of accruals is significant. In earnings management, it is accruals that change as a result of management's accounting decisions that are of interest, which are discretionary accruals. Discretionary accruals represent managerial interventions into financial reporting process.

Several methods have been used by researchers in order to calculate the discretionary accruals like DeAngelo (1986) model, Healy (1985) model, Jones (1991) model, Modified Jones (1995) model and Yoon et al. (2006) model. The most commonly used discretionary model is Jones (1991) model. This model can separate accruals into discretionary and non-discretionary accruals. In 1995, Dechow, Sloan and Sweeney Modified the Jones (1991) model, and they replaced the change in receivables instead of changes in sales. That is to decrease the measurement error of discretionary accruals when discretion is applied over sale. They found that the Modified Jones model (1995) provides the most powerful examination of earnings management compared to Healy, DeAngelo and Jones (1991) models.

Additionally, Guay et al. (1996) concluded that the Modified Jones (1995) model provide reliable estimates of discretionary accruals. Also Peasnell, Pope and Young (2000) found that the Modified Jones (1995) model are able to generate powerful tests for earnings management and are more powerful for the revenue and bad debt manipulations than non-bad debt manipulations.

However, most the models have been developed for and tested in developed countries (e.g., the US and European countries and few other countries i.e., Malaysia, Taiwan, and India etc.). There is no guarantee that these models are as effective in different industries, economic and political environments and/or in different time periods. The outcomes of the models may not be generalisable to other countries. For example, Yoon et al., (2006) and Islam et al., (2011) documented that the Modified Jones (1995) model is not effective in measuring discretionary accruals for Korean and Bangladeshi firms.

Therefore, this study attempt to find out if the Modified Jones (1995) and Yoon et al., (2006) models are effective in detecting earnings management in an emerging economy as Palestine. We also compare the Modified Jones (1995) model with the Yoon et al., (2006) model. That is to give an overview of the best model in detecting earnings management practiced by listed companies in the PEX.

3 PALESTINE EXCHANGE – AN OVERVIEW

Palestine Exchange (PEX) was established in 1995 to promote investment in Palestine. The PEX was fully automated upon establishment-a first amongst the Arab Stock Exchanges. The PEX operates under the supervision of the Palestinian Capital Market Authority. There are 48 listed companies on the PEX as of 31/03/2014 with market capitalization of about $ 3 billion across five main economic sectors; banking and financial services, insurance, investments, industry, and services1. Most of the companies are profitable and trade in Jordanian Dinar, while others trade in US Dollars. Only stocks are currently traded on the PEX. In 2009, the PEX ranked thirty third amongst the worldwide security markets, and regionally comes in second in terms of investor protection.

[1] *Palestine Exchange: http://www.pex.ps*

4 STUDY PROBLEM

The most commonly used model in detecting earnings management is the Modified Jones (1995) model. Prior research documented that the model is effective in detecting earnings management in mostly developed countries (Dechow et al., 1995). Recently an empirical research revealed that the Modified Jones (1995) model does not fit for Asian and Bangladeshi firms (Yoon and Miller, 2002; Yoon et al., 2006; Islam et al., 2011). It is therefore possible that the Modified Jones (1995) model is not effective also to other countries as Palestine in today's context. Yoon et al., (2006) proposed a model to be employed in detecting earnings management in Bangladesh capital market. Yoon et al., (2006) showed that the model was effective in detecting earnings management with less error rates.

Therefore, in this paper, we investigate the effectiveness of the Modified Jones (1995) and Yoon et al., (2006) model in PEX. We want to find out if the two models detect earnings management effectively. We also compare the Modified Jones (1995) model with the Yoon et al., (2006) model. That is to determine the best model in detecting earnings management practiced by Palestinian listed companies in the PEX from the period of 2006 - 2011.

5 DATA AND METHODOLOGY

The population of this study includes all listed companies in the PEX. It includes listed companies in all sectors such as banking, industry, insurance, investments and services. The study sample was selected on the basis of the following main conditions: (1) The company must be classified as an industrial or services company; (2) its annual financial reports are available for six years (balance sheets and income statements); (3) its shares must have been publicly traded; (4) its fiscal year ends on 31 December. This selection approach resulted in a sample of 26 listed industrial and services companies from the period 2006-2011. The data was derived from companies' financial reports. We collected six financial reports for each company. Therefore, 156 financial reports were obtained for the study purposes.

As we mentioned above, we are looking for an appropriate model to the Palestinian environment; we want to use it to detect earnings management practiced by listed companies in the PEX. Based on that, we first applied the Modified Jones (1995) model for the study sample (see Appendix 1). We second employed the Yoon et al., (2006) model (see Appendix 2). That is to analyze the effectiveness of these two models in detecting earnings management in the context of Palestine. Besides, we used the multiple regression analysis to compare the explanatory power and models fitness between the two models to determine the best model in detecting earnings management in the PEX.

Through applying the two models, we utilized the discretionary accruals as a proxy to state the extent of earnings management. In addition, we found discretionary accruals by subtracting non-discretionary accruals from total accruals. Non-discretionary accruals were valued by using a regression model.

THE MODIFIED JONES (1995) MODEL IS DESCRIBED IN THE FOLLOWING EQUATION:

$$\frac{TA_t}{A_{t-1}} = \beta 1\left(\frac{1}{A_{t-1}}\right) + \beta 2\left(\frac{\Delta REV_t - \Delta REC_t}{A_{t-1}}\right) + \beta 3\left(\frac{\Delta PPE_t}{A_{t-1}}\right) + \varepsilon$$

TAt (Total accruals) = accounting earnings – CFO

Ai,t-1 = total asset in year t - 1

ΔREV i,t = the difference of operating revenue

ΔREC i,t = the difference of account receivable.

ΔPPEi,t = the difference of gross property plant and equipment.

THE YOON ET AL., (2006) MODEL IS DESCRIBED AS THE FOLLOWING EQUATION:

$$\frac{TA_t}{REV_t} = \beta 1\left(\frac{\Delta REV_t - \Delta REC_t}{REV_t}\right) + \beta 2\left(\frac{\Delta EXP_t - \Delta PAY_t}{REV_t}\right) + \beta 3\left(\frac{\Delta DEP_t - \Delta RET_t}{A_{t-1}}\right) + \varepsilon$$

TA (Total accruals) = accounting earnings – CFO

REV = net sales revenue

REC = receivables

EXP = sum of cost of goods sold and selling and general administrative expenses excluding non-cash expenses.

PAY = payables

DEP = depreciation expenses

RET = retirement benefits expenses

Δ = change operator.

The Yoon et al., (2006) model posits that total accruals will normally depend on changes in cash sales revenue, changes in cash expenses and some non-cash expenses including depreciation expenses and retirement benefits expenses. Therefore, to get the discretionary accruals, non-discretionary accruals will be subtracted from the total accruals for each observation.

6 RESULTS

Firstly, we applied the two models to the study sample. We found that the Modified Jones (1995) model could detect 56 of listed companies practice earnings management (e.g., %36 of the study sample) (see Appendix 1). And Yoon et al., (2006) model detected that 80 of listed companies practice earnings management (e.g., 52% of the study sample). Thus, this result proves that Yoon et al., (2006) model has the ability to classify companies practicing earnings companies much more than the Modified Jones (1995) model.

Correspondingly, we used the multiple regression analysis to compare the explanatory power and models fitness between the two models. It can be observed that Modified Jones (1995) model's goodness of fit is very poor compared to the Yoon et al, (2006) model for industrial and service companies as presented in Table1. R^2 is only 17% as compared to 34% in the Yoon et al., (2006) model for industrial companies. In addition, all the three explanatory variables of the Modified Jones (1995) model are not significant explanatory variables. On the other hand, two variables of Yoon et al., (2006) model are consistent and significant (e.g, Y_1 and Y_2). As for services companies, R^2 is only 10% as compared to 41% in the Yoon et al., (2006) model, but the two models have two significant variables (e.g., X_1, X_2, Y_1, Y_2).

Table 1. Comparison between the Modified Jones (1995) Model and Yoon et al, (2006) for industrial and service companies.

		Modified Jones (1995) Model				Yoon et al., (2006) Model			
		X_1	X_2	X_3	R^2	Y_1	Y_2	Y_3	R^2
Industry	***B***	-10644.95	-0.060	-0.056	0.17	0.076	-0.099	0.264	0.34
	Sig.	0.972	0.665	0.089		0.012	0.037	0.562	
Services	***B***	79717.19	0.184	0.005	0.10	-1.00	-0.942	-0.147	0.41
	Sig.	0.013	0.038	0.838		0.000	0.000	0.940	

Notes: X_1 = 1/Ai,t-1; X_2 = (ΔREVi,t–ΔRECi,t)/Ai, t-1; X_3 = PPEi,t / Ai ,t-1.

Y_1 = (ΔREVi – ΔRECi)/ REVi ; Y_2 = (Δ EXPi – ΔPAYi)/REVi; Y_3 = (DEPi + RETi)/REVi

R^2 = R squared, indicates how well data points fits a statistical model.

Then, these results are consistent with application results in our study presented in the appendices 1 and 2. Both prove that the Yoon et al., (2006) model is better than the Modified Jones (1995) model in detecting earnings management practiced by targeted companies. In general, these results are consistent with Yoon and Miller, 2002; Yoon et al., 2006; Islam et al., 2011.

Furthermore, Table 1 shows R^2 of both models are weak compared to other studies (Yoon and Miller, 2002; Yoon et al., 2006; Islam et al., 2011). R^2 must be greater than what was resulted in the application of both models to the study sample (e.g. 34% for industrial and 41% for service companies in Yoon et al., (2006) model). Therefore, we suggest in a future research developing a new model by incorporating new variables to be used in detecting earnings management in Palestine.

7 CONCLUSION

Most previous studies using the Modified Jones (1995) and Yoon et al., (2006) models have been done in USA, UK and a few of developed countries. Only a very limited number have been carried out in emerging markets. It is therefore possible that these models do not work effectively in other countries as Palestine.

In this paper, we have focused on Palestine as an example of emerging markets to test the effectiveness of the Modified Jones (1995) and Yoon et al., (2006) models. Our application results of the two models showed that Yoon et al., (2006) model can detect companies practicing earnings companies more effectively than the Modified Jones (1995) model. Furthermore, the multiple regression analysis proves as well that the Yoon et al., (2006) model is better than the Modified Jones (1995) model in detecting earnings management in the Palestinian's context.

Additionally, the results proves that the effectiveness of the Yoon et al., (2006) model is also weak compared to other studies done in other countries (Yoon and Miller, 2006; Yoon et al., 2006; Islam et al., 2011). Consequently, developing new models is imperative to be used in detecting earnings management in Palestinian's context. The inclusion of other variables will significantly increases the explanatory power in detecting earnings management practiced by industrial and services Palestinian firms.

REFERENCES

[1] Yoon, S., G. Miller & Jiraporn P., "Cash from Operations and Earnings Management in Korea," *Journal of International Financial Management and Accounting*, pp.85-109, 2006.

[2] Baker, T., D. Collins, and A. Reitenga., "Stock option compensation and earnings management incentives," *Journal of Accounting, Auditing and Finance*, Vol. 18 Issue 4, p557, 2003.

[3] Bartov, E., Mohanram, P. 2004, "Private Information, Earnings Manipulations, and Executive Stock Option Exercises, *Available at SSRN*: http://ssrn.com/abstract=492302.

[4] Bertrand, M., Schoar, A., "Managing with Style: The Effect of Managers on Firm Policies," *The Quarterly Journal of Economics*, 118 (4): pp. 1169-1208, 2003.

[5] Cheng, Q. & Warfield T., "Equity Incentives and Earnings Management," *Accounting Review*, Vol. 80, Issue 2, pp. 441-480, 2005.

[6] Cormier, D. & Magnan, M., " Decision, decisions, CA Magazine," 129(7), 38, 1996.

[7] DeAngelo, L., "Accounting numbers as Market Valuation Substitutes: A Study of Management Buyouts of Public Stockholders," *The Accounting Review*, July, pp. 400-420, 1986.

[8] Dechow, P.M., R.G. Sloan & A.P. Sweeney., "Detecting Earnings Management," *The Accounting Review*, 70, pp. 193-225, 1995.

[9] DuCharme, L.L., P.H. Malatesta, & S.E. Sefcik., "Earnings Management: IPO Valuation and Subsequent Performance," *Working paper*, University of Washington, 2000.

[10] Guay, W., S.P. Kothari, & R.L. Watts., "A Market-Based Evaluation of Discretionary Accruals Model," *Journal of Accounting Research*, 34, pp. 83-105, 1996.

[11] Healy, P. & Wahlen, J.M., "A Review of the Earnings Management Literature and its Implications for Standard Setting," *Accounting Horizon*, 13(4), pp. 365-384., 1999.

[12] Healy, P.M., "The Effect of Bonus Schemes on Accounting Decisions," *Journal Accounting and Economics, Apri*l, pp. 85-107, 1985.

[13] Islam, Md., R. Ali & Ahmed Z., "Is Modified Jones Model Effective in Detecting Earnings Management? Evidence from A Developing Economy," *International Journal of Economics and Finance*, Vol. 3, No. 2, pp.116-125, 2011.

[14] Jones, J., "Earnings Management during Import Relief Investigations", *Journal of Accounting Research*, 29, pp. 193-228, 1991.

[15] Peasnell, K. Pope, P. & Young, S., "Detecting Earnings Management using Cross-Sectional Abnormal Accruals Models," *Accounting and Business Research*, 30(4), pp. 313-326, 2000.

[16] Roychowdhury, S., Earnings Management through Real Activities Manipulation," *Journal of Accounting and Economics*, 42: pp. 335-370, 2006.

[17] S.P. Kothari, Andrew J. Leone & Charles E. Wasley., "Performance Matched Discretionary Accrual Measures, Sloan School of Management*," Massachusetts Institute of Technology*, 2004.

[18] Schipper, K., "Earnings Management", *Accounting Horizons*, 3 (4), pp. 91-102, 1089.

[19] Sloan, R., "Do Stock Prices Fully Impound Information in Accruals About Future Earnings?," *Accounting Review*, 71, pp. 289-315, 1996.

[20] Soon Suk Yoon, Gary Miller & Pornsit Jiraporn., "Earnings Management Vehicles for Korean Firms," *Journal on International Financial Management and Accounting* 17/2. New York, 2006.
[21] Teoh, S.H., I. Welch &T.J. Wong., "Earnings Management and the Long Run Market Performance of Initial Public Offerings", *The Journal of Financial LIII* (6), pp. 1935-1974, 1998b.
[22] Teoh, S.H., I. Welch, & T.J. Wong., "Earnings Management and the Under Performance of Seasoned Equity Offerings", *The Journal of Financial Economics*, 50, pp. 63-99, 1998a.

APPENDIX 1: APPLICATION OF THE MODIFIED JONES (1995) MODEL TO THE STUDY SAMPLE

Years	TACC	ΔREV	ΔREC	$TACC_{i,t}/A_{i,t-1}$	$1/A_{i,t-1}$	$(\Delta REV_{i,t} - \Delta REC_{i,t}) /A_{i,t-1}$	$PPE_{i,t} /A_{i,t-1}$	a'1(1/Ai,t-1)	a'2(ΔREVi,t - ΔRECi,t) /Ai,t-1	a'3(PPEi,t / Ai,t-1)	non discretionary accruals	DA	Practicing/ Non Practicing
2006	1243771	555556	564356	0.888464	0.9888330	0.3898	0.4767892	0.98999	0.8787878	-0.989898	0.03	0.08	
2007	887108	553500	270858	0.11244777	0.0000001	0.03582705	0.1915504	0.00912	0.002702827	-0.0051837	0.03	0.08	**NO**
2008	4299311	1208628	317663	0.47450799	0.0000001	0.09833436	0.1817767	0.00794	0.007418439	-0.0049192	0.03	0.44	**YES**
2009	2284751	424629	833182	0.19526501	0.0000001	-0.03491676	0.1537272	0.00615	-0.002634154	-0.0041601	0.02	0.17	**YES**
2010	-213288	1.4E+07	928732	-0.0153079	0.0000001	0.95173197	0.5189782	0.00516	0.071799579	-0.0140444	0.09	-0.10	**NO**
2011	41329	2569817	755591	0.0026128	0.0000001	0.11469432	0.4325466	0.00455	0.00865265	-0.0117054	0.03	-0.02	**NO**
2006	-2E+06	-1.7E+07	4129241	-0.1050941	0.0000001	-1.38162295	0.4611864	0.00464	-0.104230971	-0.0124805	-0.09		
2007	-1E+06	489690	494043	-0.0164929	0.0000000	-6.9258E-05	0.1031992	0.00114	-5.22488E-06	-0.0027927	0.02	-0.04	**NO**
2008	3908964	314497	-1471399	0.05576922	0.0000000	0.02547939	0.3367056	0.00103	0.00192219	-0.0091118	0.02	0.04	**NO**
2009	-3E+06	2941625	1985010	-0.0452073	0.0000000	0.01271481	0.5326536	0.00096	0.000959217	-0.0144145	0.01	-0.06	**NO**
2010	1.7E+07	1.7E+07	8624265	0.21517283	0.0000000	0.10246279	0.0270863	0.00089	0.007729892	-0.000733	0.03	0.18	**YES**
2011	1.7E+07	777170	7603714	0.18810749	0.0000000	-0.07747802	0.0334098	0.00082	-0.005845017	-0.0009041	0.02	0.17	**YES**
2006	-3E+06	-2.3E+07	-8312938	-0.0341384	0.0000000	-0.1504151	0.0030246	0.00075	-0.011347461	-8.185E-05	0.01		
2007	-6E+06	524383	-479873	-0.027559	0.0000000	0.00497269	0.0014145	0.00036	0.000375144	-3.828E-05	0.02	-0.05	**YES**
2008	-901469	-391775	-1.3E+07	-0.0043973	0.0000000	0.05938752	0.0557592	0.00035	0.004480252	-0.0015089	0.03	-0.03	**YES**
2009	-2E+06	73876	-48965	-0.0419796	0.0000000	0.00234589	0.2306466	0.00137	0.000176976	-0.0062417	0.02	-0.06	**YES**
2010	-2E+07	2898046	1096407	-0.307928	0.0000000	0.03322831	0.2203733	0.00133	0.002506776	-0.0059637	0.02	-0.33	**NO**
2011	-2E+07	4123018	3896819	-0.2540332	0.0000000	0.00365223	0.1930076	0.00116	0.000275528	-0.0052231	0.02	-0.27	**NO**
2006	1.9E+07	-6529296	-8119049	0.2602837	0.0000000	0.02127239	0.0005172	0.00096	0.00160481	-1.4E-05	0.03		
2007	1328211	-51600	188387	0.04344024	0.0000000	-0.00784897	0.0073899	0.00235	-0.000592134	-0.0002	0.03	0.02	**NO**
2008	1.2E+07	2938672	-289496	0.30040075	0.0000000	0.07936022	0.01033	0.00177	0.005987012	-0.0002795	0.03	0.27	**YES**
2009	6170377	3240417	3412085	0.1216394	0.0000000	-0.00338417	0.0540426	0.00142	-0.000255305	-0.0014625	0.02	0.10	**YES**
2010	-472558	87917	-2325067	-0.009068	0.0000000	0.04630338	0.0491986	0.00138	0.003493172	-0.0013314	0.03	-0.04	**NO**
2011	1246757	-951764	4247128	0.02481939	0.0000000	-0.10349519	0.0494019	0.00143	-0.007807777	-0.0013369	0.02	0.01	**NO**
2006	-16013	-6264545	-5260802	-0.0003106	0.0000000	-0.01946878	0.014153	0.00140	-0.001468744	-0.000383	0.02		
2007	7652	61180	116896	0.00082449	0.0000001	-0.00600332	0.0970242	0.00775	-0.000452896	-0.0026256	0.03	-0.03	**YES**
2008	-16084	674881	62616	-0.0016606	0.0000001	0.0632134	1.027454	0.00743	0.00476888	-0.0278046	0.01	-0.01	**YES**
2009	-863545	42304	311240	-0.8872961	0.0000010	-0.27633288	10.824838	0.07393	-0.020846819	-0.2929381	-0.22	-0.67	**NO**
2010	-122678	117223	205498	-0.1201943	0.0000010	-0.08648782	10.42754	0.07049	-0.006524724	-0.2821866	-0.19	0.07	**YES**
2011	-822684	-175690	56217	-0.0671388	0.0000001	-0.01892581	0.9070336	0.00587	-0.001427782	-0.0245458	0.00	-0.07	**YES**
2006	185791	657536	-769355	0.0147152	0.0000001	0.11301402	0.0128342	0.00570	0.008525887	-0.0003473	0.04		
2007	629344	-108560	21420	0.02451774	0.0000000	-0.00506371	0.0221928	0.00280	-0.000382011	-0.0006006	0.03	0.00	**NO**
2008	-364043	189898	-4626	-0.1219883	0.0000003	0.06518366	0.0569668	0.02411	0.004917518	-0.0015416	0.05	-0.17	**NO**
2009	-106701	-146879	-49573	-0.0026677	0.0000000	-0.00243285	0.0045041	0.00180	-0.000183536	-0.0001219	0.03	-0.03	**NO**
2010	6127808	43011	23643	0.16161184	0.0000000	0.0005108	0.042731	0.00190	3.85354E-05	-0.0011564	0.03	0.14	**YES**
2011	4669606	186689	58167	0.12060824	0.0000000	0.00331951	0.0405363	0.00186	0.000250427	-0.001097	0.03	0.10	**YES**
2006	782703	-1012792	119697	0.02108234	0.0000000	-0.03050394	0.0031239	0.00194	-0.002301246	-8.454E-05	0.02		
2007	947146	-50648	80791	0.04913132	0.0000001	-0.00681814	0.0071501	0.00373	-0.000514367	-0.0001935	0.03	0.02	**NO**
2008	5286268	-497020	424858	0.26333537	0.0000000	-0.04592334	0.0054905	0.00358	-0.003464501	-0.0001486	0.02	0.24	**YES**
2009	2180389	20233	-541859	0.08345684	0.0000000	0.0215147	0.0033407	0.00275	0.00162309	-9.04E-05	0.03	0.05	**NO**
2010	57005	521648	565514	0.00208773	0.0000000	-0.00160653	1.1103458	0.00264	-0.000121199	-0.0300478	0.00	0.01	**NO**
2011	1788475	3445958	-268867	0.05133913	0.0000000	0.10663603	0.8877435	0.00207	0.008044725	-0.0240238	0.01	0.04	**NO**
2006	7890224	6982370	6329731	0.23744161	0.0000000	0.01963996	0.0355353	0.00217	0.001481657	-0.0009616	0.03		
2007	6912636	812242	-152136	0.16490633	0.0000000	0.02300599	0.0361588	0.00172	0.001735594	-0.0009785	0.03	0.14	**YES**
2008	1.1E+07	2838200	771239	0.24616026	0.0000000	0.04768328	0.0348261	0.00166	0.003597273	-0.0009425	0.03	0.22	**YES**
2009	1.4E+07	2923191	321300	0.30269259	0.0000000	0.05593296	0.0663015	0.00155	0.004219637	-0.0017942	0.03	0.27	**YES**
2010	-3E+06	-1.7E+07	1918509	-0.0530258	0.0000000	-0.38857245	0.0599114	0.00146	-0.029314281	-0.0016213	-0.01	-0.05	**NO**
2011	-3E+06	468243	-96526	-0.0630586	0.0000000	0.01132117	0.0566399	0.00144	0.00085408	-0.0015328	0.03	-0.09	**NO**
2006	-557779	213431	-9293501	-0.0108579	0.0000000	0.18506495	0.0299414	0.00140	0.013961479	-0.0008103	0.04		
2007	-221603	443066	28324	-0.1118397	0.0000005	0.20931406	0.7977238	0.03631	0.015790855	-0.0215877	0.05	-0.17	**NO**
2008	952630	526365	56765	0.40847155	0.0000004	0.2013565	0.7000757	0.03085	0.015190529	-0.0189452	0.05	0.36	**YES**
2009	770669	-11295	-3005	0.30970401	0.0000004	-0.00333145	0.6599235	0.02891	-0.000251328	-0.0178586	0.04	0.27	**YES**
2010	-1E+06	747692	-145250	-0.3981824	0.0000004	0.34020221	0.6657584	0.02741	0.025665183	-0.0180165	0.06	-0.46	**NO**
2011	-866544	527217	153903	-0.2371778	0.0000003	0.10217807	0.5111235	0.01969	0.007708412	-0.0138319	0.04	-0.28	**NO**
2006	-8E+06	-1897455	24085940	-2.1648836	0.0000003	-6.97490062	0.3816576	0.01931	-0.526193243	-0.0103283	-0.49		
2007	1E+07	1526263	24175949	0.23825951	0.0000000	-0.53035672	0.0401312	0.00168	-0.040010623	-0.001086	-0.02	0.25	**YES**
2008	-4E+06	1123805	-1.4E+07	-0.0689458	0.0000000	0.24796763	0.0402711	0.00116	0.018706917	-0.0010898	0.04	-0.11	**NO**
2009	-2E+07	1089162	27959342	-0.2194857	0.0000000	-0.2688665	0.0306934	0.00072	-0.020283548	-0.0008306	0.00	-0.22	**NO**
2010	-1E+06	-49598	-6.2E+07	-0.0064671	0.0000000	0.38266342	0.0175405	0.00044	0.028868499	-0.0004747	0.05	-0.06	**NO**
2011	-1E+07	806117	424967	-0.0928228	0.0000000	0.00241021	0.0460048	0.00045	0.000181829	-0.001245	0.02	-0.12	**NO**

2006	5646341	3860249	-195818	0.0228228	0.0000000	0.01639483	0.0248236	0.00029	0.001236842	-0.0006718	0.03		
2007	7277733	1610614	103160	0.28225856	0.0000000	0.05846488	0.2708881	0.00279	0.004410647	-0.0073307	0.02	0.26	**YES**
2008	-5E+06	-1.1E+07	-380330	-0.1767165	0.0000000	-0.34584326	0.1844823	0.00233	-0.02609075	-0.0049924	0.00	-0.17	**NO**
2009	-3E+06	-574261	70184	-0.0804548	0.0000000	-0.01946277	0.1560102	0.00217	-0.00146829	-0.0042219	0.02	-0.10	**NO**
2010	-63960	1.6E+07	10160278	-0.0018417	0.0000000	0.16533472	0.3218433	0.00207	0.012473011	-0.0087096	0.03	-0.03	**NO**
2011	902116	-404848	1195380	0.02415951	0.0000000	-0.0428556	0.3029954	0.00193	-0.003233068	-0.0081996	0.01	0.01	**YES**
2006	8534713	-4560708	-7658845	0.21214797	0.0000000	0.07701061	0.1556669	0.00179	0.005809755	-0.0042126	0.03		
2007	1.2E+07	4012136	152867	0.71172384	0.0000001	0.23536001	0.3711629	0.00439	0.017755787	-0.0100443	0.04	0.68	**YES**
2008	-3E+06	-1.5E+07	-1575740	-0.134471	0.0000001	-0.66172653	0.4524986	0.00366	-0.049921289	-0.0122454	-0.03	-0.10	**NO**
2009	-1E+06	-22181	-364611	-0.0549713	0.0000000	0.01667818	0.4248684	0.00350	0.001258218	-0.0114976	0.02	-0.07	**NO**
2010	744316	7652179	1419007	0.04090549	0.0000001	0.3425574	0.5160875	0.00395	0.025842861	-0.0139662	0.04	0.00	**NO**
2011	-1E+06	1913963	-716265	-0.0517527	0.0000001	0.13468831	0.4729835	0.00368	0.010161016	-0.0127997	0.03	-0.08	**NO**
2006	132289	-8656130	-2238949	0.00738791	0.0000001	-0.35837878	0.1438745	0.00402	-0.027036442	-0.0038935	0.00		
2007	32067	421032	110962	0.00695427	0.0000002	0.06724386	0.5351052	0.01560	0.005072942	-0.0144808	0.03	-0.02	**NO**
2008	1473646	1033350	-370379	0.31120981	0.0000002	0.29644449	0.5218952	0.01519	0.022364059	-0.0141234	0.05	0.26	**YES**
2009	1744468	-378780	331317	0.37790204	0.0000002	-0.15382747	0.5122793	0.01559	-0.011604893	-0.0138631	0.01	0.36	**YES**
2010	1531207	-275110	-223333	0.31490468	0.0000002	-0.01064834	0.5101492	0.01480	-0.000803321	-0.0138055	0.02	0.29	**YES**
2011	-226783	-1191819	-270511	-0.0467685	0.0000002	-0.18999759	0.4131606	0.01484	-0.014333602	-0.0111808	0.01	-0.06	**NO**
2006	-422094	6873010	32562139	-0.062968	0.0000001	-3.8323028	16.581697	0.01073	-0.289112627	-0.4487283	-0.70		
2007	-9E+06	-3048006	-3850807	-0.0562204	0.0000000	0.00477018	0.6202654	0.00043	0.000359867	-0.0167854	0.01	-0.06	**YES**
2008	-2E+07	1922336	-1.1E+07	-0.1160337	0.0000000	0.08817924	0.6468576	0.00048	0.006652327	-0.017505	0.01	-0.13	**NO**
2009	-2E+07	705287	-7760685	-0.1273877	0.0000000	0.04881359	0.5231522	0.00041	0.003682544	-0.0141574	0.01	-0.14	**NO**
2010	8078830	2.3E+07	12995856	0.06028523	0.0000000	0.07195534	0.6253003	0.00054	0.00542838	-0.0169217	0.01	0.05	**YES**
2011	-1E+07	268872	-2585152	-0.1147292	0.0000000	0.02291458	0.617207	0.00058	0.001728698	-0.0167026	0.01	-0.12	**NO**
2006	-2E+07	-2.9E+07	-2E+07	-0.1557313	0.0000000	-0.07389955	0.0300056	0.00061	-0.005575054	-0.000812	0.02		
2007	-2E+07	75480	230801	-0.1116741	0.0000000	-0.0007461	0.0398283	0.00035	-5.62863E-05	-0.0010778	0.02	-0.14	**NO**
2008	-3E+07	664062	873502	-0.1287953	0.0000000	-0.00083282	0.0362827	0.00029	-6.28287E-05	-0.0009819	0.02	-0.15	**NO**
2009	-1E+07	-167146	-205776	-0.0570284	0.0000000	0.00018	0.044828	0.00034	1.35793E-05	-0.0012131	0.02	-0.08	**YES**
2010	-4E+06	1.2E+07	388760	-0.0171564	0.0000000	0.04613611	0.0223095	0.00029	0.003480553	-0.0006037	0.03	-0.04	**YES**
2011	50669	901450	-815040	0.00019153	0.0000000	0.00648847	0.0202947	0.00027	0.000489496	-0.0005492	0.02	-0.02	**YES**
2006	-21876	-1.4E+07	-227697	-8.985E-05	0.0000000	-0.05773315	0.0047003	0.00030	-0.004355445	-0.0001272	0.02		
2007	344300	-6722	-86856	0.10644139	0.0000003	0.02477367	0.3539941	0.02224	0.00186895	-0.0095797	0.04	0.07	**YES**
2008	-241129	-10057	-111877	-0.0815908	0.0000003	0.03445284	0.3871177	0.02435	0.002599156	-0.010476	0.04	-0.12	**NO**
2009	-107342	-16442	-32649	-0.0381868	0.0000004	0.00576562	0.4061569	0.02560	0.000434964	-0.0109913	0.04	-0.08	**YES**
2010	-381606	-12805	-661	-0.1377571	0.0000004	-0.0043839	0.4113367	0.02597	-0.000330726	-0.0111315	0.04	-0.18	**NO**
2011	-124577	0	3173	-0.0464711	0.0000004	-0.00118363	0.4244439	0.02684	-8.9294E-05	-0.0114862	0.04	-0.09	**NO**
2006	1641252	1239281	3046867	0.63660066	0.0000004	-0.70111747	5.1773109	0.02791	-0.052892979	-0.1401066	-0.14		
2007	-227905	-111223	-246189	-0.0084539	0.0000000	0.00500645	0.5819694	0.00267	0.000377691	-0.0157491	0.01	-0.02	**NO**
2008	-1E+06	674069	-632797	-0.043263	0.0000000	0.0420826	0.4867325	0.00232	0.003174752	-0.0131718	0.02	-0.06	**NO**
2009	-132227	1560281	155187	-0.0046518	0.0000000	0.04943201	6.2013721	0.00253	0.003729199	-0.1678194	-0.14	0.13	**YES**
2010	-68978	1.6E+07	57269	-0.0019753	0.0000000	0.45531174	0.038673	0.00206	0.034349158	-0.0010466	0.06	-0.06	**NO**
2011	-818283	775155	1347048	-0.0190914	0.0000000	-0.01334285	0.0039824	0.00168	-0.001006597	-0.0001078	0.02	-0.04	**NO**
2006	-1E+06	-1.7E+07	-2140184	-0.0241855	0.0000000	-0.34864209	0.0342662	0.00166	-0.026301896	-0.0009273	0.00		
2007	-457068	81344	-577565	-0.0560485	0.0000001	0.08079951	0.192033	0.00882	0.006095593	-0.0051967	0.03	-0.09	**NO**
2008	1247655	141960	-547818	0.13444241	0.0000001	0.07432777	0.1652628	0.00775	0.005607359	-0.0044723	0.03	0.10	**YES**
2009	-51317	249190	-61670	-0.0047147	0.0000001	0.02855992	0.1409469	0.00661	0.002154588	-0.0038143	0.03	-0.03	**NO**
2010	-182808	68649	785689	-0.0174885	0.0000001	-0.06859644	0.1425714	0.00688	-0.005174982	-0.0038582	0.02	-0.04	**NO**
2011	-759404	124882	178410	-0.0629694	0.0000001	-0.00443852	0.1203005	0.00597	-0.000334846	-0.0032555	0.03	-0.09	**NO**
2006	228734	-2355292	-927713	0.0181617	0.0000001	-0.11335114	0.2081868	0.00571	-0.008551319	-0.0056339	0.02		
2007	-30492	687116	240219	-0.0064995	0.0000002	0.09525859	0.5183865	0.01534	0.0071864	-0.0140284	0.03	-0.04	**NO**
2008	-677949	47501	89141	-0.1500214	0.0000002	-0.0092144	0.5316934	0.01592	-0.000695143	-0.0143885	0.03	-0.18	**NO**
2009	-424920	472947	141090	-0.1014139	0.0000002	0.07920294	0.5338536	0.01717	0.005975146	-0.014447	0.03	-0.13	**NO**
2010	3343098	-2150571	607320	0.79953077	0.0000002	-0.65957346	0.4843269	0.01721	-0.049758859	-0.0131067	-0.02	0.82	**YES**
2011	3513363	-138733	-123350	0.59108637	0.0000002	-0.00258803	0.3354027	0.01210	-0.000195243	-0.0090766	0.03	0.56	**YES**
2006	-3E+06	2726639	-1198746	-0.4982144	0.0000002	0.68398236	0.7349432	0.01254	0.05160029	-0.0198888	0.07		
2007	1950999	738916	119814	0.01316551	0.0000000	0.00417775	0.0282039	0.00049	0.000315174	-0.0007632	0.02	-0.01	**NO**
2008	5.2E+07	5259137	-291647	0.5134153	0.0000000	0.05526868	0.0648776	0.00072	0.004169522	-0.0017557	0.03	0.49	**YES**
2009	-5E+07	4942284	-31173	-0.2048672	0.0000000	0.01916191	0.0478428	0.00028	0.001445593	-0.0012947	0.02	-0.23	**NO**
2010	-6E+06	-1.3E+07	-7720	-0.0188283	0.0000000	-0.04055941	0.040154	0.00022	-0.003059841	-0.0010866	0.02	-0.04	**NO**
2011	-5E+07	225321	0	-0.106774	0.0000000	0.00052826	0.0451315	0.00017	3.98525E-05	-0.0012213	0.02	-0.13	**NO**
2006	29765	-499526	8272	6.3644E-05	0.0000000	-0.00108578	4.407E-05	0.00015	-8.19123E-05	-1.193E-06	0.02		
2007	52984	4553	-30	0.11708473	0.0000022	0.01012757	0.0542465	0.15900	0.000764034	-0.001468	0.18	-0.07	**NO**
2008	29707	-4551	845	0.06518996	0.0000022	-0.01184115	0.0733598	0.15789	-0.000893308	-0.0019852	0.18	-0.11	**NO**
2009	52754	25663	8067	0.09953059	0.0000019	0.03319825	0.0816221	0.13575	0.002504508	-0.0022088	0.16	-0.06	**NO**
2010	207430	94301	21930	0.33445878	0.0000016	0.11669053	0.1378274	0.11601	0.008803246	-0.0037298	0.15	0.19	**YES**
2011	184480	-15009	-1023	0.25338084	0.0000014	-0.01920959	0.0777023	0.09882	-0.00144919	-0.0021028	0.12	0.13	**YES**

2006	6373381	1.8E+08	50163981	9.98995421	0.0000016	209.067723	217.33944	0.11278	15.77227109	-5.8815663	10.03		
2007	-3E+07	4.2E+07	22081136	-0.0699748	0.0000000	0.05410395	0.3966482	0.00019	0.004081654	-0.010734	0.02	-0.09	**NO**
2008	-6E+07	-2.3E+08	-7.2E+07	-0.1327001	0.0000000	-0.36452947	0.0003688	0.00017	-0.027500455	-9.98E-06	0.00	-0.13	**NO**
2009	-74570	16028	157	-0.1788464	0.0000024	0.03806452	0.3913083	0.17256	0.002871624	-0.0105895	0.19	-0.37	**NO**
2010	311367	23208	6329	0.58608052	0.0000019	0.03177104	0.3579592	0.13543	0.002396838	-0.009687	0.15	0.43	**YES**
2011	326263	31900	10107	0.59184851	0.0000018	0.039533	0.3764242	0.13052	0.002982408	-0.0101867	0.15	0.44	**YES**
2006	#VALUE!	3233701	1809307	#VALUE!	0.0000017	2.47918168	7.3212263	0.12523	0.187031862	-0.1981245	0.14		
2007	-6E+07	6878537	-1875194	-0.3418585	0.0000000	0.05081193	0.0229001	0.00042	0.003833301	-0.0006197	0.03	-0.37	**NO**
2008	7.1E+07	-2349794	57398	0.30600138	0.0000000	-0.01033911	0.014267	0.00031	-0.000779992	-0.0003861	0.02	0.28	**YES**
2009	-9E+06	2078760	-3392	-0.031007	0.0000000	0.00690027	0.0112777	0.00024	0.000520563	-0.0003052	0.02	-0.06	**NO**
2010	2311130	8576237	30316	0.00772607	0.0000000	0.02856886	0.0131964	0.00024	0.002155263	-0.0003571	0.03	-0.02	**YES**
2011	6290715	-3424993	39137	0.01602012	0.0000000	-0.00882186	0.0091195	0.00018	-0.000665529	-0.0002468	0.02	-0.01	**YES**
2006	2646457	3.4E+07	2788146	0.00740576	0.0000000	0.08668858	0.0096041	0.00020	0.00653987	-0.0002599	0.03		
2007	-770751	748772	126488	-0.0247354	0.0000000	0.01997069	0.1395131	0.00231	0.001506608	-0.0037755	0.02	-0.05	**YES**
2008	774261	401261	3311528	0.02844146	0.0000000	-0.10690482	0.1644982	0.00264	-0.008065003	-0.0044516	0.01	0.01	**YES**
2009	-5E+06	9484139	-800168	-0.1448475	0.0000000	0.33058242	0.2102558	0.00231	0.024939457	-0.0056899	0.05	-0.19	**NO**
2010	-314737	1.8E+07	5588018	-0.010648	0.0000000	0.41467095	0.2202951	0.00243	0.031283177	-0.0059616	0.05	-0.06	**YES**
2011	-1E+06	-1.1E+07	1747723	-0.0350237	0.0000000	-0.31064142	0.1531043	0.00180	-0.023435089	-0.0041433	0.00	-0.03	**YES**
2006	1911198	-5.8E+07	-6913033	0.04585094	0.0000000	-1.21525092	0.0857925	0.00173	-0.091679704	-0.0023217	-0.07		
2007	-915726	-689172	223663	-0.0450306	0.0000000	-0.04488841	0.2075026	0.00354	-0.003386425	-0.0056154	0.02	-0.06	**NO**
2008	1624353	306715	1243789	0.08493941	0.0000001	-0.04900075	0.2465172	0.00376	-0.003696664	-0.0066712	0.02	0.07	**YES**
2009	-101496	2645374	1052831	-0.0042787	0.0000000	0.06713563	0.3280213	0.00303	0.005064777	-0.0088768	0.02	-0.03	**NO**
2010	-910359	-1.2E+07	2159672	-0.0364911	0.0000000	-0.55361835	0.4071124	0.00288	-0.041765503	-0.0110171	-0.03	-0.01	**YES**
2011	-2E+06	9205	513276	-0.0507214	0.0000000	-0.01694931	0.5031992	0.00242	-0.001278672	-0.0136174	0.01	-0.06	**NO**
2006	468154	69884	-1.1E+07	0.01323955	0.0000000	0.30805854	0.1732439	0.00203	0.023240234	-0.0046883	0.04		
2007	56040	-28937	-84607	0.00494256	0.0000001	0.00490993	0.6221493	0.00635	0.00037041	-0.0168364	0.01	-0.01	**YES**
2008	493777	566749	707205	0.04474669	0.0000001	-0.0127283	0.0062507	0.00652	-0.000960235	-0.0001692	0.03	0.02	**YES**
2009	-635208	-350534	591967	-0.0477064	0.000000	-0.07078513	0.0136742	0.00540	-0.005340099	-0.00037	0.02	-0.07	**NO**
2010	853897	5063126	1014167	0.06228834	0.000000	0.29535523	0.0037442	0.00525	0.022281884	-0.0001013	0.05	0.01	**YES**
2011	-234348	493176	1601678	-0.143612	0.000001	-0.679307	0.0317383	0.04409	-0.051247577	-0.0008589	0.02	-0.16	**NO**
								Total companies practicing earnings management					**56**

APPENDIX 2: APPLICATION OF THE YOON ET AL., (2006) MODEL TO THE STUDY SAMPLE

Years	(ΔREV-ΔREC)/ REV (X1)	(ΔEXP-ΔPAY)/ REV(X2)	(DEP+RET)/ REV(x3)	TA/REV	a'1*(ΔREV-ΔREC)/REV	a'2*(ΔEXP-ΔPAY)/REV	a'3*(DEP-RET)/REV	non discretionary accruals	DA	practicing /non-practicing
2006	0.4444555	0.64965877	0.847635	1.746664	-0.877462	0.94883223	-0.74664092	0.3	1.54	
2007	0.463334628	1.4028232	0.9986443	1.4542349	-0.08098288	0.061407257	-3.612096474	0.20	1.26	**YES**
2008	0.489905946	3.06947535	0.3326867	2.3640188	-0.08562709	0.134363377	-1.203327801	2.67	-0.31	**YES**
2009	-0.182123539	0.60038676	0.28539715	1.0184895	0.031832045	0.026281362	-1.032281493	2.85	-1.84	**NO**
2010	0.80696959	0.15711769	0.0373591	-0.0129795	-0.14104433	0.006877678	-0.135127878	3.56	-3.57	**NO**
2011	0.095473057	0.14081127	0.04112666	0.0021749	-0.01668704	0.00616388	-0.148755126	3.67	-3.67	**NO**
2006	0.748787488	-0.9989389	0.87387438	-0.8734873	-0.6747634	-0.897837487	-0.37823728	2.79	-1.787468	
2007	-0.001985639	-0.036179	0.37627752	-0.4728549	0.000347055	-0.0015837	-1.360995794	2.47	-2.939585	**NO**
2008	0.712438236	-0.7535375	0.45099568	1.5593828	-0.12452188	-0.032985389	-1.63125138	2.04	-0.480821	**YES**
2009	0.175578426	-0.0074551	0.238104	-0.6242668	-0.03068807	-0.000326339	-0.861222162	2.94	-3.560992	**NO**
2010	0.3712024	-0.0382217	0.04394917	0.7795285	-0.06487976	-0.001673121	-0.158964142	3.60	-2.823917	**NO**
2011	-0.29478902	-0.2187529	0.05864124	0.7157129	0.051524023	-0.009575703	-0.212105367	3.66	-2.943092	**NO**
2006	0.4654828	-0.7777463	0.9376767	-0.0387773	0.93767637	-0.84767467	-0.937878	3.56	-8.99	
2007	1.170655283	-5.0028035	8.64991176	-6.4878663	-0.2046103	-0.218992985	-31.28673118	-27.88	21.393506	**YES**
2008	26.12119515	-2.9948099	2.12494341	-1.9341383	-4.56553318	-0.131094969	-7.685920406	-8.55	6.6194479	**YES**
2009	0.227500607	-9.5590054	1.30600286	-4.0711073	-0.03976317	-0.418436409	-4.72381241	-1.35	-2.718058	**NO**
2010	0.524036178	1.27033294	0.31830815	-4.8562626	-0.09159246	0.055607621	-1.15132058	2.64	-7.497919	**NO**
2011	0.029916454	0.26479724	0.15441257	-2.0808576	-0.00522888	0.011591248	-0.558510275	3.28	-5.357672	**NO**
2006	0.4444555	0.64965877	0.847635	1.746664	-0.877462	0.94883223	-0.74664092	0.3	1.54	
2007	-0.244852963	-0.627285	0.04672762	1.3551417	0.042796063	-0.027458808	-0.169013796	3.68	-2.320144	**YES**
2008	0.823764628	0.16557241	0.02289426	3.1181806	-0.14397981	0.007247775	-0.082808536	3.61	-0.491241	**YES**
2009	-0.023978603	0.02591415	0.02901058	0.8618789	0.004191045	0.001134367	-0.104931265	3.73	-2.867478	**NO**
2010	0.332957047	0.04132172	0.04097938	-0.0652062	-0.05819513	0.001808819	-0.148222411	3.62	-3.68956	**NO**
2011	-0.825828002	-0.0037073	0.05017831	0.1980435	0.144340453	-0.000162285	-0.181494962	3.79	-3.593602	**NO**
2006	0.748787488	-0.9989389	0.87387438	-0.8734873	-0.6747634	-0.897837487	-0.37823728	2.79	-1.787468	
2007	-0.605582366	3.95788227	1.06932307	0.0831703	0.105845325	0.173252548	-3.867741599	0.24	-0.16	**YES**
2008	0.798379157	-0.1586379	0.37203492	-0.0209732	-0.13954287	-0.006944222	-1.345650323	2.34	-2.36	**YES**
2009	-0.332352516	-0.5423554	0.41443717	-1.0671734	0.058089472	-0.023741093	-1.499019265	2.36	-3.43	**NO**
2010	-0.095286978	0.39156229	0.03041951	-0.1324227	0.016654516	0.017140268	-0.110027372	3.75	-3.89	**NO**
2011	-0.308911954	-0.298498	0.03808334	-1.0958571	0.053992467	-0.013066466	-0.137747437	3.73	-4.83	**NO**
2006	-0.478798479	-0.9847898	0.00999377	-0.4378897	0.387897894	-0.38789789	-0.37897897	3.56	-3.20	
2007	-0.100007848	-0.1497194	0.01816576	0.4842233	0.017479642	-0.006553825	-0.065705549	3.77	-3.29	**NO**
2008	0.130588428	-0.0044066	0.01666224	-0.2443904	-0.0228246	-0.000192893	-0.060267308	3.75	-3.99	**NO**
2009	-0.072469478	-0.0130809	0.02563757	-0.0794665	0.012666411	-0.000572606	-0.092731089	3.75	-3.83	**NO**
2010	0.013976769	0.0161417	0.04290597	4.4220857	-0.0024429	0.000706587	-0.155190885	3.67	0.75	**YES**
2011	0.081735316	0.48307097	0.06110593	2.9696995	-0.01428592	0.021145974	-0.221020144	3.61	-0.65	**YES**
2006	0.748787488	-0.9989389	0.87387438	-0.8734873	-0.6747634	-0.897837487	-0.37823728	2.79	-1.787468	
2007	-0.258241532	-0.8591901	-0.0445403	1.8608817	0.045136154	-0.037610233	0.16110235	4.00	-2.14	**NO**
2008	-77.09943966	-75.365978	-2.1257004	442.10655	13.47564871	-3.299074314	7.68865853	21.69	420.41	**YES**
2009	17.46169618	-4.1080149	-0.7757999	67.73498	-3.05200251	-0.179824462	2.806068407	3.40	64.33	**NO**
2010	-0.079203666	-3.4035693	0.46233556	0.1029272	0.013843431	-0.148988022	-1.672267727	2.02	-1.92	**NO**
2011	0.928753616	1.64320705	0.18282907	0.4471416	-0.16233007	0.071929833	-0.661292769	3.08	-2.63	**NO**
2006	0.4444555	0.64965877	0.847635	1.746664	-0.877462	0.94883223	-0.74664092	0.3	1.54	
2007	0.081765698	0.03700898	0.01765811	0.5860944	-0.01429123	0.001620033	-0.063869399	3.75	-3.17	**YES**
2008	0.141257184	-0.2488478	0.01498229	0.7292264	-0.02468931	-0.010893079	-0.054190949	3.74	-3.01	**YES**
2009	0.148206926	0.02257322	0.01621595	0.8020518	-0.02590401	0.000988122	-0.0586531	3.75	-2.94	**YES**
2010	-65.11119296	7.46556155	1.03468457	-8.8852798	11.38031051	0.326797886	-3.742454143	11.79	-20.68	**NO**
2011	0.740377708	-0.0402131	0.37367792	-4.1238811	-0.12940522	-0.001760288	-1.351593045	2.35	-6.47	**YES**
2006	0.748787488	-0.9989389	0.87387438	-0.8734873	-0.6747634	-0.897837487	-0.37823728	2.79	-1.787468	
2007	0.292214028	0.10367439	0.00264284	-0.1561344	-0.05107396	0.004538248	-0.009559136	3.77	-3.93	**NO**
2008	0.241355952	0.23560525	0.00650571	0.4896144	-0.04218485	0.010313396	-0.02353117	3.77	-3.28	**YES**
2009	-0.004285613	-0.0432206	0.00554752	0.3984064	0.000749051	-0.00189194	-0.020065368	3.81	-3.41	**YES**
2010	0.332930038	0.19474801	0.01984101	-0.3896709	-0.05819041	0.00852491	-0.071764937	3.71	-4.10	**NO**
2011	0.116322997	0.08336491	0.01965296	-0.2700113	-0.02033125	0.00364922	-0.071084747	3.74	-4.01	**NO**
2006	0.346786387	0.3467836	0.08788	-0.3687627	-0.378687	0.007333	-0.38798009	2.65	-4.80	
2007	-7.980591918	-2.0650894	0.09411873	3.5852321	1.394869453	-0.090397333	-0.340427462	4.79	-1.21	**YES**
2008	3.870490706	-2.696475	0.10785454	-1.0761657	-0.67649484	-0.118035639	-0.390109867	2.64	-3.72	**YES**
2009	-5.319707951	-0.4437256	0.11539571	-4.3426758	0.929792952	-0.019423668	-0.417386287	4.32	-8.66	**NO**
2010	12.44530033	6.65143593	0.13981243	-0.2103282	-2.17522327	0.291160308	-0.505701583	1.44	-1.65	**YES**
2011	0.065629723	0.10666901	0.12851717	-2.5275536	-0.01147094	0.004669335	-0.464846607	3.36	-5.88	**NO**

2006	0.4654828	-0.7777463	0.9376767	-0.0387773	0.93767637	-0.84767467	-0.937878	3.56	-8.99	
2007	0.133657964	0.04546646	0.07144114	0.6452781	-0.0233611	0.001990251	-0.258402616	3.55	-2.90	**YES**
2008	-45.97665848	34.4140825	3.91496616	-23.492823	8.035924791	1.506443869	-14.16043277	-0.79	-22.70	**NO**
2009	1.882850139	-4.7658727	-2.8588721	7.7832887	-0.32908964	-0.208621562	10.34054037	13.63	-5.85	**YES**
2010	0.369022686	-0.3715096	0.06810161	-0.0041105	-0.06449878	-0.01626248	-0.246323514	3.50	-3.51	**YES**
2011	-0.105589703	-0.0660642	0.06621412	0.0595254	0.018455254	-0.002891898	-0.239496462	3.61	-3.55	**YES**
2006	0.4444555	0.64965877	0.847635	1.746664	-0.877462	0.94883223	-0.74664092	0.3	1.54	
2007	0.264214416	0.34168827	0.01883624	0.798979	-0.04618011	0.01495708	-0.068130669	3.73	-2.93	**YES**
2008	-378.9743395	-265.47935	2.20694582	-77.012276	66.23816065	-11.62110734	-7.982523127	50.46	-127.48	**NO**
2009	28.26962767	316.812598	5.94237596	-93.176752	-4.94104203	13.86817144	-21.49357409	-8.74	-84.44	**NO**
2010	0.813274338	-0.3987219	0.00410031	0.0971148	-0.14214629	-0.017453673	-0.014830834	3.65	-3.56	**YES**
2011	0.27460409	0.25233218	0.00450082	-0.1055141	-0.04799605	0.011045602	-0.016279465	3.78	-3.88	**YES**
2006	0.748787488	-0.9989389	0.87387438	-0.8734873	-0.6747634	-0.897837487	-0.37823728	2.79	-1.787468	
2007	0.230851643	0.04276194	0.36859354	0.0238743	-0.04034887	0.001871863	-1.333202867	2.46	-2.43	**YES**
2008	0.590668994	0.03478088	0.23719055	0.6200891	-0.10323873	0.0015225	-0.857918225	2.87	-2.25	**YES**
2009	-0.355452472	-0.0124787	0.29112987	0.8732264	0.062126945	-0.000546242	-1.053016748	2.84	-1.96	**YES**
2010	-0.030057175	0.74192348	0.1586795	0.8888842	0.005253474	0.032476998	-0.573943749	3.29	-2.40	**YES**
2011	-1.735703601	-1.1052171	0.29893858	-0.4272492	0.303370973	-0.04837983	-1.081260853	3.00	-3.43	**NO**
2006	0.4654828	-0.7777463	0.9376767	-0.0387773	0.93767637	-0.84767467	-0.937878	3.56	-8.99	
2007	0.184306128	2.02352471	1.89759544	-2.1721926	-0.03221352	0.088577878	-6.863602774	-2.98	0.81	**YES**
2008	2.117692379	0.81472086	1.01921	-2.7866375	-0.370136	0.035663634	-3.686482594	-0.19	-2.59	**NO**
2009	1.212295113	-0.07642	1.0483565	-3.1636988	-0.21188822	-0.003345211	-3.791905508	-0.18	-2.99	**NO**
2010	0.325526136	-0.029914	0.23624787	0.2727305	-0.05689634	-0.001309455	-0.854508546	2.92	-2.64	**NO**
2011	0.09548138	-0.0194892	0.23335313	-0.4780584	-0.01668849	-0.000853123	-0.844038264	2.97	-3.45	**NO**
2006	0.748787488	-0.9989389	0.87387438	-0.8734873	-0.6747634	-0.897837487	-0.37823728	2.79	-1.787468	
2007	-0.127709241	2.16157598	3.85128777	-19.11524	0.022321367	0.094620941	-13.93010803	-9.98	-9.13	**NO**
2008	-0.111388258	0.65359762	2.83386588	-17.22615	0.019468741	0.028610617	-10.25009301	-6.37	-10.85	**NO**
2009	0.022549448	1.07800661	2.22121808	-7.1442517	-0.00394125	0.047188719	-8.034145882	-4.16	-2.98	**YES**
2010	0.843538343	-0.0841128	0.20450027	-0.3136826	-0.14743591	-0.003681956	-0.739677486	2.94	-3.25	**YES**
2011	0.119738603	-0.085823	0.236599	0.0035346	-0.02092824	-0.003756823	-0.85577859	2.95	-2.94	**YES**
2006	0.4444555	0.64965877	0.847635	1.746664	-0.877462	0.94883223	-0.74664092	0.3	1.54	
2007	1.808730589	4.44075027	0.36542976	7.7713073	-0.31613483	0.194389637	-1.32175945	2.39	5.39	**YES**
2008	2.973107133	-5.1050019	0.14643618	-7.0408795	-0.51964771	-0.223466623	-0.529659684	2.56	-9.60	**YES**
2009	0.91024993	-0.5509688	0.29154732	-6.028756	-0.15909595	-0.024118139	-1.054526662	2.59	-8.62	**YES**
2010	-2.4288	0.3696	0.5978	-76.3212	0.424512237	0.01617889	-2.162242625	2.11	-78.43	**NO**
2011	-0.6346	2.1092	0.3176	-24.9154	0.110917105	0.092328232	-1.148759213	2.88	-27.80	**NO**
2006	0.23468763	-0.362876	0.32876	-0.8783279	-0.32687687	-0.7328789	-0.32789789	2.87	-34.45	
2007	0.119116585	-2.2678274	0.11274533	-0.2011415	-0.02081952	-0.099271998	-0.407799869	3.30	-3.50	**NO**
2008	0.723173302	1.60249501	0.56833858	-0.7434585	-0.12639819	0.070147701	-2.055680681	1.72	-2.46	**YES**
2009	0.417262773	0.20708212	0.29606718	-0.0392667	-0.07293032	0.009064824	-1.070875012	2.69	-2.73	**YES**
2010	0.822777766	0.05494459	0.04477268	-0.0035695	-0.14380732	0.002405147	-0.161942786	3.53	-3.53	**NO**
2011	-0.028453308	0.20294318	0.06061863	-0.0407119	0.004973146	0.008883645	-0.219257576	3.62	-3.66	**NO**
2006	0.4654828	-0.7777463	0.9376767	-0.0387773	0.93767637	-0.84767467	-0.937878	3.56	-8.99	
2007	0.225879647	-0.15299	0.01937965	-0.1566868	-0.03947986	-0.006696991	-0.070096208	3.71	-3.87	**NO**
2008	0.225488389	0.348662	0.00125856	0.4078583	-0.03941147	0.015262349	-0.004552229	3.80	-3.39	**YES**
2009	0.093965655	0.15263026	0.02320667	-0.0155119	-0.01642357	0.006681245	-0.083938524	3.74	-3.75	**YES**
2010	-0.212338079	0.00388258	0.02984827	-0.0541352	0.037113024	0.000169956	-0.107961198	3.76	-3.81	**NO**
2011	-0.015286023	-0.0313893	0.00169915	-0.2168635	0.002671733	-0.001374039	-0.006145808	3.82	-4.04	**NO**
2006	0.4444555	0.64965877	0.847635	1.746664	-0.877462	0.94883223	-0.74664092	0.3	1.54	
2007	0.243728543	0.44583044	0.14490411	-0.0166297	-0.04259953	0.019515805	-0.524118167	3.28	-3.30	**NO**
2008	-0.022136149	-0.1464601	0.14120354	-0.360403	0.003869016	-0.006411151	-0.510733206	3.32	-3.68	**NO**
2009	0.14097381	0.13428104	0.1116913	-0.1805072	-0.02463978	0.005878025	-0.403987427	3.41	-3.59	**NO**
2010	-13.55482105	7.76277143	0.64999361	16.431068	2.369148305	0.339807967	-2.351026916	4.19	12.24	**YES**
2011	-0.237652366	1.17622704	0.02989387	54.278036	0.041537524	0.051488225	-0.108126112	3.81	50.46	**YES**
2006	0.748787488	-0.9989389	0.87387438	-0.8734873	-0.6747634	-0.897837487	-0.37823728	2.788	-1.787468	
2007	0.175368894	-0.0417839	0.08938743	0.5526465	-0.03065145	-0.00182905	-0.323314324	3.47	-2.92	**NO**
2008	0.631530109	0.0457095	0.35065268	5.866564	-0.11038054	0.00200089	-1.268310746	2.45	3.41	**YES**
2009	0.362187871	-0.0546295	0.34338183	-3.8722882	-0.06330418	-0.002391354	-1.242012095	2.52	-6.39	**NO**
2010	-40.08756115	-0.0515182	17.7441006	-18.60927	7.006612423	-0.00225516	-64.18041266	-53.35	34.74	**YES**
2011	0.402834417	2.48067272	15.0193854	-81.422404	-0.07040849	0.108589099	-54.32511754	-50.46	-30.96	**NO**
2006	0.4654828	-0.7777463	0.9376767	-0.0387773	0.93767637	-0.84767467	-0.937878	3.56	-8.99	
2007	0.071202187	-0.1371687	0.07754094	0.8231675	-0.01244491	-0.00600443	-0.280465575	3.53	-2.71	**YES**
2008	-0.090211485	0.22379002	0.09915573	0.496648	0.015767408	0.009796196	-0.35864628	3.50	-3.00	**NO**
2009	0.205854138	-0.0112661	0.10952526	0.6171647	-0.03597974	-0.000493161	-0.396152863	3.40	-2.78	**NO**
2010	0.40255536	0.07878562	0.0322229	1.1538055	-0.07035972	0.003448766	-0.116550216	3.65	-2.49	**YES**
2011	-0.084881957	-0.0062633	0.03393215	1.1196213	0.014835898	-0.000274169	-0.12273258	3.72	-2.60	**YES**

2006	0.436876837	0.3567536	0.87342894	-0.7738749	-0.6732876	5.26876872	-0.236877	2.56	-2.88	
2007	0.090236252	0.02320488	0.19484523	-0.1167061	-0.01577174	0.001015772	-0.7047552	3.11	-3.23	**NO**
2008	-513.8808783	318.877123	0.29069363	186.15068	89.81749058	13.95854408	-1.051438875	106.55	79.60	**YES**
2009	0.050369416	-177.08585	0.28687812	-0.236661	-0.0088037	-7.751765421	-1.037638165	-4.97	4.73	**NO**
2010	0.049893586	0.20006503	0.09331658	0.9203872	-0.00872054	0.008757657	-0.337526084	3.49	-2.57	**NO**
2011	0.058868179	0.0269503	0.10033766	0.8813155	-0.01028914	0.001179724	-0.362921303	3.46	-2.58	**NO**
2006	0.748787488	-0.9989389	0.87387438	-0.8734873	-0.6747634	-0.897837487	-0.37823728	2.79	-1.787468	
2007	0.835085407	0.32120428	0.09805954	-5.6183855	-0.14595849	0.014060413	-0.354681344	3.34	-8.96	**NO**
2008	-0.295991316	0.3900649	0.14601684	8.7603075	0.051734163	0.017074722	-0.528142926	3.37	5.39	**YES**
2009	0.203904576	-1.2118277	0.13010189	-0.9162656	-0.03563899	-0.053046609	-0.470578556	3.27	-4.19	**NO**
2010	0.454869294	0.15344204	0.29689449	0.1230133	-0.07950329	0.00671678	-1.073867365	2.68	-2.56	**NO**
2011	-0.225490423	-0.0375773	0.39850884	0.4094812	0.039411826	-0.001644911	-1.441406483	2.43	-2.02	**YES**
2006	0.748787488	-0.9989389	0.87387438	-0.8734873	-0.6747634	-0.897837487	-0.37823728	2.79	-1.787468	
2007	0.012476167	0.00051608	0.0042241	-0.0154528	-0.00218062	2.2591E-05	-0.015278577	3.81	-3.83	**YES**
2008	-0.057882264	0.00232992	0.00605964	0.0153993	0.010116819	0.00010199	-0.021917709	3.82	-3.80	**YES**
2009	0.172084221	0.17181907	0.004862	-0.0754002	-0.03007735	0.007521217	-0.017585868	3.79	-3.86	**NO**
2010	0.157934104	0.24607064	0.00192807	-0.0040555	-0.02760415	0.010771509	-0.006973825	3.81	-3.81	**YES**
2011	-0.184895292	-0.1277301	0.00360976	-0.0208462	0.0323165	-0.005591262	-0.013056485	3.84	-3.86	**NO**
2006	0.4654828	-0.7777463	0.9376767	-0.0387773	0.93767637	-0.84767467	-0.937878	3.56	-8.99	
2007	-0.104735365	-0.0455554	0.00408129	-0.1050671	0.01830593	-0.001994144	-0.014762015	3.83	-3.94	**NO**
2008	-0.103861434	-0.1204234	0.00722672	0.1800366	0.018153182	-0.005271421	-0.026139053	3.82	-3.64	**NO**
2009	0.136491339	0.14418933	0.00477068	-0.0086989	-0.02385633	0.006311751	-0.01725556	3.79	-3.80	**NO**
2010	-861.9177484	95.609336	51.0268347	-56.812219	150.6483166	4.185208135	-184.5640634	-25.90	-30.91	**NO**
2011	-19.9798248	54.9207658	40.5922946	-59.79036	3.492127849	2.404104509	-146.8223312	-137.10	77.31	**YES**
2006	0.4444555	0.64965877	0.847635	1.746664	-0.877462	0.94883223	-0.74664092	0.3	1.54	
2007	0.841241538	0.76907036	4.06819693	0.8468327	-0.14703447	0.033665327	-14.71466846	-11.00	11.85	**YES**
2008	-0.221915709	1.31452858	0.13078485	0.7801509	0.038787028	0.057542244	-0.473048801	3.45	-2.67	**NO**
2009	-3.337574498	2.13947682	0.35793988	-2.2493918	0.583350303	0.093653572	-1.294668552	3.21	-5.46	**NO**
2010	0.757449467	0.41898398	0.00960225	0.1597408	-0.13238907	0.018340627	-0.034731345	3.68	-3.52	**NO**
2011	-0.189854476	0.0547119	0.00887031	-0.0401371	0.033183279	0.002394962	-0.032083901	3.83	-3.87	**NO**
					Total companies practicing earnings management					**80**

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The Creation of Ceramic Crafts with Traditional Technology for Export Purpose Following Design Trend 2015

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ABSTRACT: This article reported the results of a study of the creation of ceramic crafts following design trend 2015. Ceramic craft arts have become one of Indonesian main export commodities. It used social, esthetic and design approaches. The creation method consisted in exploration of shapes as inspiration sources, alternative sketches, working drawings, and prototype preparation process. It gave 25 new prototypes as design standards of coming trend of 2015. The theme raised in 2015 would be Re+Habitate based on the prediction of Indonesian forecasting trends through the focus on the themes of Alliance, Biomimetics, Adroit and Veracious. Six designs would be created for each of the selected themes in the form of product samples. It might be one of the strategies in developing and improving ceramic craft arts, especially in the big ceramic craft art centers in Indonesia as an important part of populist economy.

KEYWORDS: creation, ceramic and design trend 2015.

1 RESULT PREDICTION

This paper was the result of the continuation of the study in 2013 that has produced 25 new alternative designs and their prototypes have been produced in the ceramic craft art center of Kasongan and Pleret Purwakarta, Indonesia. The result of the study had significant impact on the increase in the production from a container to two containers that contained 400 pieces of new products for each so that it might be considered that there was 100 percent increase. The creation of ceramic craft followed the existing design trend and hence it was able to give new nuances in the resulting products in addition to the new spirit of the craftsmen in producing the ceramic artistic crafts after the declining periode because of the global economic crisis in 2008 (Timbul Raharjo, 2013).

Design trend was created by designers by observing changes in human life both in the process of the human life and their behavior. They observed and along with forecasting team determine the coming trends. The trends were created by observing the emerging phenomena in the right time and place (Camara Municipal, ed., 2009). The right momen of the creation of the trends had significant impact on the success of the ternds. Additionally, the credibility of the team also played an important role in the creation of the trends. It was the case of the forecasting team in Paris, Frence that was of world class and different from the design forecasting experts in each countries with their understanding of the problems facing them in their home countries. Thus, in forecasting the coming trends they would considere which parts that were potential to bring new trends (Fitinline, 2014).

Trend forecasting such as Promostyle, PeclersParis or Stylesight in Europe, especially in Frence have been the standard in developing new world trends. Indonesian Trend Forecasting (ITF) predicted that the coming trends of 2015/2016 would raise the theme Re+Habitate as main theme. Based on several prior studies the emerging trends in Indonesia also followed the existing world trends. It was because there were many people in the world who changed places. They mixed and interaced. Therefore, they had similarities no matter where they lived. The similarities were clearly observed in their dress, speech and culture and so on. It was triggered by the presence of information technology that has become inseparable part of modern life. The information technology caused the absence of distance and all became close and interrelated (Khairiyah Sartika, 2014).

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The questions of the creation that would be answered in these activities were (1) What were the influencing factors of the emertence of the trends in 2015? (2) What would be the emerging trends in 2015? (3) What were the trend themes according to ITF? (4) What was the process of materializing the trend in 2015 based on earthenware material and local technology? It was predicted that the study would give:

1.The prediction of the coming trends in 2015.
2.The creation of 25 ceramic artistic crafts as prototypes.
3.The use of local and traditional potential that were presented globally.

2 CREATION METHOD

It was necessary to consider the orientation of the understanding of the purpose of the creation of the products in order to effectively design them. In the prior study the design trend of 2014 was considered to as natural and antique. Meanwhile, the coming trend of 2015 was predicted to have similar charcteristics though they would be more blured and mixed as a result of changing world condition becase of globalization that tended to be decentralistic in nature. In other words, it woud be highly possible for the areas with the potential to create their own creative products while following the similarities with world trends. They used local culture inspiration to create products that were sold globally.

Consistent with prior pattern the study of the design trends of 2014, the study used esthetic and economic framework (Joko Subiharto, 2013). The two approached were used to collect data. In-field data represented written and visual ones. They were real and represented what actually happened in field. It enabled easier construction and interpretation of various social changed in both tangible and intangible manners. Reading could be conducted freely as long as data appropriateness could be applied in the study so that they represented the design development pattern of the day (Denzim, 1997). The collection of the data in the creation of new ceramic artistic crafts was also carried out using literature study and observation of earthenware clay potentials and also the skills of the local ceramic crafts makers as important point of departure. The finishing characters were adjusted to consumers' interest that was predicted to take place in 2015 so that they could create artistic ceramic products that properly ansere their needs.

Exploration and eksperimentation were translated into alterantive sketches, shape experiments, shape establishment and product finishing. The complete stages were raw material preparation, tools and instruments preparation, spinning shapping process, casting shapping process, drying, burning and finishing.

During the materialization of the prototypes observations and recordings were conducted that it could produce ceramic artistic crafts that met the consumers' predicted interests in 2015. Additionally, market test was also conducted to introduce the products to the consumers by displaying the new products in art shops and then representational test was conducted with closer evaluation of the products along with producers and also exporters (Joko Subiharto, 2013).

3 CERAMICS AS EXPORT COMMODITY

At international level, it was common practice to sell ceramic products in a big quantity and packed in packing containers that were coordinated in export activity. The export activit of the artistic ceramic products reached countries as Netherlands, Italy, Spain, Frence, Australia, and Canada and Caribean countries. The countries represented potential world markets and played a determinant role in globalization era. The sale of products in global market was inseparable of world trade rules. Globalization era was facing countries, companies, communities and individuals all over the world. Of course, they agreed to commit to better and well-ordered world trading process and hence they founded World Trade Organization (WTO). The free trade rules had logical consequences for every country involved. It had to protect itself against various changes that posed danger to its domestic trade and even the danger included environmental one suchas disease spreading. Therefore, there was international agreement among the countries to formulate rules of trading zones as Asia Pacific Economic Cooperation (APEC), General Agreement on Tariff and Trade (GATT), and so on. Consequently, it was necessary for the creation of products for export purpose to follow the existing international standard that they were accepted by the exporting target countries or the target market. The craftsmen were required to understand caucality aspects of the rules. Thus, they had to maintain the quality of their artistic ceramic products for international market. For example, they had to follow the standard packaging rules to prevent products that contained dangerous diseases. Canada was among the markets with strict rules of fumigation, which was International Standard Pycosanitary Measure (ISPM#15) and also Australia.

The rules and the stipulations of each country had the consequences for the commodity of artistic ceramic products that they must meet export quality standard. They were contained in export document such as fumigation certificate, Bill of Leading (BL), Certificate of Origin (COO), Invoice Packing List, and ISPM#15. The documents must be in the hands of buyers

before the containers arrived at the harbor of destination. Additionally, in addition to the documents the quality of the products, including the materials, the processing and the timeliness in shipping was very important. The condition of consumers' region was of course different from that of Indonesia. The commodity of the artistic ceramic products that seemed to be appropriate to use in Indonesia was not always so in the target countries with different culture, seasons, weather and trends. Thus, it was necessary to make a good and careful calculation of the aspects related to the quality of the commodity of the artistic ceramic products (Timbul Raharjo, 2008).

4 WORLD TREND IN 2015

Indonesian artistic ceramic products had in general competitiveness in international market. They had distinct characteristics, especially the availability of local raw materials and local technology. They were able to follow world trends because 90% of their market was international market. Therefore, the coming ceramic designs of 2015 also were adjusted to the international needs as characterized by the change in shape and finishing with improved color characters. It was necessary for designers to be able to make use of their experience and knowledge of various scientific areas, including social and humanity sciences. They had to be able to find the solution of the problem of the competitive global market for global products using creative ideas. The condition defined the role of the design in broader strategic context. The design became an important part of the effort to solve the problems in micro and medium scale business (*Usaha Mikro dan Menengah* [*UMKM*]). The solution included the characteristic shapes that followed the existing trends in interior and exterior arrangement styles. The enthusiasm of the designers in responding the design trend of 2015 was quite high consistent with the improvement in economy though some of them still focused on reproducing technique. However, some of them thought that it was necessary for entrepreneurs to creatively predict the coming trends to survive. The implementation of technology to improve ceramic productivity was required that the quality of the ceramics improved and had better competitiveness in international market. Therefore, information technology was highly required in predicting the world trends. The role of the designers was to manage the complexity, which was to send clear message to people, to uncover various correlations in establishing information context and sustainable communication with clients (Timbul Raharjo, 2012).

The design trenda of 2015 were classified into four sub-trends with their own details, which were Alliance, Biomimetics, Adroit and Veracious. Each of the trends got its inspiration from local genius in the area of traditional arts and presented different concepts. The ceramic design trend referred to the change in other product trends as indicated by the fact that fashion trend was the most fluctuative one and the most developed one as compared to the design trend as house ascessories. The fashion trend experienced change and development every year. Entering new year, there were always new trends that served as fashion reference for designers and fashion industry lovers. In general, observers were able to predict the coming trend earliear, especially the special team in trend forecasting (Khairiyah Sartika, 2014).

Re+Habitate was the theme to bring back a good agreement for community and environment. Habitate was a typical living place for an individual or a society. It was the place for living creature to proliferate. Essentially, it was physical environment for population of a species that was influenced and used by the species. It was physical environment in the surrounding areas of a species or population of species or a group of species or community on earth (KBBI, 1991). In this case the prefix "re" that meant repeating or bringing back to original position. It was closely related to the attitude and the behavior of the people of urban areas who more appreciated various things that have been out of their position, function and meaning. It was this trend that brought people aroud to be back to the right situation in different situation so that it represented the past truth that was presented in the present time.

4.1 ALLIANCE

Alliance meant in Indonesian *persekutuan.* In business science alliance was in generally defined as a combination or association of two individuals or more to own and to operate a business collectively for the purpose of getting profit. The theme alliance in design trend represented several things that were combined. More precisely, it was referred to as eclectic style that tended to combine old elements and new elements. It was also predicted by Indonesian forecasting team in Fashion Week 2014. As sub-theme trend, the alliance represented a combination of simpler elements and artistic elements of local genius applied in the motifs and complicated working technique.

Figure 1. The sub-theme alliance that was predicted to take place in 2015.

(Source: eclectictrens.com, www.pinterest.com, June 30th, 2014)

4.2 BIOMIMETICS

Biomimetics meant mimicking. It was the term used in biology and represented a scientific branch that tried to catch ideas fromliving creaures and then developed the ideas in technological products that got their inspiration from natural phenomena. Technological products such as machines or robots were principally different from natural biological elements. The machines and the robots represented dried and hard materials and were completely different from biological elements that were wet and soft. Designin skill was required to create a machine, but a biological element was designed automatically and in a very complex manner. For example, a tree consisted of soft and wet parts and it designed itself during its growing period. It was necessary to develop a scientific branch called ciomimetics to create technological products that mimicked biological elements. It was a scientific branch that got its inspiration from natural biological elements that were subsequently developed into artificial biological system-based products. The word mimetic meant to imitate and hence biomimetic meant to imitate biological system. In biomimetics and bioengineering technologists and researchers tried to mimick biological objects in creating smart and active objects that functioned like natural biological creatures (http://www.kamusilmiah.com, June 30th, 2014).

Figure 2. Natural biomimetic shapes that inspired the coming designs of 2015.

(Source: http://www.squidoo.com, blacklemag.com, voc.aliasclick.com)

4.3 ADROIT

Adroit might be translated into agile, energetic and so on. It repesented a sub-theme of new development that sent the impression of speed and skills in solving problems in modern era. The design was mostly reflected on modern products characterized by agility and of slim impression such as automobile design or motorcycle design and houshould furnishings that were likely to have futuristic design. Even, monochrome colors and lines that gave slim, cheerful and agile were selected. The design trend was mostly found in the products such as motorcycle. The application of the design might also be found in ceramic products.

Figure 3. The sub-theme adroit with its impression of agility that was predicted to take place in the coming product design of 2015.

(Sumber:www.the-capsule.com, latimesblogs.latimes.com, suzukigunungsahari.blogspot.com)

4.4 VERACIOUS

Truth, honesty and sincerity were expensive things in this modern era and probably they were only found in a part of this global society. An increasingly complex condition forced one to tell lies while another element brought one to bay to cover truth in their effort to answer living needs. Therefore, people were yearning for truth, honesty and sincerity. Designs with the themes of truth, honesty and sincerity were predicted to have their place among people in 2015. Boredom and lies have been Lehman Brother's scandal of global finance and it raised human awarness of truth. It was this longing that inspired veracious designs.

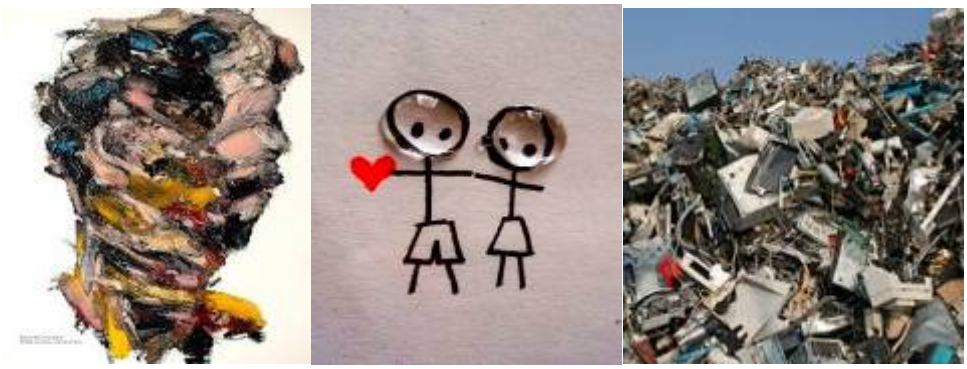


Figure 4. The veracious trend with its impression of honesty and sincerety and the strong willingness to be back to simplicity, love and nature

(Source: // veraciousverves.blogspot.com/, designyoutrust.com, veraciousthoughts.wordpress.com, June 30th, 2014)

5 LOCAL EARTHENWARE MATERIALS AND LOCAL TECHNOLOGY

5.1 LOCAL EARTHENWARE MATERIALS

The exploration of earthenware materials in Indonesia was one of the bases in establishing spinning technique with the clay commonly used in producing bricks, earthenware and other ceramic products. The material was classified as secondary clay and contained ferrous oxide that gave terracotta color after burning. The characteristics and the condition of the material were typical. It depended on the method of extracting it wether it was mixed with other materials such as sand or not. There were plastical clay and fragile clay with excessive content of sands. Its burning colors were yellow, bright orange, red, brown to black, depending on the burning temperature and the ferrous oxide content. Its raw colors were red, brown, greenish and grey.

The earthenware sediments in the Special Region of Yogyakarta had different caracteristics. They could be found in all of the districts of the region, including Bantul, Sleman, Kulon Progo and Gunung Kidul. Each of the districts had its own

characteristic earthenware raw material and it could not be used as single raw material. It was therefore necessary to mix some raw materials as found in Kasongan ceramic craft industry center. For example,

a. The clay from Godean Sleman 25%.
b. The clay from Dlingo Bantul 25%.
c. Fine sandy clay 50%.

The composition might change with the results of the experiment with the clay. Traditional craftsmen have practiced various compositions directly by considering the plasticity of the clay with their "feeling" while they were folding it. They were able to determine wether it contained too much sand or it needed additional sand. They further tested it by burning it. Once the raw material has met the requirements related to cracks, shrinkage, and surface smoothness and strength, it could be used in ceramic production.

Figure 5. Traditionally, craftsmen extracted the clay manually by randomly digging ground and selecting which clay was the best. The location of clay mining in Pagerjurang, Klaten (Foto: Timbul Raharjo, 2013)

5.2 TRADITIONAL SPINNING TECHNIQUE

a) Foot Spinning Technique

Traditional techniques were used in producing ceramics. One of the techniques was food spinning technique that has been mastered by Indonesian craftsmen from generation to generation. They used their foot to spin the spinning table that enabled the production of big ceramic products, which were higher than a meter. The technique was commonly used by the ceramic craftsmen in the areas of Brebes of Central Java. Even, many of the craftsmen from Brebes worked in the artistic ceramic industry centers such as Kasongan Bantul, Banyumulek Nusa Tenggara Barat, Pleret Purwakarta, Klampok and so on.

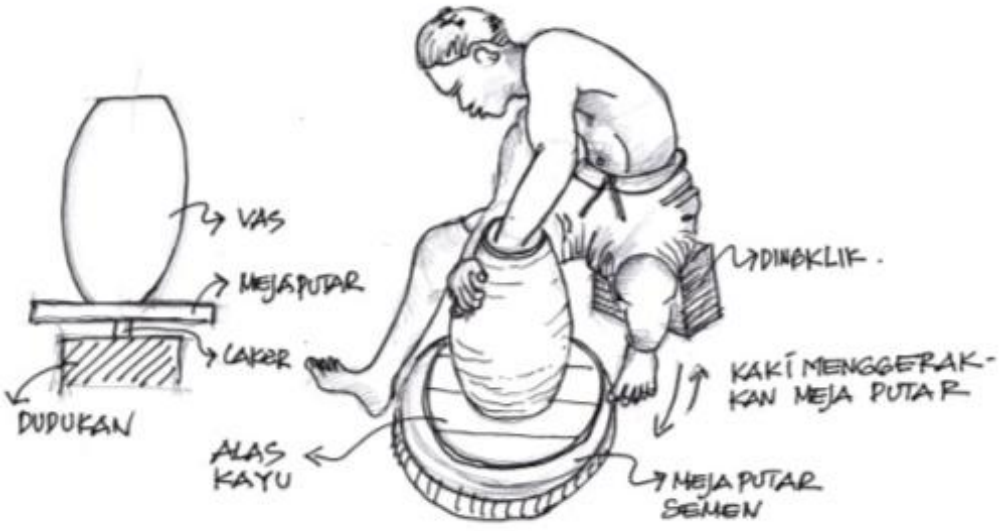


Figure 6. Foot spinning technique

The technique was commonly used in the production of ceramic products of big dimension up to the height of 2 meters. The craftsmen used their foot to spin the spinning table by moving it forward and backward as illustrated in the sketch above.

(Sketch: Timbul Raharjo, 2012)

b) Oblique Spinning

The oblique spinning technique was very unique. It enabled oblique working position. It was commonly used in Pagerjurang village, Bayat, Klaten. The position of the spinning table was approximately 30 degrees oblique. It was spinned using foot sideways, while the other foot driving a pedal sideways. The spinning table had an axis that was connected to a string. The string worked to hold and free the axis and gave the table spinning impact.

Figure 7. Oblique spinning technique

It was commonly used by the craftsmen in Pagerjurang, Klaten, Central Java. It was used in oblique position and the spinning table was spinned by a string connected to the spinning axis of the table and and driven sideways using foot (Sketch: Timbul Raharjo, 2012)

6 THE MATERIALIZING PROCESS OF CERAMICS

6.1 ALTERNATIVE SKETCHES

Exploration was made by drawing several sketches of imagined shapes. Various alternative sketches were drawn. They were drawn in perspective drawings to catch complete shapes as imagined. It was because people did not see the drawings as regular objects. Light sensation went through retina to reach brain that almost simultanesously interpreted it into meaningful drawings. There was not any real object, but optical perception in the brain. Indeed, the optical process took place in eyes, but perception was the function of brain. We could not experience any sensation without characterization in some ways such as labeling and directing its meaning.

For practical purpose manifestations in our life such as homes, trees, boys, ground, and sky and so on had some levels. We could train perception to identify elements of a drawing by focusing our attention to shapes, colors, textures and dark and bright sides of the drawing. Actually, during the focus on the elements of a manifestation, for example its shape, the elements became manifested because they represented a sequence that gave a meaning. Meaningful manifestations in ceramic artworks represented a combination of the elements. Earthenware jug or vase as inspiration source was influenced by visual expression.

Designs were considered as the bases to make a further step into more freedom. The sketches enabled the creation of imagined shapes. The embryonic sketches were then standardized with clearer position and proportion. The sketches were drawn in diffeent perspectives (front view, side view and top view). They served as reference in the forming process of the artistic ceramic products in order to avoid some mistakes in terms of proportion and other elements of the products. The ceramicts were three dimensional ones and hence it was necessary to give serious attention to harmony among the elements (i.e., composition). However, it was often the case that in the actual process of the creation of the artistic ceramic products they were different.

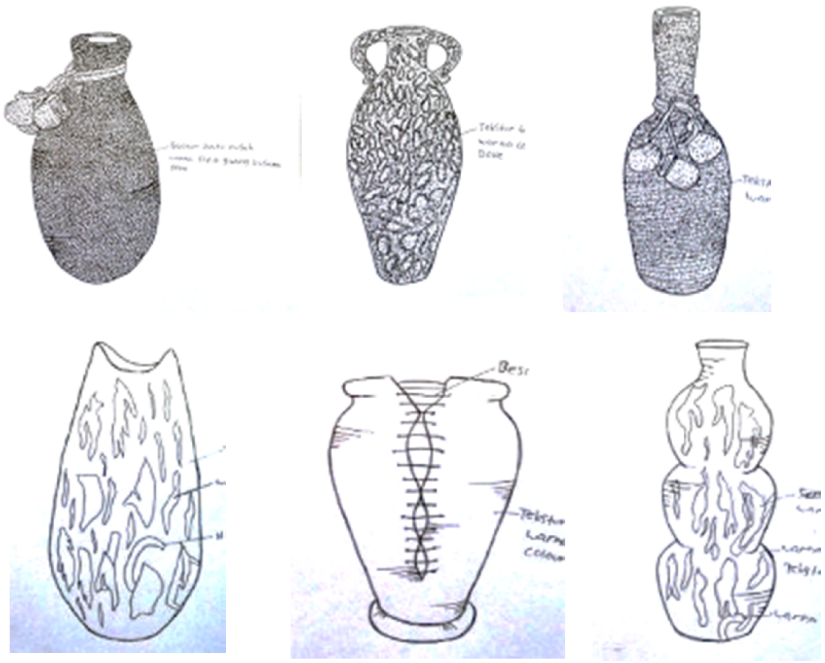


Figure 8. The sketches of the designs of the theme Alliance that would be developed in the finishing process using doft and antique touches. (Sketch: Awaludin, 2014)

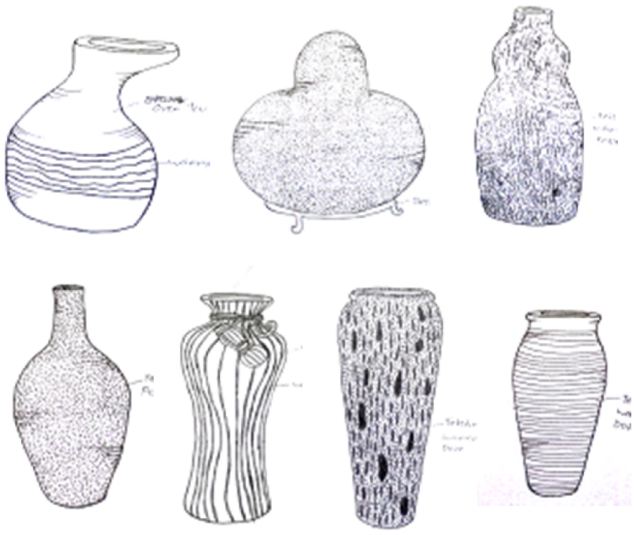


Figure 9. The sketches inspired by biomimetic shapes.

(Sketch: Awaludin, 2014)

Figure 10. Alterantive sketches inspired by the sub-thema Adroit

(Sketch: Awaludin, 2014)

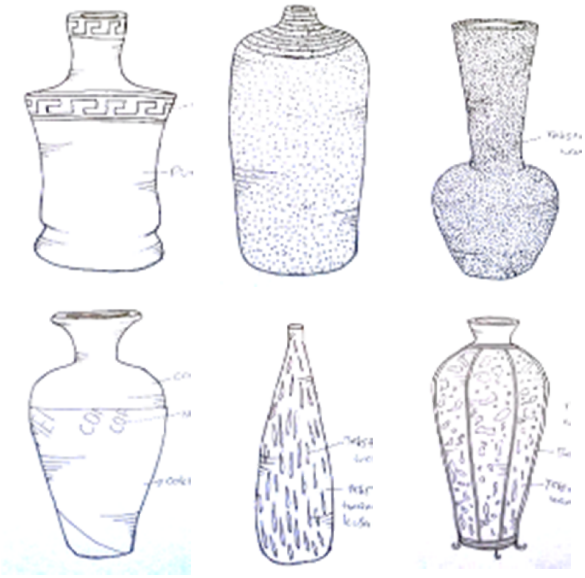


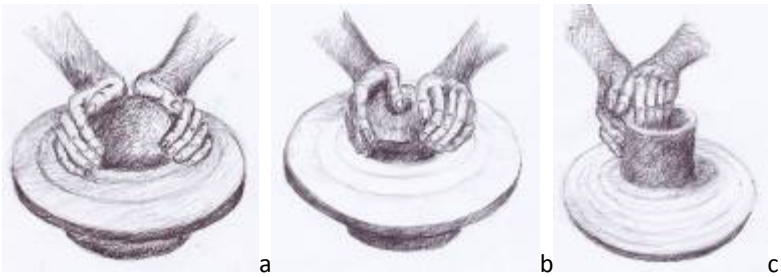
Figure 11. The sketche of desaon inspired by the theme Veracious

(Sketch: Awaludin, 2014)

6.2 SHAPING

Shaping was an important part of the creation process of artistic ceramic products because it enabled the creator to express their imagination. Followings were the steps in the foot spinning technique and oblique spinning technique:

1. Preparing raw materials and tools, which were earthenware clay that was mixed with find sand using mixing machine for even and high plasticity result.
2. Preparing spinning table, water, cloth (*dalim*), scraper (*secang*), cutting string, measuring tools, lining (*lemek*), etc.
3. Taking a handful raw material and shaping it into a ball of clay and putting it on the spinning table and then giving it bowl shape and extending it upward by spinning it to obtain a cylindrical shape with even thickness.
4. Modifying the cylindrical shape into the expected shape by referring to standard drawings.



a b c

Figure 12. The shapping process using spinning table, consisting of: a. Preparing clay pattern, b. Making bowl shape, and c. Extending the bowl upward and making even thickness by spinning it.

(Sketch: Totok, 2013)

6.3 BURNING

Traditional burning was one of the burning techniques. It had high efficiency from the point of view of the availability of firewoods and the knowledge of the craftsmen of the burning process. The burning process took place in vessel furnace. It was of the kind of the furnace with fire that was directed upward and used firewoods and dried leaves as cover. It was commonly used in traditional ceramic centers in Indonesia so that its efficiency has long been proven.

Figure 13. Open vessel furnace with firewoods

(Photograph: Timbul Raharjo, 2013)

6.4 FINISHING

Finishing was a very important part in adapting to the existing design trends. First, the characteristics of the trends would be established. It enabled an object in old shape following the trends of prior years to be transformed and modified into the coming trends. Wall paints were used in the creation of the artistic ceramic products. The wall paints were processed using melamin burning and scrapping technique and then it was tried out in a technical exploration with paint combination and it resulted in the expected trends. Thus, each of the processes had its own consistency with market.

7 FINAL RESULTS/DISCUSSION

The final results of the creation were earthenware jugs with the colors that followed the predicted emerging world trends in 2015. Followings were the photographs of the products:

Figure 14. The resulting products of the theme Alliance that would be further developed in the finishing process with doft and antique touches. (Photograph: Awaludin, 2014)

It was predicted that earthenwar jugs as interior complementary decoration would be one of the important elements of spatial design in 2015, which put the emphasis on minimalist rooms. Consequently, classic and antique shapes of the theme Alliance would give special impression of togetherness to the interior part of modern houses

Figure 15. Biomimetics

(Photograph: Awaludin, 2014)

The appearance of the resulting artistic ceramic products represented the mimetic aspects of nature such as bee nests, coralline, cocoon, etc. The mimicking of the nature was made by considering antique elements that gave the impression of simplicity and nature loving that represented present life style.

Figure 16. Adroit

(Photograph: Awaludin, 2014)

Adroit was the representation of joy and characterized by sexy and agile looks that gave the impression of living enthusiasm. Global society wanted agility in almost every aspect of their life that gave them joy and fun.

Figure 17. Veracious

(Photograph: Awaludin, 2014)

Antique colors gave the impression of simplicity and honesty and simple shapes gave the impression of sincerety and genuine look. The earthenware jugs above represented social concern and longing for honesty that was increasingly rare.

8 CONCLUSION

The coming design trends that were set by experts or a goup of people could be the standard designs in 2015. The prediction that was made in the creation gave the signal that the predicted trends would be able to provide producers with clear direction to the coming trends.

The successful creation of the 25 prototypes was very interesting experience becaue sometimes a finishing technique was found unwittingly and even it gave the product interesting characteristics. It was certain that the finishing has given new and unique characteristics that were different from those found in the prior products. Additionally, the huge local potential of the raw material and also local technology that has been long mastered by Indonesian craftsmen represented invaluable capital in developing world market. Therefore, it was necessaro to annually create new designs in the effort to follow the prediced coming world trends.

REFERENCES

[1] Bahagijo, Sugeng, ed., (2002), *Globalisasi Menghempas Indonesia*, LP3ES dan Perkumpulan Para Karsa, Jakarta.
[2] Denzim, Norman K., (1997), Qualitative Research, terj. Dariyatno (2009), Pustaka Pelajar, Yogyakarta.
[3] Fitinline (2014), **"**Kecenderungan Gaya Hidup 2014", platform untuk belajar tentang Fashion secara online (Fitinline.com). Yogyakarta.
[4] Kamus Besar Bahasa ndonesia (KBBI), (1991), Departemen Pendidikan dan Kebudayaan, Balai Pustaka, Jakarta.Kamus Ilmiah (2014) Kliping Artikel Ilmiah Indonesia beserta Kamus Ilmiah Online dalam bidang ilmu teknologi, sains dan social, http://www.kamusilmiah.com.
[5] Municipal, Camara (ed), (2009), Mude: Museu Do Design E Da Moda, Presselivre-Imprensa Livre S.A Custamer Publishing Division Lisboa.
[6] Naisbitt, John, (1995), *Megatrens Asia: Delapan Megatren Asia yang mengubah Dunia*, PT. Gramedia, Jakarta.
[7] Raharjo, Timbul (2011), *Globalisai Seni Kerajinan Keramik Kasongan*, Program Pascasarjana ISI Yogyakarta.
[8] (2012), Seni Kriya dan Kerajinan, Penerbit Program Pascasarjana ISI Yogyakarta, Yogyakarta.
[9] (2014)." Creative Batik Motif Design Based on Local Cultural Art and Natural, Environments, *ChinaUSA Journal,* Vol.13, No.1, 2014. David Publishing Company, New York, NY 10034.
[10] Sartika, Khairiyah (2014) "Indonesia Tren Forecasting: Re+Habitat, Tren Fesyen 2015/2016", Artikel, Indonesia Fashion Week, Jakarta.
[11] Subiharto, Joko, (2013), "Penciptaan Seni Kerajinan Gerabah Komudite Ekspor Berbasis Material Earthenware dan Teknologi Lokal", Penelitian Hibah Bersaing Tahun 1, Ditjen Pendidikan Tinggi (Dikti), Yogyakarta.
[12] eclectictrens.com, www.pinterest.com, 30 Juni 2014
[13] http:// veraciousverves.blogspot.com/, designyoutrust.com, veraciousthoughts. wordpress. com, 30 Juni 2014
[14] http://www.squidoo.com, blacklemag.com, voc.aliasclick.com
[15] www.the-capsule.com,latimesblogs.latimes.com, suzukigunungsahari.blogspot.com

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Innovation of Mechanical Machinery in Medieval Centuries Part I: Windmills, Water Wheels and Automatic Fountains

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ABSTRACT: The fascinating mechanical inventions aiming at the welfare of the human kind started from ancient Egyptians and continued development through different eras. In the medieval centuries, the Islamic civilization paid wonderful attention to mechanical engineering. Banu Mosa invented 100 ingenious devices including automatic fountains and automatic feedback level control systems. Al-Jazari invented 50 mechanical devices including automatic fountains, clocks, positive displacement pumps and robotics. Taqi Al-Din invented a 6-cylinder positive displacement pump. Those great inventers used clean-energy prime movers in the form of windmills, overshot water wheels and undershot water wheels (turbines). This paper focuses only on windmills, water wheels and automatic fountains.

KEYWORDS: Muslim civilization, Mechanical machinery inventions, Windmills, Water wheels, Automatic fountains.

1 INTRODUCTION

Mechanical machinery in the medieval centuries used clean sources of energy to generate motion and mechanical power. Different types of prime movers started to appear from the 9th century AC in Iraq and then spread to the east with various applications. The genius Arabic mechanical engineers invented windmills, overshot water wheels (turbines) and undershot water wheels and used them in different engineering machinery used for the welfare of the mankind. The role of Arabic/Muslim engineers in this field is clarified by a large number of researchers, scientists and mechanical engineers around the whole world.

Hill (1974) translated an annotated Al-Jazari manuscript on ingenious mechanical devices. As a mechanical engineers he reproduced some of the manuscript drawings and provided modern explanations for their operation. He also handled the Islamic technology up to Al-Jazari including the works of Banu Musa, Al-Khuwarizmi and Ridwan [1]. Hill (1977) a manuscript dated 1266 AC belonging to Ibn Muadh Al-Jayyani (died 1079 AC). He pointed out that Al-Jayyani treatise consists of 31 models in which models numbers 1-5 are very large toys similar to automatic clocks but without precise timing. While models numbers 6-20 and 27-30 are water clocks recording the hours by a moving automata. Models numbers 25 and 26 are raising water machines. Finally, models numbers 21-24 are war machines and 31 is a universal sundial [2]. Al- Hassan (1977) presented the manuscript of Al-Jazari after redrawing some of Al-Jazari machines with English letters concentrating on Al-Jazari machines for raising water. He provided an English-Arabic Glossary for the terms used in Al-Jazari manuscript [3]. Coomamswamy (1994) pointed out that the Museum of Fine Arts of Boston possesses six leaves of the Arabic manuscript on Automata. He inferred that Al-Jazari was first and foremost a craftsman and secondarily an author. His writing was intelligible and his diagrams were clear explaining his practical experience [4]. Hill (1998) claimed that until modern times there was no other document from any cultural area that provides a comparable wealth of instructions for the design, manufacture and assembly of machines like that of Al-Jazari who was a creative added several mechanical and hydraulic devices. The impact of Al-Jazari inventions (as he said) was seen in the later design of steam engines and internal combustion engines [5].

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Mansour (2002) pointed out that there were recorded contributions to the area of automatic control. He investigated the work of Banu Musa, Al-Muradi, Ridwan Al-Saati and Al-Jazari [6]. Shakerin (2004) provided a review of innovative fountains developed through history including Al-Jazari's fountains [7]. Hassaan (2004) introduced Banu Musa as the founders of feedback automatic control in the 9th century AC and reviewed their scientific activities with emphasis on their book "Kitab al-Hiyal" (Ingenious Mechanical Devices". He analyzed two of their level control systems [8]. Sindi (2005) clarified that some Arab clocks had their time pieces moved by water, burning candles and mercury. He pointed out the known historical event of the gift of Abbasid Caliph Haroon Al-Rashid (died 809 AC) to the French King Charlemagne which was a water clock, and how the French king was totally impressed by it [9]. Al-Hassan (2007) described the operation of the elephant clock of Al-Jazari and the characteristics of a physical model built and located in Ibn Battota Mall, Dubai. The model weighs 7.5 ton and has 7 m height. He also described some of Banu Musa inventions such as the mechanical jars [10]. Nadarajan (2007) declared mechanical devices was the most comprehensive and methodical compilation of the most current knowledge about automated devices and mechanics [11]. Al-Hasssan (2008) analyzed the geometric and physical principles lying behind the mechanical devices of Banu Musa with the help of basic line drawings and 3D computer generated representation. He presented the basic shapes of Banu Musa fountain outputs which are: lily, shield and spear styles. He referred to the use of Banu Musa of wind/water tutbine to alternate water shapes [12]. Uzun and Vatansever (2008) stated that Al-Jazari invented the crankshaft and some of the first mechanical clocks driven by water and weight. They said that his use of crankshaft came before the western engineers Francesco Martini and Leonardo Davinci [13]. Abdallah (2009) focused the light on the fact that Muslim scholars, inventors and mechanical engineers used dynamics of water and its power to design and control mechanical devices. He presented the elephant clock of Al-Jazari and its available physical model. He stated that this clock is classified as fine technology as it is used for amusement or for astronomical observation and computation [14].

Romshare and Zeghloul (2010) pointed out that two of Al-Jazari machines are most remarkable: his elephant clock and one of his water pumps. The elephant clock was the most sophisticated clock at that time, and the water pump used a crank-slider-like system which was the first known machine to use a crank [15]. Ambrosett (2010) pointed out that in the Arabic world from Baghdad to al-Andalos, mechanical culture and practice underwent an extraordinary development. She mentioned the work of Banu Musa, Al-Jazari and Al-Muradi as witnesses of the extraordinary level of development of the mechanical devices [16]. Masood (2010) declared that Banu Musa designed industrial and scientific machines. They described devices in their book about ingenious devices such that each one had a master piece of ingenuity [17]. Shuriye and Faris (2011) pointed out that in the Islamic history of knowledge, engineering ranked high and their engineeris have made immense contributions to this field. Early scholars including Al-Battani, Al-Bairuni, Al-Razi, Jabin Ibn Hayyan and Al-Zarqali have mastered engineering sciences for the service of mankind [18]. Bruton (2011) presented Al-Jazari elephant clock as in one of his manuscript copies and a physical model built for the clock. He also presented a physical model for Al-Jazari castle clock, a copy and physical model of his cup clock and one of his positive displacement pumps [19]. Ness et. al. (2011) described the adaptation of available techniques to deal with one of the practical problems experienced with music robots. They pointed out the mechanical birds playing piano as in the early 19th century. This means that they did not read the translation of Al-Jazari treatise by Donald Hill in 1974 [20]. Dergisi (2012) presented and described the colored design of Al-Jazari for the elephant clock and the two-cylinder positive displacement pump [21]. Still (2013) braised the work of Banu Musa , Al-Jazari as designers of programmable music players, humanoid automata that depicted many machines such as one that measures blood letting was established with a pair of automatic scribes [22]. Mangun (2014) acknowledged the Islamic civilization emerged around 750 and prolonged until around 1500 where theoretical studies, discoveries, innovation and inventions had been encouraged to improve the lives of people during the Islamic Golven Age [23]. Ul-Haque (2014) pointed out that in the Islamic society, several individuals and groups of scientists devoted their life towards mechanical engineering and automation. He talked about the three brothers (Banu Musa) and Al-Jazari and how they contributed to the development of mechanical engineering [24].

2 WIND MILLS

Banu Musa Bin-Shaker invented the wind mills in the 9th century AC [25]. They used it to drive a dynamic water fountain as illustrated in Fig.1.

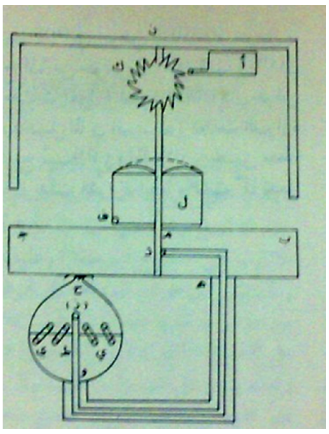

Fig. 1. Banu Mosa dynamic fountain [25].

The prime mover in the top of the dynamic fountain can work by water as shown in Fig,1, or can be a wind mill as stated Banu Musa in the description of their design [25].

Another design and application of wind mills was described by Mohammed Ibn AbiTalib Al-Dimashki (died 1326 AC). It was used in driving a seed mill. The design of the mill as described by Al-Dimashki is shown in Fig.2 [26]. The wind wheel consisted of 6 to 12 vanes rotors with air nozzles with narrow outlets to increase the air speed when striking the vanes. They put these mill machines over the houses in windy Asian zones.

Fig. 2. Seed mill of Al-Dimashki [26].

3 WATER WHEELS (TURBINES)

The Arabic mechanical engineers in the medieval centuries could differentiate between two types of water wheels: the undershot and the overshot water wheels.

3.1 UNDERSHOT WATER WHEELS

This type has been used in early stages by Banu Musa bin Shakir in the 9th century AC. They used it to drive the dynamic fountain shown in Fig.3 [25].

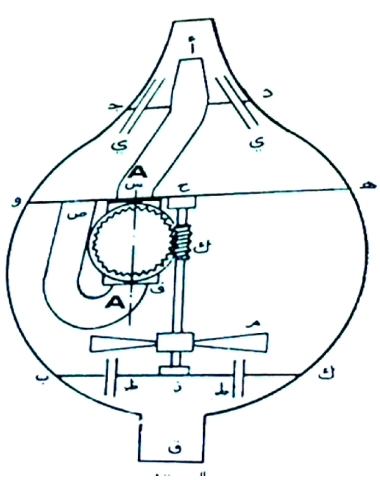

Fig. 3. Undershot water wheel of Banu Musa driving an automatic fountain [25].

Here, the water strikes the wheel vanes through nozzles guiding the flow vertically while the wheel itself is a horizontal one. Quite different design was used by the great mechanical engineer Ibn Al-Razzaz Al-Jazari in the late of the 12th century AC. In his design the wheel is vertical and the driving power comes from a water stream as shown in Fig.4 [27]. He used this undershot water when to drive a 2-cylinder positive displacement pump through a simple gear train.

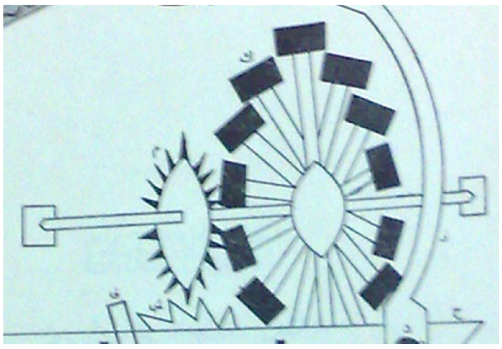

Fig. 4. Undershot water wheel of Al-Jazari [27].

In the 16th century AC, Taqi Al-Din ibn Ma'roof (died 1585 AC) used an undershot water wheel to drive a 6-cyliner positive displacement pump. His wheel is shown in Fig.5 [28]. The water wheel in this design drives a cam shaft having 6 out-of-phase cams.

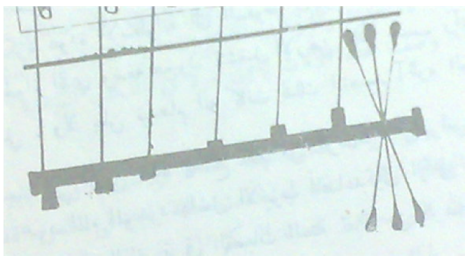

Fig. 5. Undershot water wheel of Taqi Al-Din [28].

3.2 Overshot Water Wheels

This design of overshot water wheels was first used by Al-Jazari of the 12th century AC. He used this type to drive a number of his mechanical inventions. Figs. 6 and 7 show two of his use of the overshot water wheels [27].

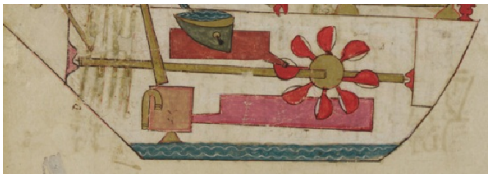

Fig. 6. Overshot water wheel of Al-Jazari – design 1 [27].

The wheel of Fig.6 drives an automatic band through a cam shaft and a timing cuff. Each cam drives a musician robot. In this design, the rotor is vertical and its hub is connected by stems to buckets.

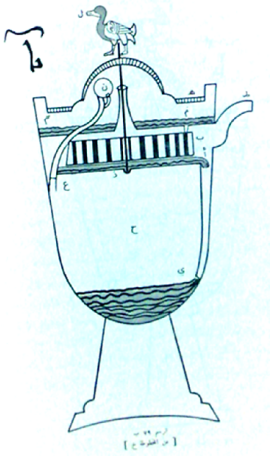

Fig. 7. Overshot water wheel of Al-Jazari – design 2 [27].

The application of Fig.7 is for driving a dummy duck located above a drinking jug. During filling the jug, the wheel rotates with the duck, the jug whistles. In this design, the rotor is horizontal and carries inclined vanes exerting horizontal force components to drive the wheel.

As a heavy duty application of overshot water wheels, Al-Dimashki of the 14th century AC described a twin-seed-mill each mill is driven by one wheel as illustrated in Fig.8 [26]. The water supply splits into two branches each ends with a nozzle striking the water wheel vanes from the top.

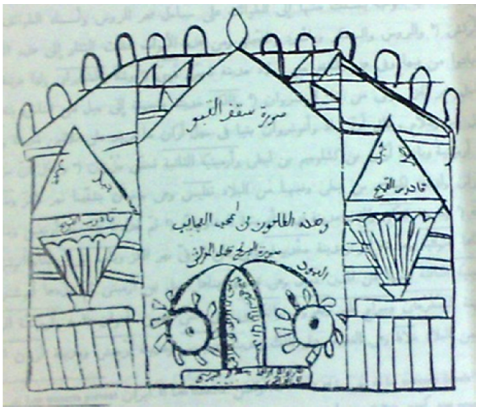

Fig. 8. Overshot water wheel of Al-Dimashki [26].

4 AUTOMATIC FOUNTAINS

Banu Musa bin Shakir invented a new generation of fountains. This type is different than the static type who has a fixed shape all the time. Their new fountains are dynamic since the shape of the fountain outlets change with time in a controllable manner. Figs.3 and 9 show two of their designs.

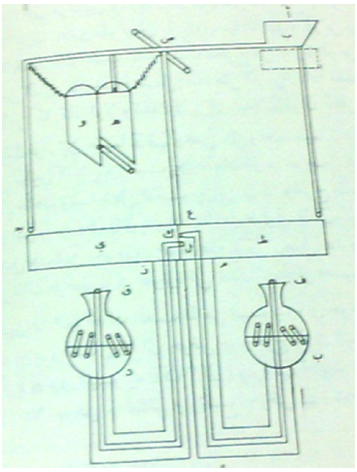

Fig. 9. Four outlets automatic fountain of Banu Musa [25].

The fountain design in Fig.3 provides two interchanging outlets, one as a bar and the other as a flower originating at the fountain outlet. It used a worm and wheel gear train driven by an undershot water wheel. They used the worm-wheel type to slow down the frequency of flow interchange in the two outlets . A specially designed flow control valve is driven by the wheel of the gear train to control the flow direction to one of the fountain outlets.

The fountain design in Fig.9 is quite different than that in Fig.3. Here, the fountain has four interchanging outlets (2 from each side). They used the lever balancing and the gravitational forces due to water accumulation in small tanks to control the direction of the flow to the fountain outlets. The lever is from the first type and its inclination due to the weight of either tanks near its ends directs the input water flow to one of the main tanks feeding both fountains. It is a generous idea which requires deep imagination to understand its operation.

Now, we move to the dynamic fountains of the great mechanical engineer, Al-Jazari. Figs.10 and 11 show two of AlJazari designs for the dynamic fountains [27]. The first AlJazari design of Fig.10 is for a two outlets dynamic fountain. The water flow direction is controlled by a first-class tube lever directing thee flow to two tanks each tank feeds one outlet of the fountain. As in Banu Musa designs, one of the fountain outlets is a water stream bar forwarded vertically, and the other takes the form of a flower. The timer required to control the duration of each fountain flow pattern consists of a cuff joined to the tank frame and a rigid pin secured to the cuff and used to drive the tube level changeover the flow from the right tank to the left tank and hence interchange the flow through fountain outlets. When the cuff is filled by water through the small tube feeding it, it comes into unbalance, pours its contents in the tank and comes to its original position ready to receive water again.

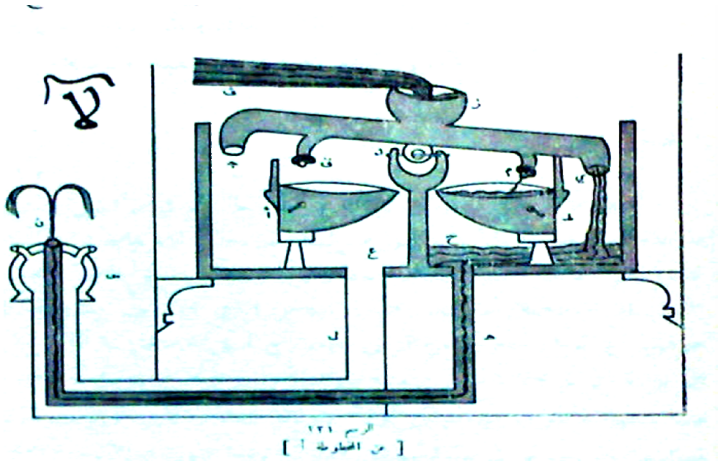

Fig. 10. Two outlets automatic fountain of Al-Jazari [27].

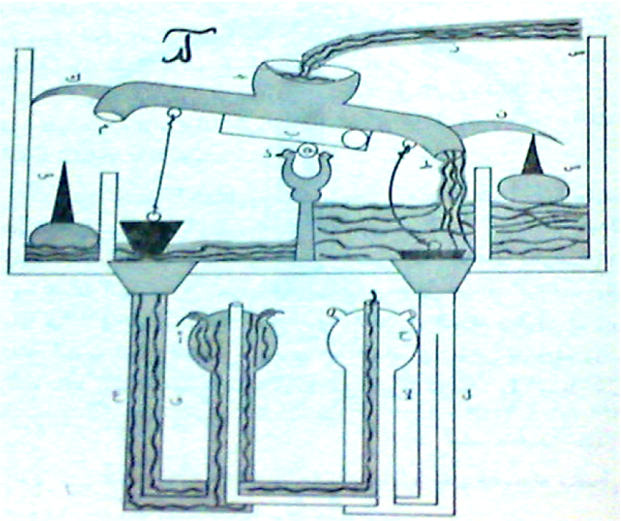

Fig. 11. Four outlets automatic fountain of Al-Jazari [27].

The second AlJazari design in Fig.11 is for a four outlets dynamic fountain. Here, AlJazari used a tube lever of the first class as in his design of Fig.10. However he control the timing of the interchange through using a small tank and a float used as a level sensor and has a sharp end stem used to drive a follower rigidly connected to the tube level. It is a sort of feedback action depending on the level in the large and small tanks which are connected to each other. A conical flow control valve driven by the tube-lever is used to control the direction of the flow each two outlets together as clear in Fig.11.

5 CONCLUSION

- The Arabic mechanical engineers put an important stone in the building of modern mechanical machinery since the 9th century AC up to the 16th century.
- They invented very important machinery such as the wind and water wheels and automatic fountains.
- Their discoveries helped the humanity through detailed description of their inventions in very clear manner written in manuscripts with two colors and colored drawing with complete labeling of the various elements of each machine.
- These inventions encouraged recent engineers to salute those engineers and keep their names known to the new generations of mechanical engineers through building models, making exhibitions, organizing conferences and putting their names on teaching classrooms in mechanical engineering departments.

REFERENCES

[1] D. Hill, "The book of knowledge of ingenious mechanical devices", D. Reidal Pub. Co., USA, 1974.
[2] D. Hill, "A treatise on machinery by Ibn Muadh Abu Abdallah Al-Jayyani", Journal for the History of Arabic Science, Vol.1, No.1, pp.33-46, 1977.
[3] A. Al-Hassan, "The Arabic text of Al-Jazari", ibid, pp.47-64.
[4] A. Coomamswamy, "The treatise of Al-Jazari on automata", Museum of Fine Arts, Boston, 1994.
[5] D. Hill, "Studies in medieval Islamic technology from Philo to Al-Jazari", Edited by D. King, Aldershot, Eng/Brookfield, Ashgate, 1998.
[6] M. Mansour, "A review of early Muslim control engineering", www.muslimheritage.com/article/review-early-muslim-control-engineering (2002).
[7] S. Shakerin, "Water fountains blend art and engineering: A resource for engineering education", Proceedings of the 2004 American Society for Engineering Education Annual Conference and Education, 2004.
[8] G. A. Hassaan, "Banu Musa, the founders of automatic control in the 9th century", Proceedings of the MDP-8, Cairo University Conference on Mechanical Design and Production, Cairo, Egypt, 1-6 January, 2004.
[9] A. Sindi, "Arab civilization and its impact on the west", www.radioislam.org/sindi/arab.htm (May 2005).
[10] S. Al-Hassani, "1001 inventions: Muslim heritage in our world", Foundation for Science Technology and Civilization, 2007.
[11] G. Nadarajan, "A reading of Al-Jazari's book of ingenious mechanical devices (1206)", Foundation for Science Technology and Civilization, pp.1-16, August, 2007.
[12] S. Al-Hassani, "The self changing fountain of Banu Musa bin Shakir", http://muslimheritage.com/article/self-changing-fountain-banu-musa-bin-shakir (2008).
[13] A. Uzun and F. Vatansever, "Ismail Al-Jazari machines and knowledge", Acta Mechanica, Vol.2, No.3, 2008.
[14] M. Abdallah, "Art and Science of feedback control", Cleveland State University, Department of Electrical and Computer Engineering, February, 2009.
[15] M. Ceccarelli (Editor), "Distinguished figures in mechanisms and machine science", Springer, 2010.
[16] N. Ambrosetti, "Cultural roots of technology: an interdisciplinary study of automated systems from the antiquity to the renaissance", Ph.D. Thesis, Universta Degli Studi di Milano, 2010.
[17] E. Masood, "Ingenious devices", Al-Noor, Vol.28, No.2, February, 2010.
[18] A. Shuriye and W. Faris, "Contributions of early Muslim scientists to engineering studies and related sciences", Iium Press, Malaysia, 2011.
[19] M. Bruton, "Opportunities created by acknowledging the multi-cultural roots of science", 6th Science Center World Congress, September, 2011.
[20] S. Ness et. al., "Music information robotics: coping strategies for musically challenged robots", 12th International Society for Music Information Retrieval Conference, pp.567-572, 2011.
[21] Y. Dergisi, "Mekanigin ortacaggdaki ustalari", http://temizyasam.net/php/index.php?option=com_content&task=view&id=1262&Itemid=2 (November 2012).
[22] C. Still, "A survey of Andalos and audiences: 285BCE to the present day", Degree of Master of Arts, Simon Fraser University, Canada, 2013.
[23] M. Mangun, "Early Muslim scholars contribution in modern mathematics and modern engineering", International Islamic University, Malaysia, Report Paper, 5th April, 2014.
[24] A. Ul-Haque, "Automation and Muslim scientists", International Journal of Pathol., Vol.12, No.1, pp.52-56, 2014.
[25] Banu Musa bin Shakir, "The book of ingenious devices", Edited by A. Y. Al-Hassan, University of Aleppo, 1981.
[26] Mohammed Al-Dimashki, "Elite eternity in the wonders of land and sea".
[27] Ibn Al-Razzaz Al-Jazari, "A compendium on the theory and practice of the mechanical arts", Edited by A. Y. Al-Hassan, University of Aleppo, 1979.
[28] Taqi Al-Din ibn Ma'roof, "Lighting ways in spiritual machines", University of Aleppo, 1976.

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Politicizing Trauma and Desire in American Cinema: World Trade Center (2006) and The Kingdom (2007)

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ABSTRACT: Any understanding of historical trauma today needs to attend to the roles that discourses about and representations of trauma play in struggles over identity and the meanings of the past. The approach this essay has undertaken to investigate is one that makes a reference point of 9/11 as a historical trauma and thereby makes a case for the political significance of violence, terror, civilizational barbarism and colonial desire engendred by this "traumatic" event. This essay focuses mainly on the structural traumatic violence of the image that works in conjunction with the sovereign violence and barbarism of the state and capitalism as a desiring machine. It is in the context of colonialism as a desiring capitalist machine and a group fantasy and empathy that this thesis considers the work of Deleuze, Guattari and Walter Benjamin. As far as the structure is concerned, this essay is split into two sections. The first section aims to investigate the connections between traumatic memory and empathy and between traumatic memory and paranoid investment of social energies as represented in *World Trade Center* (2006) and *The Kingdom* (2007). This fascistic investment of desire impedes the utopian dimension of traumatic memory that has the impulse to imagine a better future. The second section examines the violent physical and historical material procedures of American neocolonialism and its ideological operations as represented in *The Kingdom* (2007). It considers the links between capitalism, colonialism and spatiality as articulated by Deleuze and Guattari.

KEYWORDS: Historical trauma, civilisational barbarism, colonial desire, empathy, traumatic memory, capitalism.

1 TRAUMA AND COLONIAL DISCOURSE IN *WORLD TRADE CENTER* AND *THE KINGDOM*

1.1 EMPATHIZING AND IDENTIFYING WITH THE VICTOR AND/OR THE VICTIM IN *WORLD TRADE CENTER* AND *THE KINGDOM*

In thesis VII "On the Concept of History" Benjamin Writes--

Consider the darkness and the great cold

In this vale which resounds with misery.

Brecht, *The Threepenny Opera*

> To historians who wish to relive an era, Fustel de Coulanges recommends that they blot out everything they know about the later course of history. There is no better way of characterizing the method with which historical materialism has broken. It is a process of empathy whose origin is the indolence of the heart, acedia, which despairs of grasping and holding the genuine historical image as it flares up briefly. Among medieval theologians it was regarded as the root cause of sadness. Flaubert, who was familiar with it,

> wrote: "Peu de gens devineront combien il a fallu être triste pour ressusciter Carthage".The nature of this sadness stands out more clearly if one asks with whom the adherents of historicism actually empathize. The answer is inevitable: with the victor. And all rulers are the heirs of those who conquered before them. Hence, empathy with the victor invariably benefits the rulers. Historical materialists know what that means.[1]

Benjamin's most cited thesis VII "On the Concept of History" in trauma theory constellates two dialectic concepts. Empathy and barbarism can be conceived of as a "dialectic image" which generates an aporia, hence a rethinking of the way one should approach traumatic memory and images. Here we may refer to Giorgio Agamben's biopolitical theory of sovereignty and his concept of "bare life"[2], the reduction of the human individual to mere biological existence, and highlight how trauma is embedded in larger ideological formations. After all, what does identification and empathy with the victim assume? Simply put, it assumes a progressive liberal account of social relations. However, this claim is not as simple as that. With whom are we going to empathize? Is it with the victim or with the victor? How can we discriminate between the victim and the victor? Is there some universal moral and ethic value on which we can constitute empathy and identification? If there is some, is it not articulated and appropriated in a way that makes it tainted and untenable? After all--

> There is no document of civilization which is not at the same time a document of barbarism. And just as such a document is not free of barbarism, barbarism taints also the manner in which it was transmitted from one owner to another.[3]

If so, how can we argue for a certain universal ethics on which we articulate a theory of empathy when history itself resists any? The "moment of danger" arises when the communities of grieving and mourning that quickly formed through the aid of news media and other information networks tended to put aside political analysis in response to a perceived need for empathy and human solidarity. A sense of national identity, or identification with the West, emerged strongly in many intellectuals' responses to 9/11, including those involved in contemporary trauma studies. 9/11 was certainly, in Benjamin's memorable phrase, a "moment of danger" in which the "true image of the past" must be seized from uncritical narratives of progress and homogeneous constructions of historical time. For what is lost in the gradual transformation and increasing centrality of trauma as a concept in cultural criticism is a sense of power and violence that traumatize individuals and populations in the first place.

Trauma theory, by focusing increasingly on how trauma is transmitted across time, has lost its grasp of the dynamics of group identification and social exclusion that was a central concern of Freud's, Benjamin's and Adorno's theories of historical trauma. What I found invaluable in Benjamin, Adorno and Agamben is the lost copula between trauma transmission and barbarism, between trauma as a structure and trauma as a historical document, between trauma poetics and trauma politics. Ipso facto, in this section I demonstrate how Hollywood appropriated the traumatic events of 9/11 with the position of the victim to generate a form of empathy that serves as a means to avoid guilt and responsibility.

---

[1] *Walter Benjamin, Illuminations. Trans. Harry Zohr. Ed. Hannah Arendt. (NY: Schocken Books, 1968).*

[2] *See for example Agamben's Homo Sacer: Sovereign Power and Bare Life. Trans. Daniel Heller-Roazen. (Stanford: Stanford UP,1988), Alison Ross's "Introduction". The Agamben Effect. South Atlantic Quartly. Vol. 107: 1. (Duke UP, Winter 2008), or Agamben's The Open Man and Animal. Trans. Kevin Attell. (California: Stanford UP, 2004)*

[3] *Ibid., 256*

Figure 8: World Trade Center[4] (2006)

Figure 9: World Trade Center (2006)

Figure 10: World Trade Center (2006)

Figure 11: World Trade Center (2006)

[4] *World Trade Center. Screenplay by* Andrea Berloff. *Dir. Oliver Stone. Perf. Nicolas Cage, Maria Bello, Michael Peña, Maggie Gyllenhaal and Michael Shannon.* Paramount Pictures, 2006. Film.

Figure 12: World Trade Center (2006) ***Figure 13: World Trade Center (2006)***

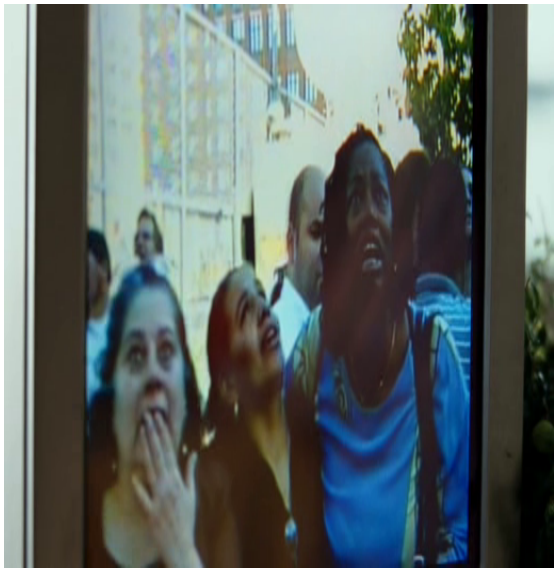

Figure 14: World Trade Center (2006)

In an interview with Giovana Borradori, Derrida said, "In situations and cultures where the media do not spectacularize the event, the killing of thousands of people in a very short period of time might provoke fewer psychic and political effects than the assassination of a single individual in another country, culture, or nation-state with highly developed media resources."[5] The influence of media on 9/11 as a historical event is undeniable and logical. The images above are extracted from a newsreel footage in *World Trade Center.* What do these images add to 9/11 as a catastrophic event which took place inside America? In a news footage in *World Trade Center*, a news anchorman says—

[5] *Giovanna Borradori, Philosophy in Time of Terror: Dialogues with Jürgen Habermas and Jaques Derrida. (London : Chicago UP, 2003), 108-109*

> I'll leave that to you to determine just how widespread the human loss will be in New York City alone. America has changed today. This is a dark day in this country. It's in bold print in future history books about how America was attacked within its continental borders to devastating effect by terrorists in a coordinated assault using hijacked civilian airliners.

However, it is untenable that "America has changed today" though "It's in bold print in future history books about how America was attacked within its continental borders". The point made here is that 9/11 is a media industry; this is not to say that 9/11 was not a catastrophe in American history. Rather, it is so but one which is directed by a dominated and dominating apparatus. Media now should better be considered as a source of influence and authority. Since discourse plays a vital role in constituting people's realities, the implications for the power and influence of media discourse are clear. Nevertheless, 9/11 events are not only a product of media, but a process; to understand the images above we need to look at both the text itself and the interaction and context that the text is embedded in. The function of the images above is to constitute a community of witnesses that is basically based on empathy and identification. The problematic with these images is that they are embedded in a broader cultural context which puts emphasis on empathy. Nevertheless, empathy assumes a liberal conception of individual agency that cannot adequately account for the political violence that is the cause of so much traumatic experience. The images represent not only the reaction of American community but also the reaction of world communities to 9/11. What the newsreel footage in *World Trade Center* foregrounds is the identification and empathy of the world with America.

The sacralization of 9/11 by media is not the first in history of trauma industry. We have the example of the Holocaust as an industry of event uniqueness. In *The Holocaust Industry*, Norman Finkelstein writes--

> At the most basic level, every historical event is unique, if merely by virtue of time and location, and every historical event bears distinctive features as well as features in common with other historical events. The anomaly of The Holocaust is that its uniqueness is held to be absolutely decisive. What other historical event, one might ask, is framed largely for its categorical uniqueness? Typically, distinctive features of The Holocaust are isolated in order to place the event in a category altogether apart. It is never clear, however, why the many common features should be reckoned trivial by comparison.[6]

This is to say that the singularity of the Jewish sufferings adds to the moral and emotional claims that Israel can make on other nations. The Holocaust, which pointed to the peculiar distinctiveness of the Jews, gave Jews the right to consider themselves specially threatened and specially worthy of whatever efforts were necessary for survival. The same thing can be said about 9/11catastrophe. By conferring total blamelessness on Americans, as the extreme example of the perpetrators of Abu Ghraib demonstrates, 9/11 as a terrorist attack immunizes America from legitimate condemnation. This is the "moment of danger" of appropriating memory Benjamin warns against. The invasion of Iraq is not very far from us. Let's think about the atrocities committed against the civilian population in Iraq, not to mention Afghanistan.

The methodology used here is derived from the Brechtian and Benjaminian sense of shock. What Brecht and Benjamin refuse is the "Aristotelian catharsis, the purging of the emotions through identification with the destiny which rules the hero's life".[7] The method used here is interruption, for one of its aspects is the quote; quoting a text implies interrupting its context. The extraction of the images above from their context and commenting on them is an act of turning the visceral into the cerebral. I now move to the American film *The Kingdom*[8], directed by Peter Burg and produced in 2007, to examine the way empathy can be produced through the work of editing to serve American political and ideological agenda.

When a terrorist bomb detonates inside an American oil company housing compound in Riyadh, Saudi Arabia, killing many Americans and Saudis in the process, an international incident is ignited. While diplomats slowly debate equations of territorialism, FBI Special Agent Ronald Fleury quickly assembles an elite team and negotiates a secret five-day trip into Saudi Arabia to locate the terrorist behind the bombing. Upon landing in Saudi kingdom, however, Fleury and his team discover Saudi authorities suspicious and unwelcoming of American interlopers into what they consider a local matter. Hamstrung by protocol, the FBI agents find their expertise worthless without the trust of their Saudi counterparts, who want to locate the "terrorist" in their homeland on their own terms. Fleury's crew finds a partner in Saudi Colonel Al-Ghazi, who helps them

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[6] *Norman G. Finkelstein, The Holocaust Industry: Reflections on the Exploitation of Jewish Suffering. (London: Verso, 2000), 24*

[7] *Walter Benjamin, Understanding Brecht. Trans. Anna Bostock. (London: verso, 1998), 18*

[8] *The Kingdom. Dir. Peter Berg. Perf. Jamie Foxx, Chris Cooper, Jennifer Garner, Jason Bateman, Ashraf Barhom, Ali Suliman. Screenplay by Matthew Michael Carnahan. 2007, Universal Pictures. Film*

navigate royal politics and unlock the secrets of the crime scene and the workings of a terrorist cell bent on further destruction. With these “unlikely” allies sharing a propulsive commitment to crack the case, the team is led to the killer's front door in a blistering and bloody confrontation which ended in Abu Hamza’s and Colonel Al-Ghazi’s deaths.

Figure 15: Shot 1, The Kingdom (2007)

Figure 16: Shot 2, The Kingdom (2007)

Figure 17: Shot 3, The Kingdom (2007)

Figure 18: Shot 4, The Kingdom (2007)

Figure 19: Shot 5, The Kingdom (2007)

Figure 20: Shot 6, The Kingdom (2007)

Figure 21: Shot 7, The Kingdom (2007)

Figure 22: Shot 8, The Kingdom (2007)

Figure 23: Shot 9, The Kingdom (2007)

Figure 24: Shot 10, The Kingdom (2007)

Figure 25: Shot 11, The Kingdom (2007) ***Figure 26: Shot 12, The Kingdom (2007)***

Appropriating memories to sustain an order of discourse is done through a process of dividing labour. The role of Hollywood is not to aesthetisize or even to politicize art, because art had been already politicised. Appropriating memories is itself art, because, after all, there is no such memory as 'it really was". Memories are not somewhere in the distance, waiting to be relived either in our imagination, in Derrida's "mystic writing pad", or to be recreated through photography by a "camera lucida". As the images above from *The Kingdom* demonstrate, tendentious use of the camera is not at all innocent. With whom are the audience in general going to empathize, whether consciously or unconsciously? This is not a difficult question to answer "if one asks with whom the adherents of historicism actually empathize. The answer is inevitable: with the victor. And all rulers are the heirs of those who conquered before them. Hence, empathy with the victor invariably benefits the rulers". If we take into consideration the way images are ordered to produce a coherent narrative that makes the audience empathize with the victor in *The Kingdom*, we will begin to refuse, in Brechtian sense, the Aristotelian catharsis, the purging of the emotions through identification with the destiny which rules the hero's life and adventure. This is the dialogue interchanged at the Clark Griffith Elementary School, Washington, D.C in *The Kingdom*--

> **Kevin Fleury**: And this is the skateboard that my Grandma Ruth gave to me. This is my fish Jaws. And he's a really neat fish. And this is the day that my daddy says is the happiest day of his life.
>
> **Miss Ross**: Can you tell us about that day, Mr. Fleury?
>
> **FBI Special Agent Ronald Fleury**: Yeah. You guys want to hear it? You want to hear the story? Do you want to hear about that day? Well, I'll tell you what. This is December and we were at the hospital all day and most of the night. And we was waiting on this little man to come out. And then all of a sudden the doctor showed up and said, 'He's not coming out.' 'We got to go in and get him.' Like a search team, right? So what she did was...You sure I can tell this story? Yeah, go ahead. So what happened was, is they took a tiny little knife then cut right underneath the belly button, and they opened her up and then took her hands and stuck them all the way in her belly and disappeared. And she was in there just rustling and rumbling and looking for something. Then she started pulling and pulling and pulling and pulling and she was pulling, and all of a sudden she stopped! Then she looked at me and said, 'Mr. Fleury, are you ready to have your world rocked?'And I said, 'Well, I guess so. 'And so she starts pulling and pulling and all of a sudden a head popped out. And I looked down and I said, 'Kevin!' And then he looked back at me and he said...Daddy! Daddy! Yeah. And that was...That was the happiest day of my life.
>
> **GIRL**: Say that again!

What Deleuze and Guattari say, in *Anti-Oedipus*, on the concept of "deterretorialization" of desire in relation to family is worth quoting at some length--

> The family becomes the subaggregate to which the whole of the social field is applied. Since each person has his own private father and mother, it is a distributive subaggregate that simulates for each person the collective whole of social persons and that closes off his domain and scrambles his images. Everything is reduced to the father-mother-child triangle, which reverberates the answer "daddy-mommy" every time it is stimulated by the images of capital. In short, Oedipus arrives: it is born in the capitalist system of the application of first-order social images to the private familial images of the second order. It is the aggregate of destination that corresponds to an

> aggregate of departure that is socially determined. It is our intimate colonial formation that corresponds to the form of social sovereignty. We are all little colonies and it is Oedipus that colonizes us. When the family ceases to be a unit of production and of reproduction, when the conjunction again finds in the family the meaning of a simple unit of consumption, it is father mother that we consume. In the aggregate of departure there is the boss, the foreman, the priest, the tax collector, the cop, the soldier, the worker, all the machines and territorialities, all the social images of our society; but in the aggregate of destination, in the end, there is no longer anyone but daddy, mommy, and me, the despotic sign inherited by daddy, the residual territoriality assumed by mommy, and the divided, split, castrated ego.[9]

The dialogue interchanged, at the Clark Griffith Elementary School, Washington, D.C, between Roland Fleury, Miss Ross and his son Kevin evinces the role the family or the "Oedipal triangle", the father-mother-child triangle, has in decoding flows and reterritorializing the deterritorializing flows. Oedipus is this displaced or deterritorialized limit where desire is oriented. We should understand that the family corresponds to all capitalism's efforts to social reterritorialization. The shot-sequence and the dialogue above provide us with what we may call, in the wording of Benjamin, "a dialectic image", a "monad", or a "constellation". The constellation of the images together with dialogue presents a comparison between Abu Hamza al-Masri and his unnamed son, on one side, and Ronald Fleury and hid son Kevin on the other. What kind of comparison do the dialogue and the images try to establish through editing that is itself governed by an order of discourse which is not only a sequel of an orientalist and "cultural strength" as Said argues in Both *Orientalism*[10] and *Culture and Imperialism*[11], but also of an economic and capitalist strength?

Simply put, the family of Kevin is a civilized and human family, whereas the family of Abu Hamza, and because of Abu Hamza, is barbaric and terroristic. Kevin is in Washington, D.C, and Abu Hamza's son is in Riyadh in the far desert, watching a well-planned terroristic attack on the American oil company housing compound in Riyadh through binoculars. The distance in place is also a distance in origin, race, and time. As the images show, Kevin is raised in a civilized society represented by Clark Griffith Elementary School, Miss Ross, his classmates, his father, etc. whereas the son of Abu Hamza is raised in a hostile and barbaric environment. Speaking about The Falling Man[12], the photographer Richard Drew describes the camera as "a filter" between himself and the events he is photographing. Drew says, 'I see this not as this person's death but as part of his life. There is no blood. There is no guts. It is just a person falling". Can Abu Hamza's binoculars function here as ''a filter'' between his son and the events he is watching? Are these events, for both Abu Hamza and his son, about just people dying there in the housing compound in Riyadh? For whom the people are just bare lives, for al-Qaeda or for the United States of America?

There is in figure 22, shot 4 in the above image-sequence two words relevant to our analysis here and which can be explained by a detour through Deleuze and Guattari's concept of family 'deterritorialization' of desire. In *Anti-Oedipus*, Deleuze and Guattari write--

> The father is first in relation to the child, but only because what is first is the social investment in relation to the familial investment, the investment of the social field in which the father, the child, and the family as a subaggregate are at one and the same time immersed.[13]

It is the concept of ''the family as a subaggregate'' which makes of a child like kevin or Abu Hamza's a social investement, because ,after all, the family is the productive machine or apparatus through which societies distribute their values and norms. The two words are ''family' and ''laws'' and between them there is Kevin. What can we make of them in this analysis? First, they are not there coincidentally. Following Benjamin, no image can claim finality for itself. For I think that there is something traceable in this image. Kevin is an investment of the family which is itself an object of the investment of desire in society. Through their families Kevin and Abu Hamza's grasp, underneath the triad of father-mother-child, the

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[9] *Gilles Deleuze and Félix Guattari. Anti-Oedipus: Capitalism and Schizophrenia. Trans. Robert Hurley, Mark Seem and Helen Lane. (MN: MN UP, 1983), 265*
[10] *Edward W. Said. Orientalism. NY: Penguin, 1978.*
[11] *Edward W. Said. Culture and Imperialism. London: Chatto and Windus, 1993.*
[12] *The Falling Man. Dir. Henry Singer. Eds. Alan Mackay and Ben Stark. Produced by Henry Singer. Darlow Smithson, 2006. Documentary.*
[13] *Ibid., 276*

economic, financial, social, and cultural problems. Their sense of belonging or the desire to belong to a ''superior'' and ''civilized'' or a ''barbaric'' and ''inferior'' race is ordained as an 'idée fixe' at that age. 'There is no document of civilization which is not at the same time a document of barbarism. And just as such a document is not free of barbarism, barbarism taints also the manner in which it was transmitted from one owner to another'.

1.2 RELATING COLONIAL DISCOURSE AND DESIRE IN *THE KINGDOM* (2007)

In *Colonial Desire: Hybridity in Theory, Culture and Race*, Robert J. C. Young writes--

> It is in the context of the widespread idea of the Empire *as machine* that I want to consider the work of Deleuze and Guattari; they offer, I suggest, not something that could be described as an alternative to Said's paradigm, but a related though different way of thinking about some of the operation of colonialism, particularly *not just as a form of fantasy but also as a form of ambivalent desire*. In the first place, *the Anti-Oedipus has the advantage of decentring colonial analysis away from the East towards a more global surface*. It also redirects our attention towards two obvious but important points *that tend to get lost in today's emphasis on discursive constructions—the role of capitalism as the determining motor of colonialism, and the material violence involved in the process of colonization*. The attraction of Deleuze and Guattari's argument from a theoretical point of view is similarly the way in which philosophy, psychoanalysis, anthropology, geography, economics *et al*. are all brought together in one interactive economy and shown to be implicated in capitalism's colonizing operations.[14]

As Robert Young noted in this book, Deleuze and Guattari's *Anti-Oedipus* is virtually absent from discussions of postcolonial studies. For Robert Young, this is may be due to its complexity. What I want to do here in this section is to formulate a copula between trauma and neocolonialism, between desire and Orientalism, and between Orientalism and capitalism. Colonial discourse analysis began as an academic discipline with the publication of Edward Said's *Orientalism* in 1978. In *Orientalism*, Said explicates the relation between representations used in literary texts, travel accounts, memoirs and academic studies across a range of disciplines in the humanities and social sciences, and the diverse ideological practices of colonialism. *Orientalism* provides evidence of the complicity between politics and knowledge.

The colonial Western expansion into the East was doubtless determined by economic factors, but, for Said, Orientalism was not simply determined by such factors. For Said, it is difficult to reduce the cultural into the economic. Texts about the Orient "can create not only knowledge but also the very reality they appear to describe. In time such knowledge and reality produce a tradition, or what Michel Foucault calls a discourse, whose material presence or weight, not the originality of a given author, is really responsible for the texts produced out of it"[15]. Simply put, the Orient is itself an Orientalist concept. However, as Robert C. Young puts it--

> After all, if Orientalist discourse is a form of Western fantasy that can say nothing about actuality, while at the same time its determining cultural pressure means that those in the West cannot but use it, then any obligation to address the reality of the historical conditions of colonialism can be safely discarded. Such colonial-discourse analysis has meant that we have learnt a lot about the fantasmatics of colonial discourse, but at the same time it has by definition tended to discourage analysts from inquiring in detail about the actual conditions such discourse was framed to describe, analyze or control.[16]

There is in *The kingdom* (2007) by Peter Berg what can help us understand the violent physical and historical material procedures of neocolonialism and its ideological operations. I based my analysis of this movie on Deleuze and Guattari's concepts of "territorialization" and "deterritorialization" because they, as Robert Young writes it, "have produced a theory of capitalism to which the operation of colonialism as a form of writing geography is central"[17]. Like capitalism which works as a "territorial writing machine", colonialism or neocolonialism, two sides of the same coin of exploitation, decodes or deterritorializes the territory and cultural space of an indigenous society and then reinscribes or reterritorializes it according to the needs of the apparatuses of the occupying power.

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[14] *Robert C. Young, Colonial Desire: Hybridity in Theory, Culture and Race. (London: Routlege, 1995), 158. (Emphasis added)*
[15] *Ibid., 94*
[16] *Young, 152*
[17] *Young, 161*

The opening scene of the film explains, through a timeline sequence, the origins of U.S.-Saudi diplomatic relations and how the discovery of energy resources has transformed the Middle East. It portrays the conflicts that have arisen since the late 1940s for the ownership of the oil industry, including the Persian Gulf War in Iraq and al-Qaeda's growing network of terrorism. Eventually, it explains the 9/11 terrorist attacks and the fact that the majority of the hijackers were Saudis. These are the indistinct radio transmissions of the opening scene of *The Kingdom*--

Narrator 1: After capturing most of the Arabian Peninsula with the help of the Wahhabi Islamic warriors, Ibn Saud establishes the Kingdom of Saudi Arabia.

Narrator 2: The Wahhabis were fiercely anti-Western. They want to go back in time to a pure Islam that wasn't threatened by the West.

Saudi Ruler: It was by chance that we discovered oil. We were looking for water.

Narrator 3: Despite criticism of foreign presence in the Kingdom, the King allows commercial oil production to begin.

Female Narrator 1: The result is the first union between Saudi Arabia and the United States.

Narrator 4: To accommodate the workforce the first Western housing compounds are created.

Newscaster 1: The strict Islamic laws enforced outside of these walls do not apply inside.

Newscaster 2: West and East came together in Egypt when President Roosevelt and Ibn Saud, King of Arabia...

James Baker: *They want America present there in the kingdom because we are their security*. (Emphasis added)

Narrator 5: The Saudi elite became notorious big spenders and lost credibility and respect among religious conservatives.

Narrator 6: In response to the U.S. Support of Israel in the Arab-Israeli War, Wahhabi Muslims pressured the Saudi monarchy to stop pumping oil.

Narrator 7: Those who control the flow of oil hold the Western world hostage.

Female Narrator 2: Prices quadruple.

Narrator 8: *Oil was an American national security priority* . (Emphasis added)

Narrator 9: *The embargo redefined the balance of power between the oil consumers and oil producers*. (Emphasis added)

Reporter 1: Iraq's battle-trained army swept across Kuwait's borders at first light.

Reporter 2: As a Saudi national, Osama bin Laden offered his services to the Royals.

Reporter 3: He told them he could bring his army from Afghanistan to repel the Iraqi invaders from Kuwait.

Narrator 10: *But the Saudis had a better offer. A half-million troops from the United States. His offer rejected, Osama took to the streets and mosques to denounce the U.S., the Royal Family and their unholy alliance*. (Emphasis added)

Female Narrator 3: Osama bin Laden this week again lashed out at the Saudi Royal Family.

Saudi Official: We were tracking bin Laden since the early '90s. We stripped him of his citizenship.

Man: *When it became clear that 15 of the 19 were Saudis, that was a disaster. A total disaster. Because bin Laden, at that moment, had made, in the minds of Americans, Saudi Arabia into an enemy*. (Emphasis added)

We are with you to get to...The perpetrators of this cowardly attack.

How dare they say they are Muslim!

Narrator 11: This is a nation where tradition and modernity are in violent collision.

Reporter 4: The Al Qaeda is thought to have been behind the bombing. A team of F.B.I. Agents prepares to investigate the attack in Saudi Arabia.

Female Narrator 3: The latest terrorist attacks showcase the great division between the pro-U.S. Monarchy and the extremist Wahhabi militants within the kingdom.

What is the relevance of Oedipus to our analysis here? We should understand that Oedipus is not simply the psychological structure through which all humans pass to mental, sexual and social matureness. Oedipus is also the means through which the flow of desire is encoded and--

> "inscribed within the artificial reterritorializations of repressive social structure —the family, the party, the nation, the law, the educational system, the hospital, psychoanalysis itself. The disruptive effect of the colonial space upon the claims of psychoanalysis, by demonstrating that the Oedipus complex is not universal outside the operations of capitalism, but is significant for the theory in providing the basis of the proof that Oedipus consists of a limit-case and therefore a form of ideological reterritorialization"[18].

The colonial subject is a construct of internalized cultural and political forms that condition their psychic reality and determine their social experience.

Following Robert C. Young, Deleuze and Guattari's concept of "territorialization" is particularly important in the context of colonialism and involves three implications. It should be stressed here that for Deleuze and Guattari, deterritorialisation can be physical, mental or spiritual. Deterritorialization constitutes the edge cutting of an assemblage. First, colonialism above all is the physical appropriation and exploitation of land for the interests of another culture. Cultural colonization was not just a discursive process but a seizure of cultural space, and imperialism is but one side of colonialism, another one is the colonialism of 'commerce and cultivation'. Secondly, the State is frequently regarded as a territorial indicator of the arrival of "civilization" over "primitivism" or "barbarism". Colonialism, after all, thrives on appropriation and enclosure of land and territory. Territory for Deleuze and Guattari is an experiential concept that has no fixed subject or object. In other words, territory is an empty signifier that resists representation. Territory is subject to movement and inscription. It is an outcome of processes of "deterritorialisation" and "reterritorialisation". Simply put, it is subject to different types of colonialism as well as imperialism. The third implication of "territorialization" and the most pertinent to our analysis here is the violence of both the colonizer and the colonized which is emanated from colonialism. "Here capitalism is", writes Robert Young, "the destroyer of signification, the reducer of everything to a Jakobsonian system of equivalences, to commodification through the power of money [….] *Commerce, by reducing everything in a society to a system of universal equivalency, to a value measured in terms of something else, thus performs an operation of cultural decoding that works according to the linguistic form of metaphor*."[19]

In *The Kingdom* there is Al Rahmah American Compound in Riyadh, Saudi Arabia, that indicates an act of territorializaion, or of deterritorialization of what is already territorialized. Saudi Arabia is a kingdom which is governed by strict Islamic laws; if I can put it in this way, it is a state which resisted, through Wahabism, the Western anti-Oedipus laws in favor of a Wahabi strictly conservative anti-Oedipus believes. As the narrator two in the radio transmissions of the opening scene of *The Kingdom* puts it "the Wahhabis were fiercely anti-Western. They want to go back in time to a pure Islam that wasn't threatened by the West". However, as the narrator three says, "despite criticism of foreign presence in the Kingdom, the King allows commercial oil production to begin", because "Oil was an American national security priority".

The American appropriation of Saudi Arabian territory led to a violent reaction embodied in the "terroristic" attacks on Al Rahmah compound in *The Kingdom*. Though the attacks are barbaric, it is difficult to describe them as "terroristic". In the wording of Robert Young, "terrorism would be an extreme example of a political activity whose deeds are designed to resist interpretation as much as to assert power"[20]. Terrorism as a desiring machine provides a means of articulating the physically and psychically inscribed violence on the territories and peoples subject to colonial or neocolonial violence. In *The Kingdom*, at U.S. Department of Justice, Ellis Leach, Assistant Secretary of State, Bureau of Near Eastern Affairs, says —in the presence of the F.B.I Director Robert grace, Special Agent Ronald Fleury, Special Agent Janet Mayes, Attorney General Gideon Young, Deputy National Security Advisor Maricella Canavesio--

> I met with Prince Thamer at the Saudi embassy fifteen minutes after I heard this morning's news. After speaking with Thamer, I advised we withhold additional US personnel because a big part of the religious justification for these bombs is the presence of current US personnel. More boots on Saudi soil make an already combustible situation more so.

[18] *Young, 162*
[19] *Young, 164*
[20] *Ibid., 163*

Maricella Canavesio replied, "My two cents: The Saudis haven't asked for FBI help. Sounds like they've done just the opposite. If we force the issue, that could further anger an utterly important ally that shares a 1000-mile long border with Iraq".

A statement like the above is misleading. It is a camouflage that does not harmonize with the context of the attacks in Al Rahma compound. It is parochial to regard such attacks, which affected mainly the American civilian people living in the compound, as a reaction against "the presence of current US personnel". To reduce the impetus of such attacks to more or less boots on Saudi soil, and a justification to religion leaves the issue of "deterritorialization" of territory and desire unquestioned. The first aspect of "deterritorialization" in *The Kingdom* is the compound itself.

"**Narrator Four**: To accommodate the workforce the first Western housing compounds are created".

"**Newscaster One**: The strict Islamic laws enforced outside of these walls do not apply inside".

The existence of the American housing compound on Saudi soil aims to deterritorialize the Saudi territory as territorialized by the Wahabi sectarianism. What we should emphasize here is that the process of deterritorialization via the axiomatic of capitalism occurs piecemeal. The King's concession to commercial oil production to begin is an event that broke with the past and inaugurated a new field of social, economic, and political or legal possibilities. When a territory is constituted inside another, connections appear and others disappear. These capital-based connections affect both culture and land. They conjugate territories and decode earlier forms of production. This process of decoding results in physical violence and barbarism as represented in *The Kingdom*.

"**Narrator 11**: This is a nation where tradition and modernity are in violent collision".

This "violent collision" between tradition and modernity is the outcome of capitalist deterritorialization of earlier forms of production and consumption. It is this shift from looking for water to looking for oil that changed almost everything in the Kingdom. As a Saudi ruler puts it in the Radio transmissions above, "It was by chance that we discovered oil. We were looking for water". The war is between capitals, not between cultures. Cultural reductionism is deceptive, for "oil was" and sill is "an American" and not a Saudi "national security priority". It is not a sense of what Edward Said refers to, in *Orientalism*, as "cultural strength" that is fortified here, rather, it is the economic strength of the America capitalist desire machine that is much more relevant here. The problematic with this process of capital deterritorialization is whether it is positive or negative. This is quite a poser. We can pose here, following Deleuze and Guattari, that this process of deterritorialization inheres in a territory as its transformative vector; hence, it is tied to the very possibility of change immanent to a given territory.

However, there is also the over-deterritorialization of a territory which blocks the movement of earlier forms of deterritorialization, in this context Wahabism, and which results in barbarism and "terrorism". Over-deterritorialization manifests itself in the way globalization constitutes itself as a system of values on the scale of Western modernity which has no equivalent in any other cultures. In the wording of Jean Baudrillard--

> What globalizes first is the market, the profusion of exchanges and of all products, the perpetual flow of money. Culturally, it is the promiscuity of all signs and all values or, in other words, pornography. For the global diffusion of anything and everything over the networks *is* pornography…. At the end of this process, there is no longer any difference between the global and the universal. The universal itself is global; democracy and human rights circulate just like any other global product—like oil or capital.[21]

Let's go back to the discussion in U.S. Department of Justice--

> **Roland Fleury**: This isn't Terrorism, ma'am. It's just Serial Murder.
>
> **Maricella Canavesio**: What's the distinction?

[21] *Jean Baudrillard, The Spirit of Terrorism and Requiem for the Twin Towers. Trans. Chris Turner. (London: Verso, 2002), 89-90.*

Ronald Fleury: To call this massacre an act of terrorism... that implies a specific political agenda. To me, these killings are so futile and unbalanced that they feel utterly sociopathic- more like Charles Manson than Osama Bin Laden...

Janet Mayes: Al Qaeda lost the first phase of this war, so a new, zero-sum phase has begun: if you won't join us, we'll let loose the truly talented Murderers... Abu Hamza. He will kill so many of you that the resulting humiliation of the Saudi Royal Family will cause an exodus, a rebellion, both. Because the Royal Family simply cannot protect you or yours any longer.

Roland Fleury: When she says talented, she's not talking about the walking-bombs who can sneak past any and all security, nor the hijackers tough enough to take an airliner. We're talking about the Man who teaches them how...

Janet Mayes: The operational commander who organizes, trains, plans, encourages. That is who we're fighting.

Roland Fleury: If we don't get inside Saudi Arabia within 36 hours, there is no chance we catch the killer responsible for Al-Rahmah. None.

Ellis Leach: Okay. I believe it all. So doesn't your team in that country represent the kind of target one of these `Masters' would die for? Trade ten of their own for one of you?

Roland Fleury: To not engage these criminals out of fear for our personal safety is just another way of saying 'uncle'. I'll say it another way: Evidence starts to go cold after twenty four hours. If we can't get in now, we will not find the man or men responsible for this crime. We couldn't do it at Khobar; we couldn't do it in Yemen; we have barely scratched the surface in Iraq. And we are on verge of not doing it here. They are getting stronger, we are getting weaker. I just lost a very good friend and I would very much like to go and do my job.

Gideon Young: That was spirited... let's all thank God Special Agent Fleury doesn't make policy decisions. He'd turn the FBI into Patton's Third Army.

The debate over the nature of the attacks is not our concern here. Whether such attacks should be classified as "terroristic" or not is another problematic which goes beyond the scope of this essay. What is pertinent to our analysis here is whether these attacks can be regarded as acts of political resistance. We cannot deny that resurgence of social or political resistance can incorporate different investments. Nevertheless, this does not justify the fictional massacres of civilians in Al Rahmah housing compound. It is appropriate here to highlight that *The Kingdom* is inspired by bombings at the Riyadh compound on May 12, 2003 and the Khobar housing complex on June 26, 1996, in the kingdom of Saudi Arabia. In the wording of Baudrillard--

> This resurgence can assume aspects which, from the standpoint of enlightened thinking, seem violent, anomalous, irrational—ethnic, religious and linguistic collective forms, but also emotionally disturbed or neurotic individual forms. It would be a mistake to co as populist, archaic, or even terroristic. Everything that constitutes an event today does so against this abstract universality—including Islam's antagonism to Western values (it is because it is the most vehement contestation of those values that it is enemy number one today). [22]

Though contemporary trauma studies addresses the specific communities that are

created through the collective experience of, or collective relation to, traumatic events, it has lost its grasp of the dynamics of group identification and social exclusion that was a central concern of Sigmund Freud's, Walter Benjamin's and Theodor Adorno's theories of historical trauma. This became clearer after 9/11, when accounts of the collective experience of "trauma" suffered by the American public did little to contextualize the event historically or politically. What arises from this oblivion in the context of 9/11 is the rise of a new rhetoric of Manichean allegories of good versus evil, civilization versus

[22] *Ibid., 95*

barbarism, and "us" versus "them". These theorists suggest an understanding of historical trauma that more fully acknowledges the role of both technological mediation and unconscious fantasy in shaping collective experience and identity in modern Western societies. Their works present us with tools for a critique of contemporary trauma theory and suggests possible directions for further research.

REFERENCES

[1] *The Kingdom*. Dir. Peter Berg. Perf. Jamie Foxx, Chris Cooper, Jennifer Garner, Jason Bateman, Ashraf Barhom, Ali Suliman. Screenplay by Matthew Michael Carnahan. 2007, Universal Pictures. Film.

[2] *World Trade Center*. Screenplay by Andrea Berloff. Dir. Oliver Stone. Perf. Nicolas Cage, Maria Bello, Michael Peña, Maggie Gyllenhaal and Michael Shannon. Paramount Pictures, 2006. Film.

[3] Agamben, Giorgio. *Homo Sacer: Sovereign Power and Bare Life*. Trans. Daniel Heller- Roazen. Stanford: Stanford UP, 1988.

[4] *The Open Man and Animal.* Trans. Kevin Attell. California: Stanford UP,2004.

[5] Baudrillard, Jean. *The Spirit of Terrorism and Requiem for the Twin Towers*. Trans. Chris Turner. NY: Verso, 2002.

[6] Benjamin,Walter. *Illuminations*. Trans. Harry Zohr. Ed. Hannah Arendt. (NY: Schocken Books, 1968).

[7] *Understanding Brecht.* Trans. Anna Bostock. London: verso, 1998.

[8] Borradori, Giovanna. *Philosophy in Time of Terror: Dialogues with Jürgen Habermas and Jaques Derrida*. London : Chicago UP, 2003.

[9] Deleuze, Gilles and Félix Guattari. *Anti-Oedipus: Capitalism and Schizophrenia*. Trans. Robert Hurley, Mark Seem and Helen Lane. Minneapolis : U of MN P, 1983.

[10] *The Falling Man*. Dir. Henry Singer. Eds. Alan Mackay and Ben Stark. Produced by Henry Singer. Darlow Smithson, 2006.

[11] Finkelstein, Norman *G*. *The Holocaust Industry: Reflections on the Exploitation of Jewish Suffering.* London: Verso, 2000.

[12] Ross, Alison. "Introduction." *The Agamben Effect*. *South Atlantic Quartly*. Vol. 107: 1. Duke UP, Winter 2008.

[13] Said, Edward W. *Orientalism*. NY: Penguin, 1978.

[14] Said, Edward. *Culture and Imperialism*. London: Chatto and Windus, 1993.

[15] Young, Robert C. *Colonial Desire: Hybridity in Theory, Culture and Race*. London: Routlege, 1995.

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Wahhabism and Global Terrorism

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ABSTRACT: All acts of terrorism are liable to be criticized severely. Terrorism is considered by UNO in its all Millennium Development Goals (MDG) reports as a major stumbling block to the all-round development of humanity. But terrorist activities do not take birth in one day. These activities are the result of a strong ideology which by hook or by crook considers terror activities as legal and just on one hand and promotes them through various Medias particularity through religion on the other hand. Wahhabism is one of such an important ideology in this context. Today many strategic and geopolitical analysts are busy to know how the ideology of Wahhabism is helping in promoting the global terrorism. The ideology of Wahhabism is directly promoted by Saudi Arabia's government as the said country is a place of birth of this ideology as well as the founder of this ideology 'Muhammad Abdul Wahhab'. Wahhabism has promoted a feeling of intolerance for other religions which has led to large scale violence and deaths of countless innocent people of countries of Middle East Asia particularly Syria, Iraq, Lebanon, Chechnya region of Russia, Afghanistan, India, Somalia, Nigeria, Libya etc.
In the present paper an attempt has been made to know the role of Wahhabism in the rise of global terrorism. What were the causes behind the rise of this ideology? How this ideology is spreading in different parts of world? What would be the geopolitical effects of spread of this ideology? Lastly, what type of measures are required to be taken as well as presently taken by various countries to counter Wahhabi and its associated Jihadist Ideologies?

KEYWORDS: Terrorism, Humanity, Ideology, Medias, Violence and Jihadist.

INTRODUCTION

Wahhabism, which was first introduced in early 8th century, was given a new lease of life and revived by Mohammad ibn Adb al-Wahhab. This ideology was later spread by Saudi dynasty in Saudi Arabia. The ideology of Wahhabism rejects other Islamic sects and faiths and claims that the opponents of their belief must either accept Wahhabi belief or pay tribute. The followers of Wahhabism consider and accuse their opponents of polytheism and blasphemy and consider their property, honor and lives legitimate for themselves. Having such rigid and closed thoughts, Wahhabis destroyed the holy buildings of 'Maqbaratul Baqi' and artifacts of the family and associates of the 'Prophet' following the dominance of Saudi's over Mecca and Medina (1344 AH). The barbaric and fanatical behavior of Taliban in the fields of politics, governance and diplomacy in Afghanistan and destruction of many important manuscripts in 'Ahmed Baba Institute' and many other ancient and unique buildings by Islamist rebels of 'Ansar Dine' group in Mali (Africa), is the true example of their attitudes. The formation and doctrines of Wahhabism have always been rejected by scholars of various Islamic sects. Even 'Ulemas' have also criticized them regarding their approach towards religious issues. It is also said that Wahhabis have paved the way for enemies of religion and Islam. They have fought many ruinous and destructive wars in alliance with colonial states of Britain and U.S.A. and thus they turned to source of arrogance in the Muslim world. The ideology of Wahhabism has its birth in Saudi Arabia, and U.S.A. and Saudi Arabia have had a long-standing political, economic and military alliance. U.S.A. is always serious about protection of the ruling family of the monarchy of Saudi Arabia. Inspite of the fact that the Saudi Arabia is governed by an Islamic fundamentalist religious ideology, Wahhabism and repressive authoritarian monarchy, U.S. has always given prime

importance to it while considering U.S.A's interests in Middle East Asia. Many scholars have accused this ideology of "deviat[ing] from [Islam's] core notions of tolerance, pragmatism and moderation"[1].

This has been primarily made possible by the 'Vast Oil Wealth' (or 'Petrodollars') and the purchasing power that the Saudi Arabia has its disposal. This has given the Saudi monarchy the ability to form a strong friendship with U.S. and other Western allies.

But a sharp turn has come in Saudi-U.S. and other Western European allies relationship after September 11, 2001 terror attacks on World Trade Centre in U.S.A. and later on terror attacks in London. These events raised serious questions about the role of Saudi government and their Wahhabi ideology in terrorism associated with earlier Al-Qaida and later on its splinter groups like Islamic State (ISIS former) in Iraq, Ansar Dine in Mali, Al Shebab in Somalia & Kenya, and also many terror groups working against India in Jammu & Kashmir. The terror attacks on U.S.A. and U.K. has shifted the attention of global military and strategic planners over Saudi Arabia because 15 out of 19 hijackers that attacked the World Trade Centre in U.S.A. including Osama bin Laden and other global 'Jihadists', also participated and fought in Bosnia, Chechnya, Afghanistan and Iraq. A majority of these terrorists were Saudi nationals.

The Wahhabism has generated great interest and debate among academic and defense policy experts. Some said that it is central to the growth of Islamist violence and Jihadism while others insist it as a rigid ideology with illiberal beliefs but not directly linked to violence and Jihadism. Another group of scholars which adopts middle path says Wahhabism is a contributing factor but not the sole factor in violent Islamist extremism.

Therefore, in the present paper an attempt has been to determine the role of Wahhabism and Saudi government in the rise of global terrorism. There is also an attempt made to know whether Wahhabism is a contributing factor in the spread of violent radicalization in the Muslim world and what are the causal mechanisms linking Wahhabism to violence?

OBJECTIVES OF THE STUDY

1. To understand the meaning of Wahhabism along with its historical background and present situation.
2. Role of Wahhabism in the spread of violent radicalization and terrorism in Muslim as well as other parts of the world.
3. Role of Superpowers in the spread of Wahhabi ideology.
4. To suggest some necessary measures to counter and neutralize the ill-effects of such ideologies on our present day society.

METHODOLOGY

This paper has used information obtained from various sources including articles from newspaper, magazines, internet and numerous books and research papers.

AREA OF STUDY

Saudi Arabia is a place of birth of the ideology of Wahhabism. Therefore, it is our main area of study but impacts of this ideology on human society will be studied at global level. See the map below

[1] *As`ad Abu Khalil, 'The Battle for Saudi Arabia: Royalty, Fundamentalism and Global Power' (New York: Seven Stories Press 2004), PP.19.*

Source: The World Factbook - Saudi Arabia

BACKGROUND ON WAHHABISM

Definitions: - "Wahhabism" generally refers to a movement that seek to purify the Islamic religion of any innovations or practices that deviate from the seventh-century teaching of the prophet Muhammad and his companions."[2] In the West, the term has been used mainly to denote the form of Islam practiced in Saudi Arabia and which has spread recently in various part of the world. In most of the Muslim nations, however, believers who adhere to this creed, prefer to call themselves as 'Unitarians' (in Arabic it is 'Muwahiddun') or" Salafiyyun" (singular - Salafi, noun - Salafiyya). The later term Salafiyya has been derived from word 'Salaf' which means to 'follow' or 'to precede', a reference to the followers and companions of the Prophet. Some Muslim scholars believe that western world has used the term 'Wahhabism' unfairly which carries negative and derogatory connotations. The main difference between these two terms is that the Wahhabism is in association with a 'Conservative Islamic Creed' which is centered in and emanating from Saudi Arabia whereas Salafiyya is a more general puritanical Islamic movement that has developed independently in various places in the Islamic world.

[2] *For more on Islamic religion, see CRS (Congressional Research Service) Report RS21432, Islam: A Primer*

History of Wahhabism: - It is a puritical form of Sunni Islam and is practiced in Saudi Arabia and Qatar. The word 'Wahhabi' is derived from the name of a Muslim scholar, 'Muhammad bin Abdal-Wahhab' (1703-1791AD). He was frustrated by the moral decline of his society. As a result of which he denounced many popular beliefs and practices as idolatrous. He encouraged people to return to the pure and orthodox practices of the fundamentals of Islam as embodied in the holy Quran and in the life of Prophet Muhammad. "In 18th century, 'Muhammad bin Saud', the founder of modern – day Saudi dynasty, partnered with Abdel-Wahhab to begin the process of unifying disparate tribes in Arabian Peninsula. Since the foundation of modern Saudi Arabia in 1932 Ad, there has been a close relationship between Saudi ruling family and the Wahhabi religious establish ments."[3]

Wahhabism in Saudi Arabia Today: - "With the establishment of Kingdom of Saudi Arabia, Wahhabism gained new ground and was used as official basis for determining laws and conducts in Saudi society. Wahhabism is the basis for such practices as segregation of sexes, the prohibition of the sale and consumption of alcohol, ban on women driving and a host of other restrictions. Wahhabism has also shaped the Saudi educational structure, and the Saudi school books generally denounce teachings that do not conform to Wahhabist beliefs."[4]

Wahhabism opposes most popular religious practices such as veneration of saints, celebration of the birthday of Prophet Muhammad and practices associated with Sufism. According to the US state Department's 2005 'International Religious Freedom Report' on Saudi Arabia, "Inspite of many efforts made by senior Saudi government officials to promote religious tolerance towards other religions and steps to remove some intolerant material from textbooks, not much success has been achieved. Still members of Shiite Muslim minority and other non-Islamic religious minorities suffer political and economic discrimination.

Non-Muslim groups are not allowed of freedom of worship whether public or private."[5]

FACTORS ENCOURAING WAHHABISM

Though there are a number of factors responsible for encouragement of Wahhabism but here we will discuss only important ones. These are as follows:

1. **Traditional Causes**: - Abdal-Wahhab was very much frustrated to see the moral decline of Muslim society of his country. During his time Muslims used to visit dargahs, and Sufi saints were venerated. He was against all these practices and termed them as idolatrous and useless. He encouraged the pure and orthodox practice of fundamentals of Islam as embodied in Quran and in the life of Prophet Muhammad. He was strictly against the non-followers of his ideas.
2. **Colonialism:** - The Turks of Ottoman Empire had under them a vast area of western Asia, Northern Africa and some parts of Europe under their control. But after their decisive defeat in Vienna started the process of slow but steady decline of this empire. Eying on many territories of this empire, the British started to undermine the unity of Ottoman Empire. The British, through their Masonic agent sought to destroy the Ottoman Empire from within, by pitting against their own brothers in Islam, the Arabs of Peninsula. See the map of Ottoman Empire below

[3] 'Contemporary Saudi Wahhabism combines the teaching of its founder Abd al - Wahhab and other religious and cultural tradition.' Eleanor Abdella Doumato, "Manning the Barricades: Islam according to Saudi Arabia`s Texts." The Middle East Journal 57, no.2 (2003):PP.230-248.

[4] Michaela Prokop, "Saudi Arabia: The Politics of Education," International Affairs, 79, no. 1 PP.77-89

[5] 'Approximately two million Shiites are citizens of Saudi Arabia. 'Report available online at [http://www.state.gov/g/drl/rls/irf/2005/51609.html].

Courtesy: www.houshamadyan.org

It was not legal in Islam for a Muslim to fight another Muslim. Therefore, to create a rift between Arabs and Turks, it was must to create a new interpretation of Islam that would sanction such murder, but under the guise of Islam. This interpretation came to be known as Wahhabism and was founded by British agent, Mohammad Abdul Wahhab.

3. **Attrocities Against Muslims in Different Part of World:**- Attrocities against Muslims community in different parts of the world such as Palestinian Arabs in Gaza & West Bank, Chechen Muslims in Russia, Uyghur of Xinjiang province of China etc. have further given strength to this Wahhabi ideology because its principles are very much liked by the Jihadists fighting in these areas. Wahhabists are generously providing money for these terror groups so that these groups can purchase much needed weapons and other war materials to continue their struggle against their respective governments of different countries.

4. **Radicalization of Western World:** - The preachers of Wahhabism and Islamic Jihad has not confined the achievement of their aims within the Muslim world; they want to expand it at world level. Therefore, their targets are western European countries and America. But due to their inability to fight with these mighty powers militarily, they have divided their work between militants and more moderate sounding clerics appointed as Imams. Militants work for the destruction of U.S. and its allied western European powers whereas moderate clerics try to brainwash the Muslims of these countries. The recent involvement of many British Muslim nationals and U.S. nationals in terror activities of Islamic state in Iraq and Syria and their involvement in many suicide attacks in Middle East shows that many of people in western world are influenced by Wahhabi ideology. The promotion of this ideology is equally funded either directly or indirectly by the Saudis and some other Gulf countries.

5. **Instruments of Propaganda:** - Following are the main sources of propaganda used generally by the proponents of Wahhabism.

   (i) Satellite Channels: - Satellite channels are often used by the proponents of Wahhabism. For example 'Vesal', 'Noor', and 'Safa" are the satellite channels used by radical Wahhabis in Southern Iran to promote ethnic divide among Shias and Sunnis. It is important to mention that programs of these channels are completely under the control of ruling Saudi family. (Jafari, 2007. P.98).

   (ii) Internet Websites and Social Network Sites: - Many internet websites and social networking sites are also used to promote Wahhabi ideology. Quoting 'Ayatollah', Jafari Sobhani, Husseini Qazvini writes: "based on most recent information, 40000 Wahhabi websites are working against Shias." (Qazvini, 2007, P.43).

   (iii) Publishing Books: - Wahhabis make their efforts to publish and disseminate books, studies and researches promoting their ideology and sect.

   (iv) Promoting Ethnicity: - They also promote ethnic issues to attract people particularly the youth in their fold.

   (v) Exploiting Poor and Hungry People: - We all know that a hungry man is an angry man. These evil minded people attract the poor and hungry people by giving them lure of money and power. Once they trapped they are brain washed and included in the cadre of terrorists.

ROLE OF SUPER POWERS IN PROMOTION OF WHHABISM

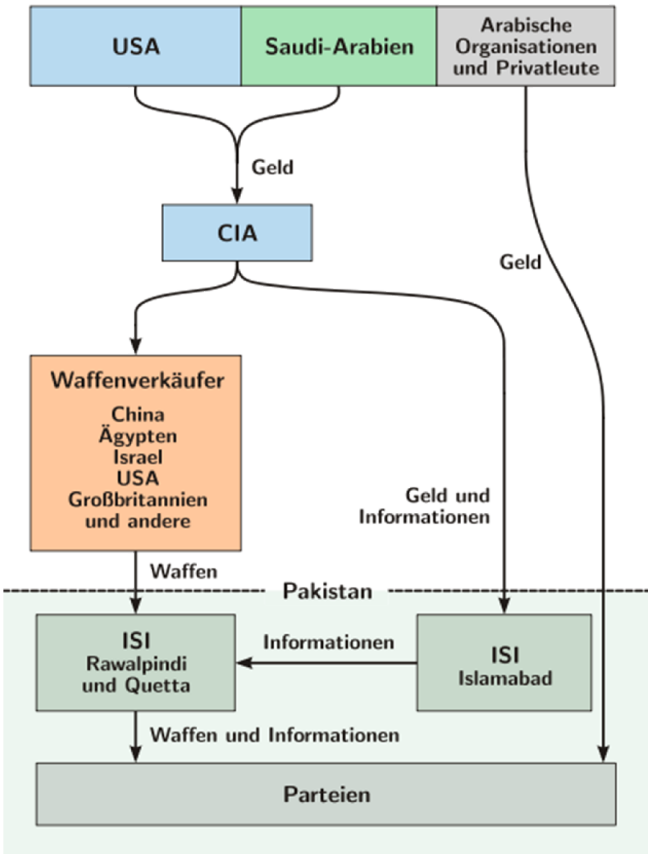
Among superpowers of the world, mainly Great Britain and U.S.A, for their personal interest against their rivals have used to promote and support the Wahhabi ideology.

In the second half of 19th century, British imperialism discovered the house of 'Al Saud' as a potentially useful ally in its attempt to gain influence in the Middle East and undermine the Ottoman Empire. Riyadh was invaded by Ottoman Sultan in 1818AD.

The Al Saud returned to power in 1823AD. Later on British helped the Al Saud to establish a base in its protectorate of Kuwait, in order to reconquer, at that time ruled by the pro – Ottoman 'Al Rashid' dynasty.

Later on, Great Britain became the first country to recognize new Saudi Arabia as an independent state, establishing its current borders in 1932 AD. In 1927AD, a treaty was also signed between The British Crown and Saudi Monarchy known as 'Treaty of Friendship and Good understanding. 'The chief aim of Britain was to secure the one link of chain passing from Suez Canal to India.

The U.S. interests in Saudi Arabia were earlier confined to use the vast oil reserves of this country. But the period of cold war saw a massive support to this ideology



A German database showing the channeling of the money and weapons, provided by *ISI* officer Mohammad Yousaf in his book: *Afghanistan – The Bear Trap: The Defeat of a Superpower*

and its promoters by U.S.A. This was period of struggle for world domination between U.S.A. and former U.S.S.R. Here the main aim of U.S.A. to support the so called 'Mujahideens' in Afghanistan was to give Russia (then U.S.S.R) its Vietnam. The involvement in the matters of Afghanistan and sending its troops against well trained Talibani and Mujaheed soldiers gave a severe blow to the U.S.S.R. which later on became another cause of its disintegration.

Another example of U.S. support to the Wahhabis can be seen in 'Syria' where the secular, multi-ethnic and multi-faith society is being targeted by these very same forces, as well as reactionary regimes such as GCC and Turkey as well. Here, the purpose of U.S. involvement is, first to isolate Iran and then once again target Russia.

Russia while on the other hand is helping Syria and its ruler Bashr-al Asad to avoid any loss of her own ground in Middle East. It is so because if the Asad's regime fall in Syria and Iran become isolated then surly, Wahhabis will turn their attention more deeply towards too soft and vulnerable Muslim populated areas of Russia such as Chechnya.

ROLE OF SAUDI ARABIA IN PROMOTION OF WAHHABISM

Sandi Arabia is a chief proponent of this ideology as Wahhabism has taken its birth here. Many scholars of geopolitics and defence analyists held Saudi Arabia and its ruling elite`s support to Wahhabism as responsible for the present day terrorist violence in various parts of the world. Over more than two decades, Saudi Arabia has spent around $100 billion or more on worldwide promotion of the violent, intolerant and crudely puritanical Wahhabist sect of Islam.

Starting in late 1980's Saudi Arabia began dispatching Wahhabist clerics and radical preachers to Chechnya. The spread of Wahhabism resulted in not only a separatist war against Russia but also a good deal of violence among Muslims.

In 2003, a 'United States Senate Committee on Terrorism' bore testimony that in previous 20 years Saudi Arabia has spent $87 billion on promoting Wahhabism. This includes financing 210 Islamic centers, 1500 mosques, 202 colleges and 2000 madrasas. This money smothers the voices of moderate Muslims and poison flows in to entire Muslim community worldwide.

Geopolitically speaking, Saudis want their domination in Middle East where Iran, Iraq, Syria as well as Lebanon are the countries where religious ideologies are not inconformity with Saudi Arabia. Therefore Saudi Wahhabis have poured millions of dollars to arm and incite the Sunni insurgents of Iraq and generated a terrorist movement which today has assumed the shape of Islamic State or IS (former ISIS). In Syria also, they are arming the anti-Assad regime to topple the present government.

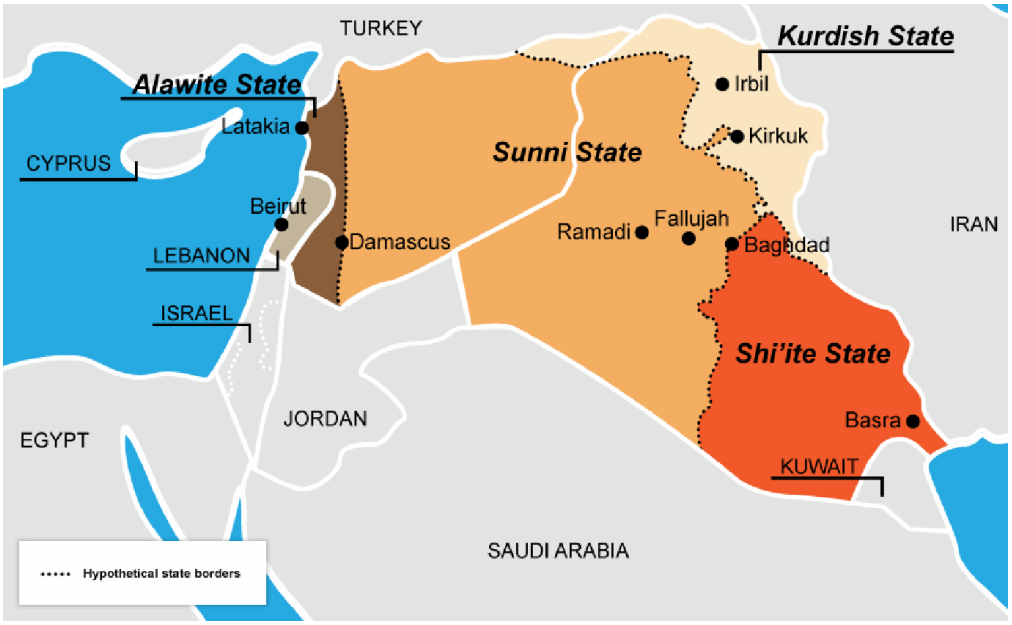
GEOPOLITICAL EFFECTS OF WAHHABISM

Due to sponsorship by oil rich Saudi State, the rigid ideology of Wahhabism is rapidly spreading in various parts of the world. Many scholars are worried about the consequences of the spread of this rigid and intolerant ideology. Some of its possible geopolitical effects are as follow.'

1. **Increase in Mutual Hatred within Islam:** - Wahhabi ideology is intolerant towards other sects of Islam such as Shias, Sufis, Yazidis, and Ahmadiyas etc. The brutle killings of Yazidis in Iraq by Islamic State terrorist forces recently and attrocities against Shias and Ahmadiyas in Pakistan is an example of how Wahhabism is encouring mutual hatred towards coreligionists in Islam.
2. **Increase in Hatred towards Other Religions**: - Wahhabism encourages hatred towards other religions such as Christianism, Judaism, Hinduism and Buddhism. The Talibanian acts of destroying ancient Buddhist structures in Afghanistan, hatred towards Jews etc. are the examples that Wahhabism has encouraged worldwide hatred towards other religions .This will have dangerous impacts on world.
3. **Increase in Discrimination against Ethnic Minorities: -** Wahhabism is very intolerant regarding ethnic minorities. Its rapid spread will surely deteriorate the condition of ethnic minorities either living in Muslim states of Middle East or in any part of the world. For example the mass killing of Yazidis, a tiny religious minority of Iraq by Islamic state (former ISIS) militants gives us a burning example of discrimination against ethnic minorities.
4. **Encouragement to Widespread Violence**: - Another geopolitical effect will be increase in terrorist violence supported by this ideology to force a government to bend according to their demands will be encouraged. The widespread violence in Chechnya is due to popularity of Wahhabist ideology among the Muslim youth of that region under Russia. They declared an armed struggle against Russia to attain independence and establish an Islamic State there.
5. **Birth of a Number of Terror Organizations:** - Influenced by Wahhabi ideology, a number of Islamic terrorist organizations have emerged & will continue to have emerge until a full stop is not placed on this large scale expansion of this ideology. Some examples of terrorist organizations are Al-Qaida, Islamic Jihad, Islamic State of Iraq and Syria (ISIS), Taliban, Tehrik - I-Taliban Pakistan (TTP), Jamat-Ud-Dawa (JUD), Ansar Dine, Al Shabab, Boko Haram etc. are all influenced by Wahhabi Ideology.
6. **Threat to The Existence of Nations:-** Many countries, where there is a sizable number of minority Muslim population, may face a challenge of breaking away. For example the rapid spread of Wahhabism in Chechnya has led to an armed struggle between Russians and Islamic terror groups of Chechnya. Similarly, the rapid spread of this ideology, is held

responsible by China for its ethnic unrest in its western province of Xinjiang inhabited by ethnic 'Uyghur' Muslim minority population.

See the map of terror Organization ISIS in Iraq and Syria



STRATEGIES & WAYS TO COUNTER TERRORISM GENERATED BY WAHHABISM

There has been a deceive shift in the thinking of nations in the world, towards the Wahhabist ideology and its related terrorist activities, after 9/11, attack of terrorists on U.S.A. Countering terrorism as well as to stop the expansion of Wahhabi ideology has become a first priority of nations to ensure the security to their population. Thus, the intelligence and the security systems of countries of the world must consider following measures in order to expand fundamental capacities of national security before offences of Wahhabi sect and its associated terrorism:

1. **To Address and Eliminate Soft Threats of the Cyber Space**: There should be proper strategic management of soft security. Modern technology should be applied for raising the security index of cyber space. The main part of propagation of Wahhabi ideas is done through cyber space. Therefore, strict actions should be taken against such internet sites, satellite channels and other Medias of cyber space which display the ideas of Wahhabi sects. A strict ban should be imposed on them.
2. **Compiling a Table of Risks of Terrorist Organizations Affiliated to Wahhabi Movement**: - The intelligence, security, military and police authorities of nations should first prepare a list of sectarian terrorist organizations of their respective countries. After this, they should analyze what possible harms these sectarian terrorist outfits can do. After a careful analysis of these organizations, the weak points of governments own security systems should be removed and strict counter actions should be taken against the activities of such organizations.
3. **Studying the Causes behind the Spread of Wahhabi Ideology in a Country**: - Governments as well as security system of countries worldwide first study the real causes behind the rapid spread of Wahhabism in their countries. After a careful study of these causes, efforts should be made to eliminate, those causes. For example, if unemployment is a main cause of youth joining Wahhabi sponsored terrorism in a country, then the government of that country should generate employment facilities and self-employment guarantee programs so that youth of all sections of society can be protected from indulging in anti-social activities.
4. **Plug the Sources of Funding to the Terror Organizations**: - Government of all the countries should first identify fund sources of the Wahhabi influenced terror organizations then fund sources should be banned so that no financial aid should reach to the terror organization. This move will hurt terrorist organizations badly.
5. **Strengthening the Feeling of Unity in Diversity**: - Governments of countries should consolidate the feelings of cultural as well as communal harmony among their countrymen. If people of a country have these strong feelings in their mind then such ideologies cannot break the unity of a country.

6. **Turning a National Strategy in to a Coalition Strategy**: - Countries should join together in international efforts to eliminate terrorism and defeat all such ideologies which encourage mutual hatred and incite a man to murder his fellow men without any guilty. Therefore 'a joint war' against Wahhabi ideology sponsored terrorism should be launched' to eliminate it from this world and save millions of precious human lives.
7. **Immigration Laws and Its Enforcement Should be Strict**: - Those immigrated organizations as well as individuals who are caught promoting Wahhabi ideology should be immediately banned, their visas should be cancelled and they must be prosecuted as per the law of land of that country where they are caught. In this context there should be an international treaty among the nations.

CONCLUSION

The act of terrorism in any of its from whether small of large is condemnable and those ideologies which encourage terrorist activities are too equally condemnable. No religion teaches to show cruelties in the poor and weaker sections of society. But when religious teachings are interpreted & exploited in such a way that they serve the vested purposes of a particular section of a society and render others i.e. weaker and minor section of society from their basic rights, then clashes between followers of different ideologies or thinking emerge. Similarly, the vested interests of British colonialism forced Britain to support the al-Wahhab's ideology and along with this just like Britain, the United State of America's personal interests in Middle East Asia also compelled U.S. to support Saudi sponsored Wahhabi ideology to teach former U.S.S.R, a lesson and to defeat the ideology of communism through Mujahideens in Afghanistan. But these two superpowers` unawareness and blind support to this ideology is now inversely hurting them. Now these two superpowers are also suffering from terrorist attacks in their own countries. To kill an innocent is a biggest sin considered by all religions. Therefore, the need of hour is that all nations of the world should unite together to fights against this evil of terrorism generated by Wahhabism. Such ideologies should not be allowed to popularize among the masses. Finally, the kingdom of Saudi Arabia should introspect itself and must realize that to support such an intolerant and rigid ideology may hurt them badly one day.

In the end, it can be said that Wahhabist ideology is a huge threat to the existence or integrity of nations of the world. Therefore, all efforts should be made to discourage its spread in a nation particularly among the minority communities.

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REFERENCES

[1] Algar, Hamid. 'Wahhabism: A critical Essay, P.23.

[2] Blanchard, Christopher M., "The Islamic Traditions of Wahhabism & Salafiya" CRS Report for Congress (Received Through CRS Web) updated January25, 2006.

[3] Dillon, R. Michael, "WAHHABISM: IS IT A FACTOR IN THE SPREAD OF GLOBAL TERRORISM?" (THESIS) NAVAL POSTGRADUATE SCHOOL, MONTEREY, CALIFORNIA, SEP. 2009.

[4] Dr. Hedieh Mirahmadi & Mehreen Farooq, "A community Based Approach to countering Radicalization-A Partnership for America." December 2010, www.worde.org.

[5] Dr. Jacquelyn K. Davis and Dr. Charles M. Perry, "Rethinking The war on Terror- Developing a Strategy to Counter Extremist Ideologies (A Workshop Report)." Future Strategic Context for WMD – related Planning & operations HDTRA1-06-F-0054. March 2007.

[6] EUROPEAN PARLIAMENT--DIRECTORATE GENERAL FOR EXTERNAL POLICIES OF THE UNION, "THE INVOLVEMENT OF SALAFISM/WAHHABISM IN THE SUPPORT AND SUPPLY OF ARMS TO REBEL GROUPS AROUND THE WORLD." June 11, 2013 at http://www.europarl.europa.eu/activities/committies/studies.do?language=EN

[7] Fisk Robert, "Sunni Caliphate has been bank rolled by Saudi Arabia." The Tribune (newspaper India), 18 June 2014. Page No. 09 OPED WORLD.

[8] Fox, Johanathan, "Are Middle East conflicts More Religious?" The Middle East Quarterly, Fall 2001, Volume VIII: Number 4 P.P. 31-40.

[9] Manthorpe, Jonathan, "Saudi Arabia Funding Fuels jihadist terror." Vancouver sun Columnist, May 28, 2013.

[10] Moor, John, "The evolution of Islamic terrorism: an overview." Frontline Magazine.

[11] Mousavi, Seyyedeh Razieh, "Propagation Methods of Wahhabism in Khuzestan Province." Published in: - International Journal of Advanced Studies in Humanities and Social Sciences.' Volume1, Issue 7, 2013, P.P.-764-773.

[12] "Saudi Arabia: The SAUD FAMILY AND WAHHABI ISLAM, 1500-1850." Source: The Library of Congress Country Studies. http://workmail.com/wfb2001/saudi_arabia/saudi_arabia_history_the_saud_family_and_wahhabi_islam_1500_1850.html. Or www.geographic.org

[13] Schett Benjamin, "U.S. sponsored Islamic Fundamentalism": The Roots of the US-Wahhabi Alliance. Source: Global Research, Seoptember12, 2012.

[14] Schwartz, Stephen, "The Real Roots of Islamic Extremism." The Dissident – POLITICS AND CULTURE FROM NEW PERSPECTIVES.

[15] Sheikh Abdul Hadi Palazzi," Wahhabism, the Saudi Arabia-based puritanical heresy at the base of Islamism." Middle East Quarterly. June 02, 2002.(Eretzyisroel.org)

[16] Stanley, Trevor, "Understanding the origins of Wahhabism & Salafism." Publication: Terrorism Monitor, Volume: 3, Issue: 14. July 15, 2005. (The Jamestown Foundation).

[17] Stefen M. Aubrey, "COMBATING AL-QAEDA & THE JIHADIST IDEOLOGY –AN IN-PROGRESS REVIEW OF THE US NATIONAL COUNTER –TERRORISM STRATEGY." Weatherhead Centre for International affairs, Harvard University, August 2005.

[18] The US 9/11 Commission Report, "WHAT TO DO? - A GLOBAL STRATEGY." SEP, 2004.

[19] Two Faces of Islam, P. 74.

[20] Two Faces of Islam, P. 82.

[21] Wikipedia- The Free Encyclopedia: 'The Islamic Terrorism.'

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Edugame an Android game for teaching children

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ABSTRACT: This paper presents the project "edugame" whose objective is to provide an educational game which introduces a series of activities such as the construction of words, the recognition of letters or mathematical operations for teaching children. We chose to follow, for this project, a methodological approach which begins with a design phase, using UML, followed by an implementation phase using the Android platform. This allowed us to make available to children of 3 to 7 years an interactive game for independent learning.

KEYWORDS: learning game, pedagogical scenario, autonomous learning, Android.

1 INTRODUCTION

Conventional educational games have emerged in the 1970-1980 years and are aimed at children and adolescents. The most classic essentially allow improving logic or lexical and syntactic skills. Simulation games are defined as "software toys", representing a "world", and they lack clear goals that allow the user to win. Serious games offer, in turn, a real training not only aimed to children but to a much larger target.

Since the design phase of a serious game, a utility dimension is covered and a utility or lesson plan is linked to that based on a ludic video. This distinguishes the serious game, of simulation game in which the user does not have a specific goal to achieve.

Julian Alvarez [1] defines serious games as "a computer application, whose original intention is to combine with consistency, the serious aspects such as teaching, learning, communication, or information with ludic springs from the video game. Serious games have main purpose is to teach, to inform, to experiment, to work out while playing. They can be applied in many fields, for example, military, educational and health care. The first significant title of serious games was America's Army, launched July 4, 2002. This game offers features simulation of military training exercises and combat missions for recruitment in the American army.

2 RELATED WORKS ON SERIOUS GAMES

Several studies have shown that serious games can provide a suitable cadre for learning through interactive tasks. For example, Johnson and Wu [2] presented the training system Tactical Language and Culture Training System that helps people to acquire quickly functional skills in foreign languages and cultures. The system includes interactive lessons that focus on the specific skills of communication and interactive games for players to apply their skills.

Richard Sandford and Ben Williamson [3] studied the serious game Civilization III which is a historical game where the player must ensure the supremacy of its civilization by building a powerful empire, while other empires controlled either by the computer or by d other players are also being created and compete for world domination. These researchers showed that learners have developed more complex than a simple perception of causal reasoning strategies. In this serious game, learners become able to identify problems, make causal interpretations and implement solutions to critical situations.

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Other work has studied not only the assessment of learning and monitoring of learner that serious games offer, but also the question of the design of such games. For example, Bertrand Marne and their colleagues [4] suggest six facets of education that must be concerned in the design of a serious game: educational objectives, simulation domain (disciplinary knowledge or skills that wants to present to students through this game), interactions with the simulation , progression and problems (what problems need to be solved to advance in the game?), immersion (what media and screenwriting elements favor the immersion of the student and make the game pleasant?) and conditions of use (do we The access to the game will be from distance or in the classroom?).

Finally, efforts of classifications of serious games have been made. For example, Michael Zyda [5] identified seven classes of serious games based on application areas: training and simulation, education, health, defense, civil security, communication, evaluation by the game.

David Michael and Sande Chen [6] identified five other application areas: politics, industry, government, religion and art. Julian Alvarez and Laurent Michaud [7] highlighted seven major markets for serious games: defense, education and training, advertising, information and communication, culture and activism.

3 DESIGN OF A LUDIC PEDAGOGICAL SCENARIO

The concept of "scenario" is relatively recent and comes from the audiovisual field (theater, cinema, literature). Several authors have defined the term "pedagogical scenario" such as Henri and al. [8] who defines it as the result of a process of learning activity that involves planning of objectives.

When Quintin and al. [9], they consider the pedagogical scenario as a "structured and coherent set of two parts" that includes the learning scenario and the coaching scenario.

As for the ludic component, it seems necessary firstly define the word "ludic."

According to Genvo [10] the ludic dimension refers to game and "the result of a joint development between the game structure and its context."

Faced with these definitions, we propose a draft definition of the concept of the "pedagogical scenario" as a digital environment consisting of a fun activity for teaching and learning."

To design a pedagogical scenario, several models exist including the model of Paquette [11], which contains four steps in the construction process. Another model was defined by Brassard & Daele [12] it is based on the model of Reeves [13] and takes into account 17 dimensions. Compared to these two examples of design models, it is possible that the model of Brassard [12] is more comprehensive and helps us to design a pedagogical scenario as it takes into account more aspects of learning.

4 UML CLASS DIAGRAM

A UML class diagram is a type of static structure diagram that describes the structure of software in the form of objects (classes), attributes and operations (methods) and the relationships between these objects.

The classes we used in our application are:

- jeu: is the class that contains the questions and answers and displays the questions and select answers (getReponse).
- Histoire: is the class that contains all the stories and displays them.
- Résultat :is the class that displays the result after each part of the game.
- Meilleur score: is the class where we store all high scores, it displays (GetHighScore) by order and on the type of game and modifies (SetHighScore).
- Aide: is the class that contains an indication of the application.

The relations between the classes:

- A game can have three types namely: “Jeu de calcul” (calculation Game), “Jeu de letters” (Letters game) and “Jeu de mots” (Words Game).
- A game can have several outcomes, and a result is for a single game
- A game can have at most a high score and a high score necessarily belong to a single game.

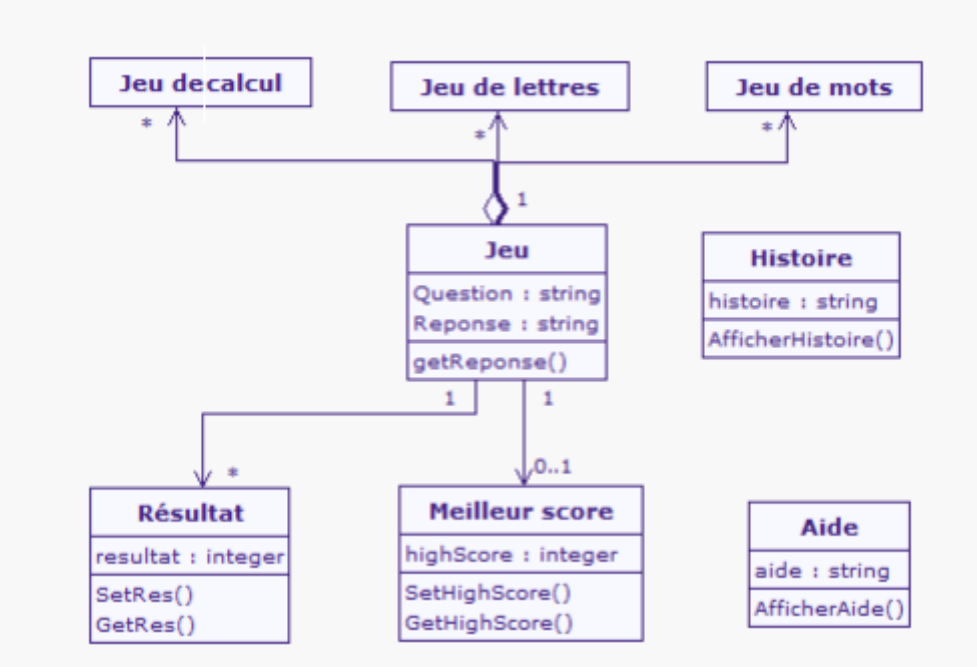

Figure 1: Class diagram of edugame

5 ANDROID AND ITS ARCHITECTURE

Android is an open-source operating system for smartphones, PDAs and other mobile devices. It is easy to develop and flexible as it is extremely portable, it adapts to different structures.

The following diagram shows the major components of the Android operating system:

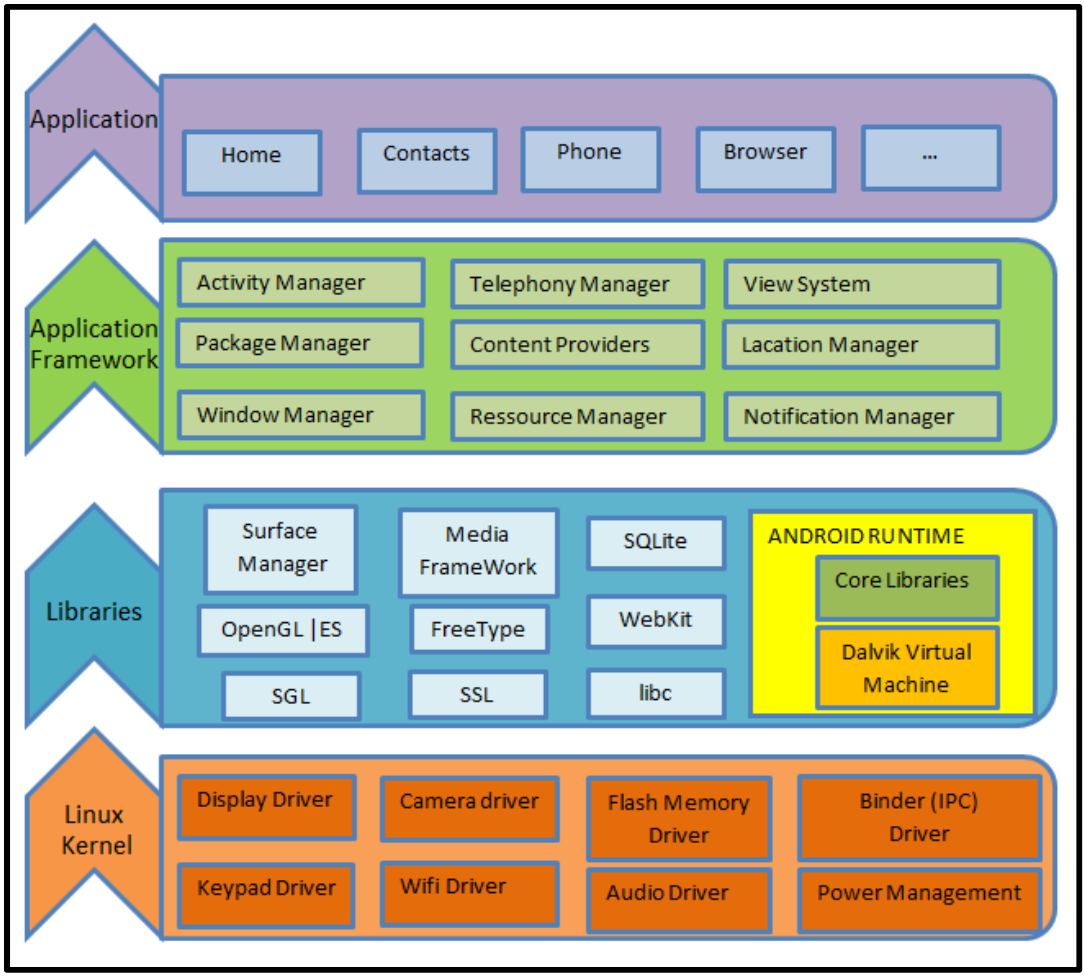

Figure 2. The Android architecture

We can observe a stack of components which constitute the operating system. The reading direction is from the bottom upwards, since the lower level component (farthest user) is the Linux kernel and the higher level (closer to the user) formed by the applications.

Android is based on Linux kernel 2.6.xx. Above this layer, there are the libraries of C / C ++ used by a number of components of the Android system. Above the libraries, there is the Android runtime. This layer contains the core libraries of the Framework and the virtual machine running the application. Above the layer "Android Runtime" and cores libraries, we find the Framework allowing the developer to create applications. Finally above of Framework, there are Applications.

6 IMPLEMENTATION OF THE APPLICATION WITH ANDROID

6.1 STRUCTURE OF THE ANDROID PROJECT

After creating the project we obtain a tree architecture (Figure 3), which allows us to exploit the different components of the application: the Java files, XML files and other resources.

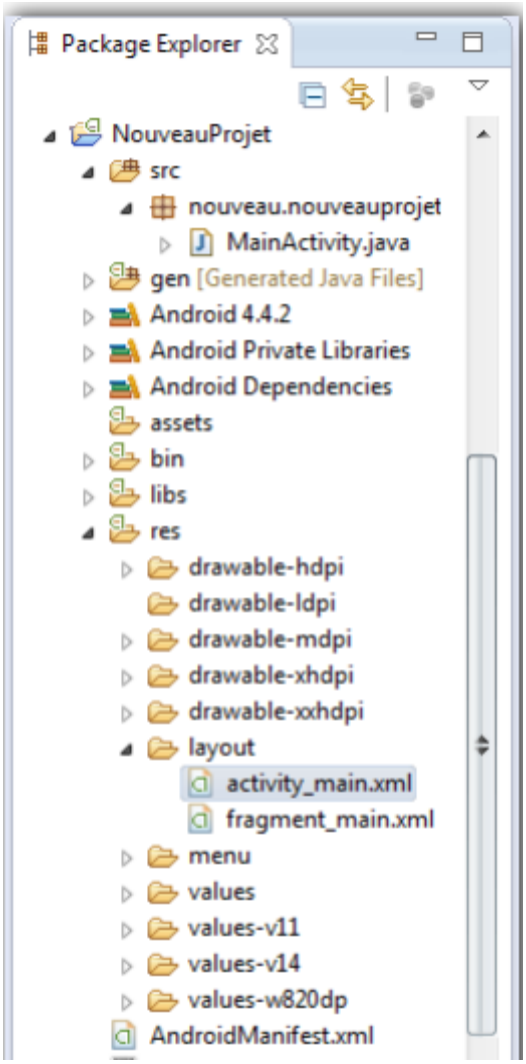

Figure 3: The Package Explorer

The Package Explorer lets to navigate through all directories of projects.

Each project contains:

- Directory src /: contains all source files .java
- Directory res /: contains all the resources within the project as:
- drawable: contains the images according to their sizes.
- Layout: Contains .XML files.
- Values: contains dimensions, strings and style.
- AndroidManifest: it is an XML file where you have to declare all activities of the application (.java inherits android.app.Activity).

Then to organize the graphical interfaces of the application is very useful to use XML files that have the following form:

```xml
<RelativeLayout xmlns:android="http://schemas.android.com/apk/res/android"
    xmlns:tools="http://schemas.android.com/tools"
    android:layout_width="match_parent"
    android:layout_height="match_parent"
    android:paddingBottom="@dimen/activity_vertical_margin"
    android:paddingLeft="@dimen/activity_horizontal_margin"
    android:paddingRight="@dimen/activity_horizontal_margin"
    android:paddingTop="@dimen/activity_vertical_margin"
    tools:context="nouveau.nouveauprojet.MainActivity$PlaceholderFragment" >

    <TextView
        android:layout_width="wrap_content"
        android:layout_height="wrap_content"
        android:text="@string/hello_world" />

</RelativeLayout>
```

Figure 4: XML file of the layout MainActivity

In addition we must associate graphical interfaces to Java files that inherit from : android.app.Activity

```java
package nouveau.nouveauprojet;

import android.os.Bundle;
import android.support.v7.app.ActionBarActivity;
import android.view.Menu;

public class MainActivity extends ActionBarActivity {

    @Override
    protected void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.activity_main);


    }
    @Override
    public boolean onCreateOptionsMenu(Menu menu) {

        // Inflate the menu; this adds items to the action bar if it is present.
        getMenuInflater().inflate(R.menu.main, menu);
        return true;
    }


}
```

Figure 5: Example of a Java file

Finally we end with the declaration of all activities in the AndroidManifest.xml file.

```xml
<?xml version="1.0" encoding="utf-8"?>
<manifest xmlns:android="http://schemas.android.com/apk/res/android"
    package="nouveau.nouveauprojet"
    android:versionCode="1"
    android:versionName="1.0" >

    <uses-sdk
        android:minSdkVersion="8"
        android:targetSdkVersion="19" />

    <application
        android:allowBackup="true"
        android:icon="@drawable/ic_launcher"
        android:label="@string/app_name"
        android:theme="@style/AppTheme" >
        <activity
            android:name="nouveau.nouveauprojet.MainActivity"
            android:label="@string/app_name" >
            <intent-filter>
                <action android:name="android.intent.action.MAIN" />

                <category android:name="android.intent.category.LAUNCHER" />
            </intent-filter>
        </activity>
    </application>

</manifest>
```

Figure 6: Example of the AndroidManifest.xml file

Each time we add an activity, it must be declared in the previous file between the tags: <application> <activity> </ activity> </ application>.

6.2 DETAILED FUNCTIONING OF THE APPLICATION

6.2.1 THE MAIN INTERFACE

Figure 7: The main interface Edugame

6.2.2 THE OTHERS INTERFACES:

✓ **Read a story:**

Once you click on the button: Reading a story (lecture d'une histoire), the following interface is launched:

The child will begin to read the story with or without music. it may also listen and read the story together.

He clicks the button to read the rest of the story.

Figure 8: the interface read a story

✓ **Calculation Game**

Once the child clicks this button, questions are raised to him about numbers and arithmetic.

Among these questions we found those in the following interfaces:

Figure 9: Example of the questions of Calculation Game

Interfaces of "game of calculation" allow children to compare numbers, counting, summing, multiplication...

✓ **Letters game**

Once the child clicks this button, questions are raised to him about the letters of the alphabet.

Among these questions we found those in the following interfaces:

Figure 10: Example of the questions of Calculation Game

These questions allow the child to test their knowledge of alphabetical order, uppercase and lowercase...

✓ **Words Game**

Once the child clicks this button, questions are raised to him about words.

Among these questions we found those in the following interfaces:

Figure 11: Example of the questions of words game

These types of questions help the child to learn the names of animals, fruits and vegetables and to build words from letters.

7 CONCLUSION

The main reason for this work is the motivation and encouragement of children to improve their knowledge. To achieve this goal we thought of designing and developing an Android game in order to provide independent learning.

The game can easily be used in education in order to get children to acquire knowledge and skills. Nothing prevents you from to use at school, on the contrary, each teacher is free to use in their lessons.

Indeed, the application that we developed could be enhanced by other advanced features such as the integration of different levels of difficulty, game ratings by age. We can also make it more fun for the child by adding other types of games like puzzle, coloring and drawing.

REFERENCES

[1] Alvarez, J. 2007. Du jeu vidéo au serious game: approches culturelle, pragmatique et formelle, Université de Toulouse-le-Mirail.

[2] Johnson, W. L., et Wu, S. 2008. Assessing Aptitude for Learning with a Serious Game for Foreign Language and Culture. Intelligent Tutoring Systems, Montreal, Canada, 2008, pp. 520-529.

[3] Sandford, R., et Williamson, B. 2005. Games and learning : a handbook from NESTA Futurelab. NESTA Futurelab: Bristol.

[4] Marne, B., Huynh-Kim-Bang, B., et Labat, J.-M. 2011. Articuler motivation et apprentissage grâce aux facettes du jeu sérieux. EIAH 2011 - Environnements Informatiques pour l'Apprentissage Humain, 2011.

[5] Zyda, M. (2005). From visual simulation to virtual reality to games. Computer,38(9), 25-32.

[6] Michael, D. R., et Chen, S. 2006. Serious games: games that educate, train and inform: Thomson Course Technology.

[7] Alvarez, J., et Michaud, L. 2008. Serious games: advergaming, edugaming, training and more. Montpellier, France: IDATE.

[8] Henri, F., Compte, C., & Charlier, B. (2007). La scénarisation pédagogique dans tous ses débats…. Revue internationale des technologies en pédagogie universitaire, 4(2), 14-24.

[9] Quintin, J.-J., Depover, C., Degache, C. (2005). Le rôle du scénario pédagogique dans l'analyse d'une formation à distance. Analyse d'un scénario pédagogique à partir d'éléments de caractérisation définis, actes du colloque EIAH, Montpellier, mai 2005.

[10] Genvo, S. (2012). La théorie de la ludicisation : une approche anti-essentialiste des phénomènes ludiques. Communication lors de la journée d'études « Jeu et jouabilité à l'ère numérique »

[11] Paquette, G. (2007). L'instrumentation de la scénarisation pédagogique. International Journal of Technologies in Higher Education, 4 (2), pp. 1-15.

[12] Brassard, C. & Daele, A. (2003). Un outil réflexif pour concevoir un scénario pédagogique intégrant les TIC. Environnements Informatiques pour l'Apprentissage Humain, Strasbourg, pp. 437-444.

[13] Brassard, C. (1999). Conception d'un enseignement basé sur le Web en accord avec le modèle en dix dimensions de Reeves, et analyse de la dimension" apprentissage collaboratif". Chicoutimi: Université du Québec à Chicoutimi.

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Design and Implementation of Efficient Elevator Control System using FPGA

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ABSTRACT: Many industrial and control applications are running through conventional PLC technology adequately because PLC provides flexibility, lower cost and security compared to other control techniques, but still a more powerful alternative is needed. In recent years, FPGA's becomes the best replacement of PLC to implement control algorithms in industrial, digital signal processing, video and audio applications and as well to perform control tasks. The basic dilemma of FPGA's is that it requires an expertise in control automation applications. In this paper, an efficient methodology is proposed to implement PLC state diagram on FPGA using Xilinx StateCAD tool. Three level efficient elevator control system is designed which can be used for different elevator control system having different number of floors. Simply changing the state diagram, VERILOG HDL(Hardware Description Language) code is generated and used in XILINX ISE 7.1i to implement control system on FPGA Spartan-3. StateBench simulator is used to simulate results of proposed control system.

KEYWORDS: Programmable Logic Controller; Field Programmable Gate Array; State Diagram, StateCAD; Hardware Description Language

1 INTRODUCTION

An elevator or lift is transport equipment which is located vertically in the building to take luggage or passenger from one floor to another. Mostly elevators are power-driven by electric motors. Elevators plays vital role in both commercial residential locations. The main operational principal of elevators is the conversion of electrical energy into mechanical energy. The early elevators were considered as cabs and driven by hands or by animals or by rope. The creation of screw drive based system was the significant step in elevator's designs, which finally led to the design of latest modern elevators [1]. Traditional elevator control system is based on Relay logic, PLC and Microcontroller etc. but these systems have reduced number of inputs and outputs [2]. FPGA technology is the best replacement of Relay logic, PLC and Microcontroller due to its flexibility, lower cost, efficiency, security, operational speed and parallel processing ([3], [4]). For the implementation of different hardware architectures, the option of reconfiguring the FPGAs by software makes it better option ([5], [6]).PLC's are still preferred in industrial and automation applications but it does not cover all the practical applications. For this reason, researchers are still investigating for other alternatives. One of the best choices for control applications is to implement control algorithms on FPGA. System performance is improved due to parallel processing of PLC instructions. As soon as possible technique to share allocated sources is used to implement different arithmetic operations with single atomic units as used by [3].

A state diagram is simply used to explain the state machine automation graphically. StateCAD is used to implement state diagram of elevator control system, which is a graphical tool that express ideas of state machines, as state diagrams [7]. After making state diagram StateCAD convert the state diagram into Hardware Description Language (HDL) that can be used as source file in Xilinx Project and changed into schematic symbol Xilinx StateCAD include StateBench which is used to see results as waveforms simulation.

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The elevator control system is basically finite state machine (FSM). FSM is a digital sequential circuit that consists on different defined states that are controlled by inputs. Finite state machines categorized in two types Asynchronous and Synchronous FSMs. Asynchronous FSMs also called Moore machines in which output depends only on the current state while synchronous FSMs also called Mealy machine in which outputs is generated by using current state and the input variables. The given elevator control system is based on Mealy machine [8].

This paper explains the design of elevator control system by using commercially existing design tool StateCAD from which Verilog HDL code is generated. The key point of this research is that there is no need to write a complex code for control system as needed in other control techniques rather that to use simple approach of state machines to implement PLC state diagram on FPGA for elevator control system deliberately.

2 ALGORITHM FOR ELEVATOR CONTROL SYSTEM

- At any floor when input button is pressed to reach any desired floor the state will be changed.
- According to this state the motor move the car upward or downward.
- As car reached at desired floor, limiter or sensor generate an input to change the state.
- At this state output “00” generated to the H-bridge which will stop the car motor.
- According to next instruction (input) the same procedure repeat.

3 DESCRIPTION OF ELEVATOR CONTROL SYSTEM

There are seven states for three level elevator control systems. To control the elevator system on each floor, input request are provided and push buttons are used for these requests, as shown in Fig. 1. Description of elevator control system is specified in Tab. 1.

- Three states F1, F2, F3 represent the floors.
- Two states MU2, MU3 represents the state for which motor rotates in upward direction.
- At MU2, MU3 states output HBRG=”01” is generated which is attached to H-bridge to control the direction of motor.
- Two states MD1, MD2 represent the state for which motor rotates in downward direction.
- At MD1, MD2 states output HBRG=”10” is generated which is attached to H-bridge to control the direction of motor.
- The transitions PB1, PB2, PB3 are inputs connected to Push buttons.
- The transitions S1, S2, S3 are inputs which are connected to sensors.

The inputs of the elevator control system can be changed any time in StateBench simulator to see the simulation for these inputs. A state can be changed in simulator and the simulator will adjust the inputs automatically. The motor derive the car when the input is given through keyboard. The presence of a car is detected through a sensor attached to each floor.

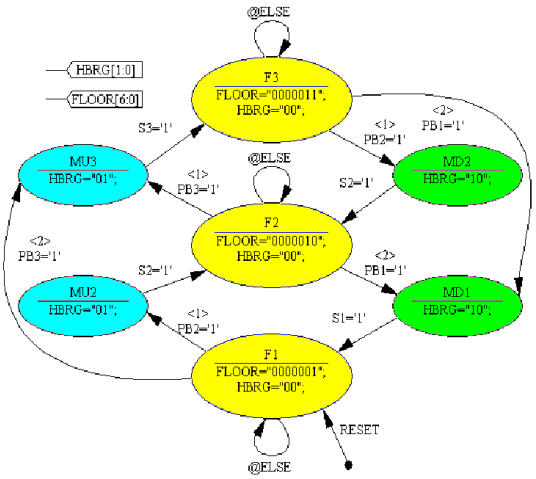

Fig. 1. Elevator control system

Table 1. State and input/ output ports

State Name	Description
Floor States	F1, F2, F3
Moving States (Moving Motor Up-ward) (Moving Motor Down-ward)	MU2, MU3 MD1,MD2
Input Transition (Push Button) (Sensor)	 PB1, PB2, PB3 S1,S2,S3
Outputs	HBRG[0:1] FLOOR[0:6]

4 WORKING MECHANISM

At state F1, when PB1 is pressed, the state remains same using Else transition as shown in Fig 2.

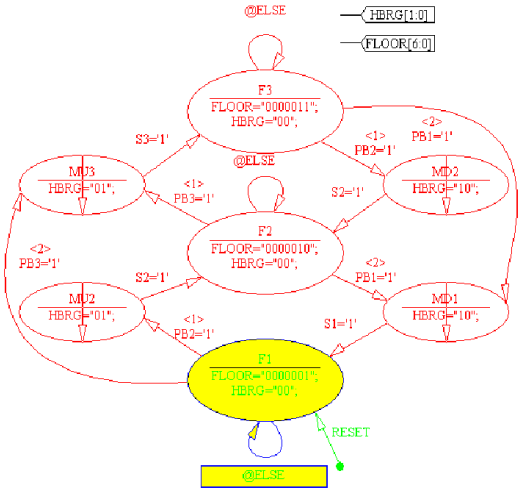

Fig. 2. Diagram for Floor 1

When PB2 is pressed the state changes into MU2 state as shown in Fig. 3 and output HBRG=”01” is generated and motor starts to rotate upward. When sensor S2 is detected due to transition S2 at that state, state will change to F2 state as shown in Fig. 4. Output HBRG=”00” is generated which stops the motor and one instruction is completed. At F1, When PB3 is pressed the state changes into MU3, output HBRG=”01” is generated and motor starts to rotate upward. When sensor S3 is detected due to transition S3 at that state, state will change to F3. Output HBRG=”00” is generated which stops the motor and one instruction is completed. At state F2, F3 the instructions for inputs PB1, PB2, PB3 will executed in the same manner.

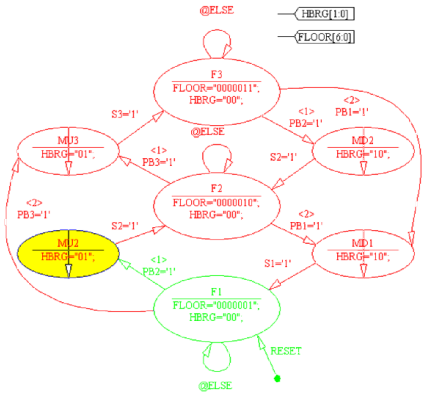

Fig. 3. Diagram for transition between floors

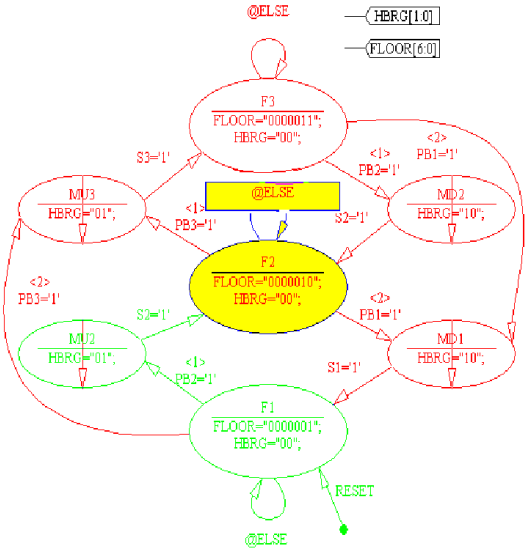

Fig. 4. Diagram for floor 2

5 IMPLEMENTATION

FPGA design work flow of elevator control system is shown in Fig 5. First "logic function " is created as state diagram using Xilinx StateCAD tool, HDL code generated from state diagram which is used in Xilinx Project Navigator to analyze register transfer level (RTL) schematic as shown in Fig 5 Finally, the generated binary file by Xilinx ISE 7.1 is downloaded in FPGA which now behaves according to control algorithm written in StateCAD.

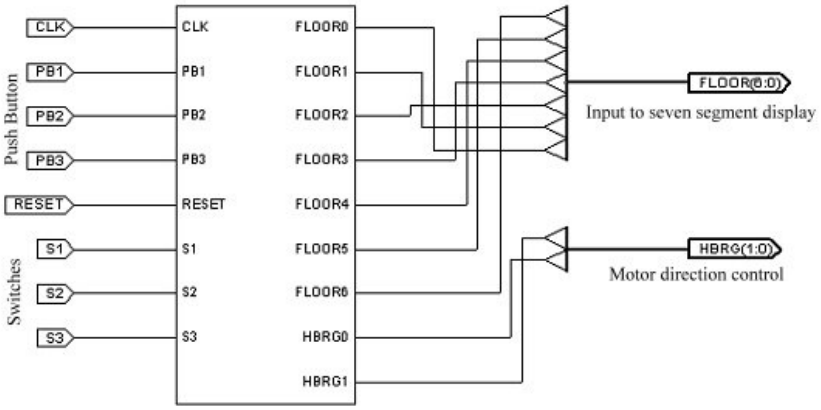

Fig. 5. RTL schematic diagram

As applied system for three floors, PB1, PB2, PB3 represent the input push buttons. S1, S2, S3 represents inputs generated by sensors. Push buttons are used to give instruction for desired floor and sensor used as input to stop elevator car at desired floor. HBRG and FLOOR is output vector, Output H-bridge (HBRG) control the direction of motor rotation, FLOOR output is to shows the floor number accordingly on seven segment display.

According to transition state will be changed, input/output detail is given in Tab. 2. Synthesis results for Spartan-3 implementation are shown in Tab. 3.

Table 2. Ports description

Port Name	Type	Width	Remarks
CLK	Input	1	Clock
PB1	Input	1	Push Button 1
PB2	Input	1	Push Button 2
PB3	Input	1	Push Button 3
RESET	Input	1	RESET
S1	Input	1	Sensor 1
S1	Input	1	Sensor 2
S3	Input	1	Sensor 3
FLOOR	Output	6	Floor number display
HBRG	Output	4	H-Bridge

Table 3. Synthesis results for Spartan-3 implementation

Logic Utilization	Used	Available	Utilization
Number Of Slices	19	768	2%
Number of Slice Flip Flops	11	1536	0%
Number of 4 input LUTs	35	1536	2%
Number of bonded IOBs	17	124	13%
Number of GCLKs	1	8	12%

6 SIMULATION RESULTS

The state diagram design is simulated using Xilinx stateCAD (State Bench Simulator) for different floors. In 2nd lock, PB2 is active state change to MU2 state and out put HBRG “01”is generated which moves the motor upward direction as shown in Fig. 6. When elevator car reached at floor 2, in the 4th clock, S2 will be active(high), sate will change to F2 state and at this state output is HBRG”00” means motor stop and FLOOR “10” shown 02 which is input to seven segment display. In the same manner the elevator moving upward and downward between three floors is shown in Fig. 7 and Fig. 8.

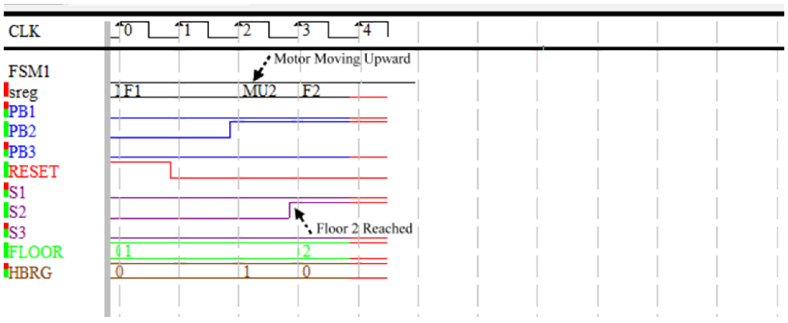

Fig. 6. Elevator moving upward for floor 2

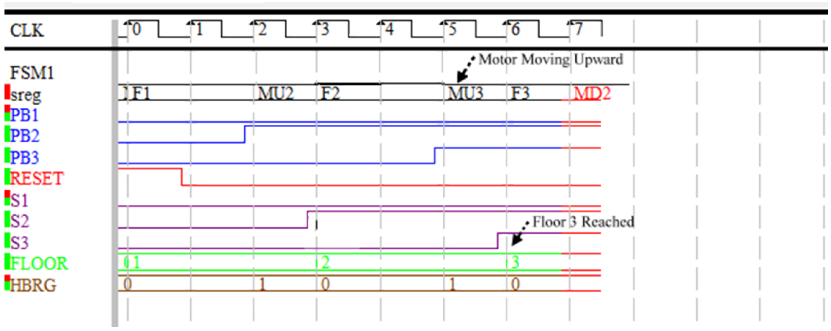

Fig. 7. Elevator moving upward for floor 3

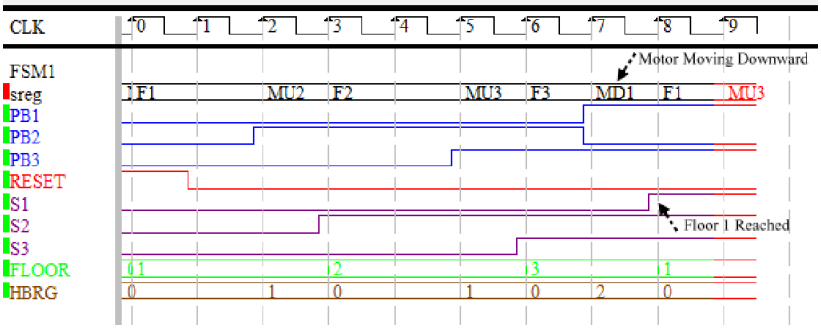

Fig. 8. Elevator moving downward for floor 1

7 CONCLUSIONS

The FPGA based elevator control system provides more flexibility, compatible than Microcontroller PLC based control system in which handwritten programming is used. In this way embedded system engineer can design a control system after a lot of process and errors that are comes in handwritten HDL programming. The designed elevator control system is implemented using finite state machine mechanism using Xilinx StateCAD tool that allows designer to change system without text oriented and errors prone rules in a time saving manner. Simulations have shown that this technique is quite promising. Reconfiguration possibilities of FPGA based control system by software and high speed due to parallel processing enhance productivity and reduce system development cost.

REFERENCES

[1] P. Rajesh, "Design and Implementation of Embedded Based elevator Control System," M Tech thesis, 2010.

[2] National Instruments, *PACs for Industrial Control, the Future of Control*, 2006. [Online] Available: http://zone.ni.com/devzone/cda/tut/p/id/3755 (Feb. 1, 2006)

[3] S. Ichikawa, M. Akinaka, R. Ikeda, H. Yamamoto, "Converting PLC Instruction Sequence into Logic Circuit: a Preliminary Study," *IEEE International Symposium on Industrial Electronics*, pp. 2930-2935, 2006.

[4] J. J. Rodriguez-Andina, M. J. Moure and M. D. Valdes, "Features, Design Tools and Application Domains of FPGAs," *IEEE Trans. On Industrial Electronics,* vol. 54, no. 4, pp. 1810-1823, Aug. 2007.

[5] K. D. Muller, G. Frick, E. Sax, M. Kuhl, "Multiparadigm Modeling in Embedded System Design," *IEEE Transections on Control System Technology*, vol. 12, no. 2, pp. 279-292, 2004.

[6] J. Becker, G. Hettich, R. Constapel, J. Eisemann, J. Luka, "Dynamic and Partial FPGA Exploitation," in *Proceedings of IEEE*, vol. 95, no. 2, February 2007.

[7] S. K. Wood, D. H. Akehurst, O. Uzenkov, W. G. J. Howells, and K. D. A. McDonald-Maier, " A Model-Driven Development Approach to Mapping UML State Diagrams to Synthesizable VHDL," *IEEE Transection on Computers*, vol. 57, 10, pp. 1357-1371, 2008.

[8] R. Nuss, *A New Paradigm for Synchronous State Machine Design in Verilog*, 1999. [Online] Available: http://www.ideaconsulting.com 1999.

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Apprentissage en milieu de travail à travers des systèmes d'activité dans une formation en alternance

[Workplace learning across activity systems in alternation training]

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ABSTRACT: The purpose of this study is to assess the transfer of knowledge taught at university to company systems in a dual training of senior technicians through a case study.
To achieve this goal, Engerström's approach on the theory of activity was used with the unit of analysis of the collective activity system and a transfer tool. The result showed that the tools with features of boundary objects enriches the task assigned to students in the work place, further explains the steps and necessary resources to the apprentice's work.
When University tutors have a horizontal expertise (as a broker), it enhances the value of the tool to foster exchange time on the knowledge and tools taught at the IUT that are relevant to the achievement of activities in the company. Thus, using the tool, the apprentice find it easier to navigate between activity systems (taught modules) of the university and those of the company (missions) to build better learning under the supervision of tutors (university, company).

KEYWORDS: Knowledge transfer; Activity theory; Activity system; Boundary object; horizontal expertise; statistics; IT processing of data.

RESUME: L'objectif de notre étude est d'évaluer le transfert de connaissances enseignées dans un apprentissage entre systèmes d'activité de l'université et ceux de l'entreprise dans une formation en alternance de techniciens supérieurs à partir d'une étude de cas. Pour atteindre cet objectif, nous avons utilisé la théorie de l'activité selon l'approche Engeström avec l'unité d'analyse le système d'activité collective et un outil d'aide au transfert. Les résultats ont montré, que l'outil doté de caractéristiques d'objet-frontière, permet d'enrichir les missions confiées aux étudiants en apprentissage en entreprise, d'expliciter davantage les étapes et les ressources nécessaires au travail de l'apprenti. Et Lorsque les tuteurs Université disposent d'une expertise horizontale (comme un courtier), l'outil est plus valorisé pour favoriser des temps d'échange sur les connaissances et outils enseignés à l'IUT qui sont pertinents pour la réalisation des activités en entreprise. Ainsi, à l'aide de l'outil, l'apprenti arrive à naviguer plus facilement entre les systèmes d'activités (modules enseignés) de l'université et ceux de l'entreprise (missions) pour mieux construire son apprentissage sous l'encadrement des tuteurs (université, entreprise).

MOTS-CLEFS: transfert de connaissance ; théorie de l'activité ; système d'activité ; Objet-frontière ; expertise horizontale ; Statistique ; Traitement de données informatique.

1 INTRODUCTION

La question du transfert et de la mobilisation de connaissances se pose dans un dispositif de formation professionnelle, surtout en alternance. En effet, ce type formation n'a pas pour vocation à rester enfermées dans le cadre d'une discipline scolaire. Par contre, il doit pouvoir s'articuler avec d'autres disciplines, des expériences de terrain, etc. pour devenir des systèmes de connaissances professionnelles, c'est-à-dire efficaces pour l'action en situation de travail. Or, plusieurs études montrent que ce travail d'articulation est difficile pour les formés lorsqu'il est laissé à leur seule charge [1], [2], [3], [4]. La plupart du temps, lorsqu'ils sont dans une entreprise, en stage, ils pensent très peu à mobiliser toutes les méthodes, tous les concepts ou les outils reçus lors des enseignements en situation scolaire. Pourtant, les tuteurs professionnels ou les responsables de stage peuvent être très demandeurs de ces mobilisations de connaissances. Lorsque les formés s'y essaient, ils sont souvent découragés par le travail important, mais nécessaire de transposition de savoirs scolaires (généraux ou techniques spécifiques) en savoirs professionnels adaptés aux situations concrètes de travail. Dans cet article, nous considérons la nécessité d'une expertise horizontale, surtout la capacité à faire des liens et des transferts entre systèmes d'activité ; et pas seulement verticale (maitrise d'un domaine de connaissances). Ainsi, nous cherchons à expliquer comment un outil d'aide puisse favoriser la construction de telle expertise horizontale en vue d'un meilleur apprentissage entre systèmes d'activité dans une formation en alternance. Un outil d'aide au transfert de connaissances a été construit pour une formation professionnelle en alternance de techniciens supérieurs (Bac+2) DUT (Diplôme Universitaire et Technologique) STID (Traitement Statistique et Informatique Décisionnelle).

Notre objectif est d'évaluer le transfert de connaissances dans un apprentissage entre systèmes d'activité de l'université et ceux de l'entreprise dans une formation en alternance de techniciens supérieurs. Dans un premier temps, nous poserons les fondements théoriques de notre démarche. Puis nous expliciterons le contexte et la problématique du travail et notre méthodologie sera basée sur des actions collaboratives entre systèmes d'activité à travers un outil d'aide au transfert qui a été construit. Enfin, nous présenterons les résultats pour apprécier et discuter l'apport de cet outil d'aide au transfert dans un apprentissage entre systèmes d'activité.

2 CADRE THÉORIQUE

Nous cherchons une approche théorique qui fait une place importante aux artefacts et aux acteurs environnant l'apprenant et aux conditions organisationnelles, dans le processus de transfert de connaissances.

Lorsque nous examinons les approches théoriques classiques (béhaviorisme, cognitivisme, cognition située) et des expériences qui y sont réalisées, elles sont limitées en laboratoire. Elles insistent énormément sur la reconnaissance d'invariants d'une tâche ou d'une situation à l'autre. Pourtant bien souvent, il est nécessaire de modifier des connaissances pour les mobiliser hors de leur contexte initial d'apprentissage [5]. Par ailleurs, les protocoles expérimentaux de la plupart de leurs études sur le transfert se basent uniquement sur la capacité mémorielle des sujets, sans qu'ils puissent s'aider d'aucun support externe. Ce qui nous conduit à nous intéresser à une approche alternative (Théorie de l'activité), à ces théories classiques, plus à même, selon nous de rendre compte du processus de transfert dans la vie courante. Cette théorie prend ses sources dans la psychologie russe historico-culturelle initiée par Vygostky. Dans son modèle de l'action médiate, les relations entre environnement et l'agent humain sont presque toujours médiatisées par des moyens culturels, des outils et des signes. Dans cette psychologie, l'activité humaine a donc une structure tripartite (objet, sujet, outil). C'est ainsi, qu'elle a été reprise et complexifiée par [6] puis [7]. C'est sur cette dernière version, développée par Engeström, et qui a introduit la notion de système d'activité sur laquelle nous nous appuyons. Notre unité d'analyse ici, est le système d'activité collective que nous modélisons à travers la figure 1 (ci-dessous).

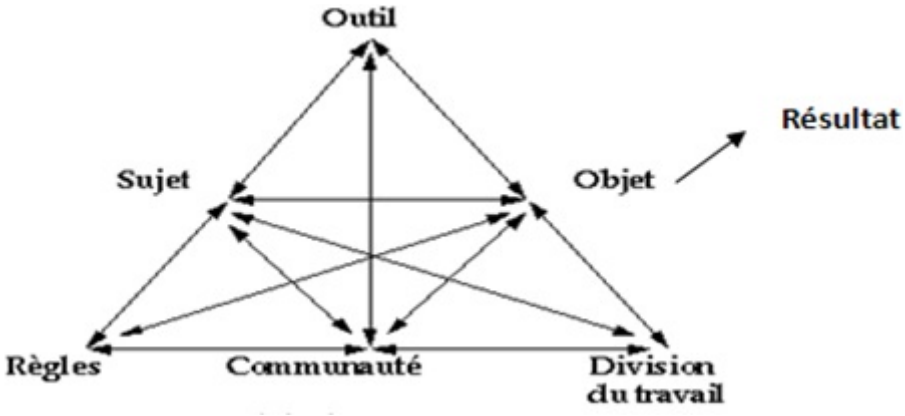

Figure 1 : Modèle de Engeström

Ce modèle de Engeström (figure 1) met beaucoup plus l'accent sur la signification collective de l'activité, et que le sujet est inscrit dans le contexte plus global de la communauté dans laquelle il évolue. Aux trois pôles du modèle de l'action individuelle (**objet, sujet, outil**) du modèle de l'action médiate [5], trois nouveaux pôles sont ajoutés. Il s'agit du pôle représentant la **communauté** elle-même, un autre pour représenter les **règles** établies par cette communauté et un troisième pour représenter le mode de **division du travail** favorisé dans cette communauté [7].

Cette modélisation représente un système dynamique évoluant continuellement en raison des contradictions qui traversent chacun de ces pôles, ces pôles entre eux, et des relations entre différents systèmes d'activité. Par exemple, un changement dans le design d'un outil peut influencer la relation du sujet à l'objet de l'activité, ce qui, en retour, peut également influencer les pratiques culturelles de la communauté. De même, un changement dans les règles de la communauté peut entraîner un changement dans le design des outils.

Lorsque nous nous situons dans les contextes d'alternance, l'accent est mis sur le fait que la relation entre les connaissances acquises situées dans les lieux de travail et les connaissances codifiées qui constituent le programme scolaire est à construire pour espérer le transfert de connaissances entre les deux systèmes : lieux de travail, et l'école ou l'université [8]. Les études menées dans cette veine sont souvent des approches de recherche et développement, qui initient de nouveaux instruments ou de nouveaux systèmes d'activité dont la finalité devient soit le transfert de connaissances en tant que tel, soit l'augmentation des capacités des apprenants à réaliser des transferts de connaissances. Le transfert n'est plus envisagé seulement comme la reconnaissance d'un problème ou d'une situation similaire et la mobilisation de connaissances ou même de patterns d'activités antérieures, avec si nécessaire un peu d'adaptation, mais comme une activité d'interprétation, de modification, de reconstruction de compétences et de connaissances, et débouchant sur des produits hybrides. Ainsi, la prise en compte de quelques concepts joue un rôle important dans l'analyse du transfert entre systèmes d'activité : « boundary-crossing », « boundary-objects » et *« broker »*.

Le concept de « boundary-crossing » (ou « polycontextuality » selon les études) renvoie au fait que, dans beaucoup de cas, les experts professionnels, mais aussi des apprenants ne sont pas simplement engagés dans de multiples tâches au sein d'un même système d'activité, mais doivent aussi souvent participer de manière croissante à différents systèmes d'activité et faire des liens entre ceux-ci [9] . Cela n'est pas sans difficulté, car les règles sociales, les façons de penser, la division du travail ou encore la manière d'utiliser les instruments, sont parfois très différentes entre différents systèmes d'activité. C'est pour cette raison que ce type d'activité nécessite un travail collectif, et qu'il est difficile pour un individu isolé qui, forcément, va rencontrer un univers qu'il maîtrise mal.

Ce type d'activité est aussi à penser en lien avec les objets qui vont pouvoir aider dans le processus de passage d'un système d'activité à un autre. Ce sont les « boundary-objects » initialement proposé par [10]. Il s'agit d'objets partagés par des communautés ou, dans l'acceptation de la théorie de l'activité, entre des systèmes d'activité. Ces objets ont des significations et des utilités potentiellement différentes dans les différents systèmes (chacun les utilisant dans une finalité propre à son activité), mais, dans le même temps, ils permettent d'introduire des préoccupations communes, de développer des représentations pour une part partagées et d'assurer des fonctions de coordination inter-systèmes. Il est important de souligner aussi le rôle crucial que peuvent jouer les « brokers » ou courtier [11], qui sont des acteurs (tels que les tuteurs IUT) pour faciliter le transfert envisagé comme activité de « boundary-crossing ». Engeström a repris ce concept au sein de la théorie de l'activité [12].

Dans cette perspective théorique, notre problématique de recherche vise à étudier les interactions entre les systèmes d'activité de l'université et ceux de l'entreprise en vue du transfert de connaissances par l'apport d'un outil d'aide. En effet, il s'agit dans le cas d'une formation DUT (Diplôme Universitaire de Technologie) dans le domaine de la Statistique et du Traitement de Données Informatiques (STID) en alternance dans un Institut Universitaire de Technologie (IUT). A l'issue de cette formation de deux ans, les étudiants de cette formation doivent être capables de maîtriser, principalement, la collecte des données et le contrôle de leur qualité ; la gestion des bases de données, l'extraction et présentation des informations pertinentes, les analyses statistiques et la communication des résultats. La première année est organisée comme une formation académique classique. La seconde est effectuée en alternance sous l'encadrement de deux tuteurs (un de l'IUT et un de l'entreprise) : quinze jours de cours à l'IUT suivi de quinze jours d'apprentissage en entreprise dans des dispositions légalement constituées. Dans cet article, nous faisons le choix de prendre la théorie de l'activité comme moyen d'analyse de l'apprentissage dans la formation par alternance DUT STID. Nous considérons que ces étudiants STID sont des acteurs engagés dans plusieurs systèmes d'activité lorsqu'ils sont dans cette formation. Certains de ces systèmes sont situés dans l'institution universitaire (IUT : Institut Universitaire de technologie), d'autres dans l'entreprise qui les accueille pour l'alternance. De ce fait, notre unité d'analyse n'est pas centrée sur les processus cognitifs des étudiants, mais sur les étudiants en tant qu'acteurs de différents systèmes d'activité, en lien avec d'autres acteurs : enseignants et tuteurs notamment.

De ce cadre théorique, nous faisons l'hypothèse que le transfert est une activité collective d'interprétation, de modification, de reconstruction de connaissances à la frontière entre différents systèmes d'activité.

3 MÉTHODOLOGIE

Le cadre théorique retenu basé sur la théorie de l'activité [7], nous amène à mettre en place une méthodologie qui devait permettre - 1) de modéliser la formation STID sous forme de systèmes d'activité pour étudier comment les organisations internes de ces systèmes et les liens entre eux favorisaient plus ou moins les mises en lien de connaissances et les transferts, notamment de connaissances enseignées, pour la réalisation d'activités en entreprise ; - 2) d'analyser l'apport d'un outil d'aide au transfert dans l'apprentissage entre systèmes d'activités de l'université et l'entreprise. Dans cet article, dans un premier temps nous posons le diagnostic du transfert dans la formation en alternance DUT STID organisée par un Institut Universitaire. En effet, il s'agit de modéliser l'organisation pédagogique et d'apprentissage en entreprise sous forme de différents systèmes d'activité, puis en tirer une interprétation qui (outils, activités, acteurs) puisse encourager et favoriser les transferts de connaissances d'un système à un autre. Et dans un deuxième, nous présentons l'outil d'aide au transfert introduit dans cette formation, suivi de l'analyse du transfert avec l'apport de cet outil. Il ne s'agit pas d'expliquer ici toute la méthodologie de conception de cet outil qui a été présenté dans un article de [13]. Mais, pour le besoin de cet article, de faire ressortir les caractéristiques pertinentes pour mieux comprendre l'analyse du transfert dans un processus d'apprentissage entre systèmes d'activité de l'université (IUT) et ceux de l'entreprise qui reçoit des apprentis.

Dans la conception de cet outil, il y a eu recours à de nombreux types et à de sources de données différentes, dans une logique d'enrichissement progressif de l'analyse sous forme de différents systèmes d'activité et selon un processus de triangulation des données [5]. La méthodologie mise en place pour concevoir cet outil d'aide au transfert se caractérisait par une forte place laissée aux enseignants jugés les plus experts de la formation. L'objectif était d'ouvrir un espace de travail pour ces experts, en leur fournissant le temps, les ressources et l'appui pour qu'ils puissent concevoir un outil très ancré dans une culture métier et susceptible de bien s'intégrer dans l'organisation de la formation. En effet, c'est en confrontant leurs représentations des missions réalisées par les apprentis en entreprise à ces écrits générés par les tuteurs lors du suivi en entreprise que les enseignants - experts ont pris conscience du poids de leur expérience (en tant qu'enseignant de telle ou telle matière, que tuteur académique dans telle ou telle entreprise, que chef de département, directeur des études ou responsable du partenariat entreprise) dans leur perception de ce que faisaient les apprentis. La confrontation à ces données et la discussion entre eux a permis d'élaborer une typologie beaucoup plus fine et plus structurée (3 niveaux ; différentes missions et tâches ordonnées séquentiellement) que celle qui existait plus ou moins formellement dans les esprits des uns et des autres et servait à présenter la formation aux entreprises notamment. C'est, ensuite, à partir de cette typologie que la réflexion sur les ressources et les connaissances a été structurée. Il nous semble important de préciser que la recherche a servi de catalyseur à la réflexion sur cette problématique du transfert, en fournissant une méthode et quelques concepts, mais aussi et surtout en légitimant, pour les formateurs, le fait de passer du temps et d'attribuer quelques moyens à la recherche de solutions aux difficultés de transfert des étudiants. En ce sens, il n'a pas été question de fournir une expertise toute faite, mais à permettre à des praticiens de mener un travail réflexif sur leur expérience et leur expertise horizontale, à formaliser leur dialogue à travers un outil pédagogique commun. Cet outil d'aide auquel nous avons participé à sa conception en tant que chercheur a été testé pour apprécier la solidité de la typologie de missions et de tâches. Les enseignants, ayant contribué à la conception de l'outil, ont profité de leur rôle de tuteur pour réaliser ce test, qui a permis d'ajuster cette

typologie, et d'associer les ressources utiles pour la réalisation des missions en entreprise (figure 2 ci-dessous). Cet outil (figure 2 ci-dessous) a été expérimenté par des tuteurs élargis à ceux n'ayant pas contribué à la conception de l'outil. Ce sont les résultats de cette expérimentation que nous analysons pour apprécier l'apport de cet outil dans l'apprentissage des étudiants DUT STID en entreprise. Cette analyse fait référence à l'approche théorique retenue. Il est question d'apprécier l'apport de l'outil d'aide dans les interactions entre les étudiants et leurs tuteurs (tuteur IUT et tuteur en entreprise) à travers les systèmes d'activité de l'université (IUT) et ceux de l'entreprise en vue du transfert de connaissances enseignées en milieu professionnel. Cet outil comporte deux grandes parties : Missions et Ressources. Cet outil que nous avons conçu [5] a été l'objet d'une publication d'article par [15]. Nous en présentons, cet extrait afin de mieux examiner l'apprentissage entre systèmes d'activité à l'aide de cet outil. L'étudiant de cette formation DUT STID, en deuxième année de sa formation et en alternance, sous l'encadrement de deux tuteurs (IUT, Entreprise) dispose de cet outil. Le tuteur Entreprise (appelé aussi maître d'apprentissage : MA), aidé du tuteur IUT (université), dispose de cet outil pour classifier les missions prescrites à l'apprenti (étudiant en apprentissage en entreprise). Lorsque la mission confiée à l'apprenti a été retrouvée sur cette grille de l'outil, le maître d'apprentissage identifie les ressources qui sont nécessaires pour sa réalisation, telles qu'indiquées par les flèches (rouges) sur cette figure 2 (ci-dessous). Tout cela se déroule au cours d'une réunion où sont présents les trois principaux acteurs de cette organisation pédagogique DUT STID : Les tuteurs et l'apprenti.

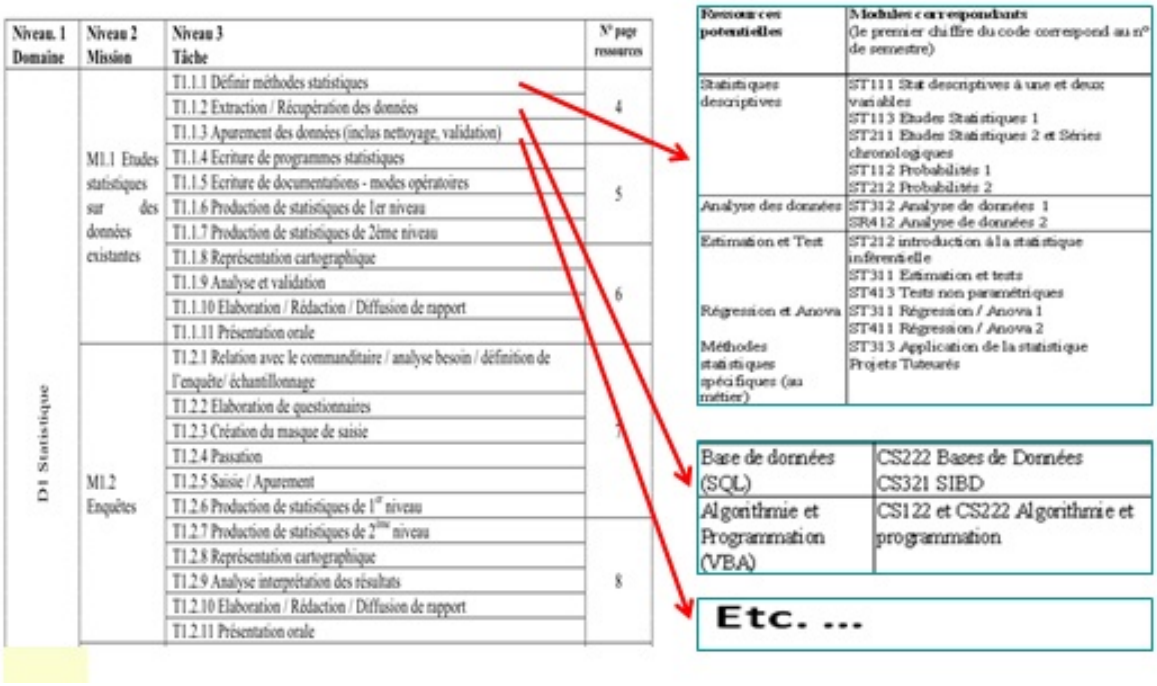

Figure 2 : Outil d'aide au transfert de connaissances (Extrait)

L'expérimentation de l'outil a été réalisée dans quatre entreprises dans des situations d'encadrement tutoral variées résumée dans le tableau 1 (ci-dessous).

Tableau 1 : Expérimentation dans des situations d'encadrement tutoral variées

Terrain (Entreprise)	Service	Tuteur IUT	Nombre de réunions
Laboratoire pharmaceutique	Service Vente	Enseignant. Bio-statistique, Ancienne chef de Département DUT STID	1
Chambre des métiers de l'artisanat	Service informatique	Enseignant Informatique, Ancienne directrice des études, Ancienne Responsable Partenariat Entreprise	1
Hôpital psychiatrique	Département Informations Médicales (DIM)	Enseignant en anglais Directrice des études	2
Service départemental d'incendie et de secours (SDIS)	Pôle de contrôle de la qualité des interventions	Enseignant mathématique et statistique	2

Pour l'analyse du transfert entre systèmes d'activité, nous avons tenté de répondre à deux principales questions :

- Cet outil introduit dans cette formation professionnelle DUT STID révèle-il les caractéristiques d'objets-frontière entre systèmes d'activité ?
- Permet-il aux principaux acteurs de cette formation (étudiants et tuteurs) de passage frontière entre les différents système d'activité en jeu pour aider l'étudiant en alternance en entreprise à mieux mobiliser les connaissances enseignées?

4 RÉSULTATS

Les résultats que nous présentons portent sur l'apport de l'outil dans le processus du transfert de connaissances enseignées entre systèmes d'activité interconnectés entre l'université et l'entreprise. Il s'agit de présenter les principaux points suivants:

- Diagnostic de la formation DUT STID par rapport au transfert de connaissances enseignées en entreprise ;
- Mise en œuvre de l'outil dans la formation DUT STID ;
- Interactions entre le tuteur de l'université (IUT) et le tuteur de l'entreprise à travers l'outil d'aide au transfert pour l'apprentissage de l'apprenti en milieu professionnel ;
- Apprentissage de l'étudiant par passage frontière entre les systèmes d'activité IUT et ceux de l'entreprise à travers l'outil d'aide au transfert.

4.1 DIAGNOSTIC DE L'ORGANISATION PÉDAGOGIQUE

La formation DUT STID de cet Institut Universitaire de Technologie (IUT) que nous analysons, comme tous les départements de la formation STID en France, est organisée sous forme de systèmes d'activité constitués par les modules, qui sont répartis dans 4 Unités d'Enseignement (UE) selon un programme pédagogique national (PPN) :

- Statistique (29% du volume horaire) ;
- Informatique et Mathématique (28% du volume horaire) ;
- Environnement économique et Communication : Economie, gestion, communication, anglais, et projet personnel et professionnel (28% du volume horaire).
- « Projets tuteurés », la quatrième unité d'enseignement est consacrée spécifiquement aux activités professionnalisantes, tels que projets tuteurés, stages, et dans le cas spécifique de l'IUT, l'alternance (14 % du volume horaire).

L'analyse qu'y est faite a révélé qu'il y a peu de liens entre les modules qui n'appartiennent pas aux mêmes unités d'enseignement. En effet, les deux principales unités d'enseignement Statistique (UE1) et Outils scientifiques (UE2) qui comportent chacune plus de dix modules (exemple : le module statistique descriptive est subdivisé en deux unités de formation) n'ont que trois liens entre les modules à travers leurs unités de formation. Les liens sont essentiellement internes au niveau de chaque unité d'enseignement. Ces deux unités d'enseignement (UE1 et UE2) n'ont aucun lien externe avec la troisième unité d'enseignement, environnement économique et communication (UE3) qui n'a que des liens internes entre les modules [5]. A priori, si l'on suit le PPN, il semble donc que les UE qui regroupent des systèmes d'activité (modules) sont relativement connectés à l'intérieur de ce périmètre (c'est particulièrement frappant pour les modules de l'UE statistique) mais assez isolés des modules d'autres UE.

Toujours si l'on se réfère au PPN, ce dernier type de liens (entre des modules d'UE différentes) doit principalement être assuré par les projets tutorés. Selon le PPN, Les projets pourront être individuels ou collectifs. **Il est fortement recommandé de proposer des sujets à caractère pluridisciplinaire, associant des notions acquises dans chacune des trois disciplines ou regroupements de disciplines académiques.** Le travail devra déboucher sur une réalisation concrète faisant l'objet d'un rapport comprenant un résumé rédigé en anglais et en français et d'une soutenance, l'ensemble de ces éléments étant pris en compte dans l'évaluation. Malheureusement, lorsque l'apprenant n'est pas suffisamment orienté par son encadreur, il mobilise faiblement les connaissances enseignées dans la réalisation de ces projets. C'est le cas de l'un des deux groupes

d'étudiants que nous avons suivi dans un projet[1]tutoré d'étude statistique (année académique 2005-2006) qui se limitait à la statistique descriptive, et les comparaisons se faisaient à travers une représentation graphique. Pourtant, en les orientant, ils arrivaient à comprendre la nécessité de recourir à un test statistique (exemple du test de khi-deux) pour faire cette comparaison de valeur.

Pour mieux chercher à comprendre le problème de mobilisation de connaissances en entreprise par les étudiants STID, nous avons examiné quelques livrets d'apprentissage (documents de suivi des étudiants en apprentissage en entreprise) pour y repérer d'éventuelles mentions d'utilisation de connaissances enseignées en situation de travail par les apprentis. L'analyse des traces fournies par les livrets d'apprentissage fournit très peu d'informations sur les connaissances enseignées qui auraient pu être utilisés par les deux apprentis. Sans doute leur activité était-elle prioritairement tournée vers l'utilisation et l'appropriation des instruments du service dans lequel ils se trouvaient. Lorsque nous avons essayé de suivre quelques traces fournies par ces livrets de suivi des apprentis en entreprise, nous sommes arrivés à la déduction que les apprentis ont peu eu recours aux enseignements à l'IUT, hormis de la bureautique générale (Excel, Word, …).

L'aide à l'établissement de liens entre les savoirs académiques et l'activité des apprentis en situation de travail renvoie principalement, dans l'organisation pédagogique, aux rôles des deux tuteurs (IUT et entreprise). Ces rôles sont évoqués dans le livret de suivi des apprentis, mais de façon assez vague. Ainsi, le tuteur IUT se voit confier la mission de « réaliser le lien entre le centre de formation et l'entreprise ». Il doit aussi « informer son interlocuteur dans l'entreprise du contenu des programmes, des résultats académiques de l'étudiant ou encore faire part au responsable pédagogique des souhaits des entreprises concernant le contenu des enseignements ». De son côté, le maître d'apprentissage, « se rend suffisamment disponible pour répondre à ses demandes [celles de apprenti], l'encourager et l'orienter, l'aider à mobiliser ses connaissances » et « faciliter l'accès de l'alternant aux informations et données dont il pourrait avoir besoin pour réaliser des dossiers relatifs à des matières enseignées à l'IUT ». Par ailleurs, un seul des critères d'évaluation de l'apprenti sur les dix-huit dans le livret d'apprentissage, porte sur la mobilisation de connaissances enseignées.

L'analyse de l'organisation pédagogique de la formation DUT-STID de cet IUT Lumière a montré qu'elle était peu favorable aux transferts de connaissances enseignées en situation de travail. Ces résultats vont dans le sens d'études qui mettent en évidence que, de manière générale, les formations professionnelles prennent assez peu en compte cette difficulté du transfert pour les apprenants [2], [14], [4], [4]. Or, les formations professionnelles se complexifient, dans le sens d'une plus grande variété de situations de formation, qui constituent autant de systèmes ou sous-systèmes d'activité ayant tendance à développer leur finalité et organisation pédagogique propre. Il y a donc un problème qui ne fait que s'accroître pour les élèves (comment parvenir à lier et à intégrer ces différentes expériences de formation ?) et dont les responsables des formations devraient davantage prendre la mesure.

4.2 MISE EN ŒUVRE DE L'OUTIL DANS LA FORMATION DUT STID

L'outil d'aide au transfert a été mis en œuvre dans la formation DUT STID et il a été expérimenté dans une dizaine d'entreprises [5], dont nous en retenons quatre (tableau 1 ci-dessus) pour notre article. Cet outil s'inscrit dans un système d'activité apprentissage (que nous avons nommé : SA Apprentissage) et dans un fonctionnement qui est conforme au programme d'apprentissage[2] des étudiants de cette formation comme l'indique la figure 3 ci-dessous.

[1] *Projet intitulé « Enquête 2004 des diplômés de DUT 2002 ». Il s'agissait d'une étude statistique commanditée par l'ADIUT (Assemblée des Directeurs d'IUT) et la direction de l'IUT, visant à analyser le devenir des étudiants après l'obtention de leur diplôme (insertion sur le marché du travail ou poursuite d'études).*

[2] *Le suivi des apprentis en deuxième année en entreprise de cette formation DUT STID est organisé en cinq séances de réunion pendant quatre périodes. La première séance sert à définir les objectifs généraux des missions à réaliser par l'apprenti pour l'année et les objectifs spécifiques de la première période d'apprentissage en entreprise. Les quatre autres séances servent à évaluer le travail accompli par l'apprenti et à porter les corrections appropriées par les tuteurs (encadreurs) pour une meilleure formation.*

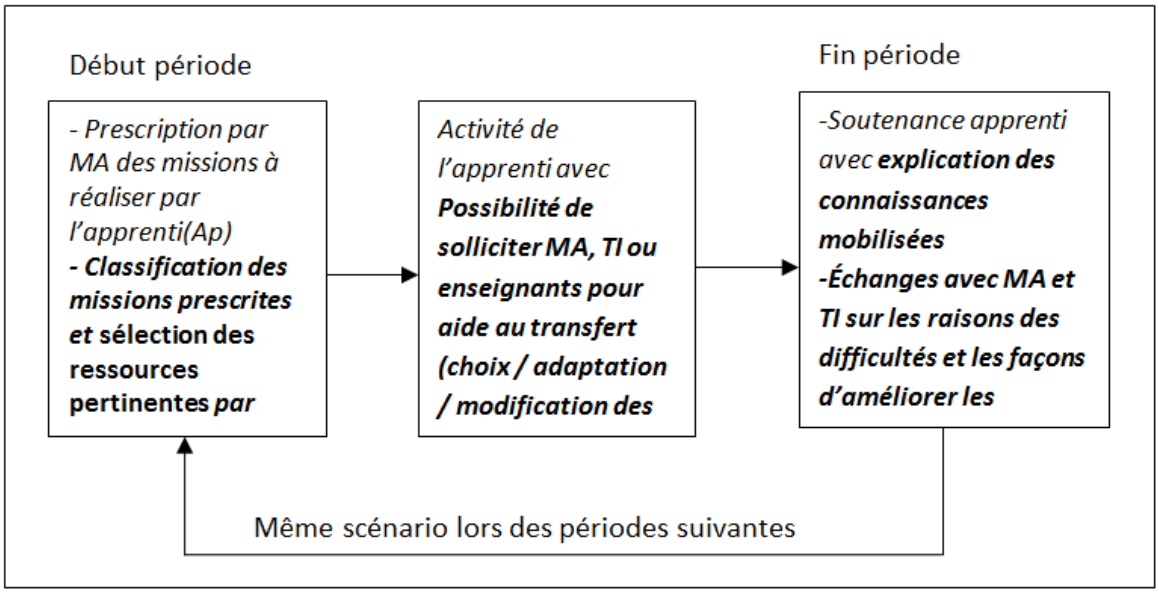

Figure 3 : Principe de mise en œuvre dans le cadre du SA Apprentissage

Cet outil est utilisé en début de période d'apprentissage par le tuteur entreprise (maître d'apprentissage), aidé du tuteur IUT (université) pour prescrire à l'apprenti les missions à réaliser dans l'entreprise. L'apprenti s'en sert dans la réalisation des missions au cours de cette période avec la possibilité de solliciter le maître d'apprentissage ou le tuteur IUT. Et en fin de période, il est utilisé par les deux tuteurs (IUT, entreprise) pour évaluer les missions réalisées par l'apprenti. Ce sont les résultats dans ces différentes utilisations de l'outil que nous présentons ici, pour analyser l'apprentissage de l'étudiant en entreprise entre systèmes d'activité.

4.3 TUTEUR IUT ET MAITRE D'APPRENTISSAGE CONNECTES A DES SYSTEMES D'ACTIVITE

Nous examinons ici, les interactions entre le tuteur IUT (université) et le maître d'apprentissage dans le suivi de l'étudiant en alternance en entreprise. Ces interactions (r1 et r2) entre systèmes d'activité IUT et entreprise sont illustrées sur la figure 4 (ci-dessous). Globalement dans les cas d'entreprise étudiés (quatre entreprise) le tuteur IUT et le maître d'apprentissage (MA) ont interagit à travers l'outil d'aide pour permettre à l'apprenti (encadré) de mobiliser des connaissances enseignées en entreprise. Le tuteur IUT et le MA ont effectué des mouvements entre plusieurs systèmes d'activité. Ces interactions à travers l'outil d'aide ne se sont toujours pas déroulées facilement, parfois à l'issue de longues explications du tuteur académique (IUT) au maître d'apprentissage. C'est le cas d'une apprentie (Adèle) en alternance dans un laboratoire pharmaceutique au service de vente, sous l'encadrement d'un maître d'apprentissage qui est responsable de gestion opérationnelle réseau dans ce laboratoire, et un tuteur IUT enseignante de Bio-statistique, qui a été chef de département de la formation DUT STID. L'extrait 1 ci-dessous, illustre la résistance du MA à changer de système d'activité pour utiliser la grille de l'outil d'aide. Celui-ci cherche à s'enfermer dans les systèmes d'activité propres à son milieu professionnel.

« - MA: *… et les tuteurs entreprise qui ne sont pas forcément des gens de la Statistique ! Moi je pense que c'est pour l'étudiant si ce n'est pas le cas faire un groupe de travail pour l'étudiant. Pour le tuteur il faut des entrées parlantes ; concrètement j'aurais dû faire une analyse un tableau de bord, qu'est-ce que j'attends de l'étudiant, il faut qu'il ait un bouton [faisant allusion à l'informatisation de la grille de l'outil] qui s'appelle tableau de bord, et je clique là-dessus et derrière ça me décrit, ce qu'il faut faire production de statistique de 2è niveau*

- TI : *ça ne vous dit rien ?*

- MA : *production de statistique oui, mais 1er 2ème niveau*

- Apprentie : *nous on comprend ça on les a vu en cours mais pour le tuteur entreprise mettre des phrases pour décrire*

- MA: *des choses plus basiques entre guillemets et quelles sont nos grandes zones d'entrée et entrer par ces grands pôles et décliner derrière tout ce que l'étudiant est censé savoir faire en fonction de l'année, de la période de l'année*

- TI: *toutes les matières sont codifiées*

- Apprentie : *moi je comprends mais pas forcément le tuteur entreprise surtout s'il n'a pas la formation statistique »* Extrait 1 [5].

Malgré quelques réticences affichées par le maître d'apprentissage, il a participé à la classification des missions prescrites[3] à son apprentie Adèle avec le tuteur IUT, pour les mettre en lien avec les connaissances enseignées (systèmes d'activité de l'université) dans cet IUT pour cette formation DUT STID.

« ….

- TI : *analyse des relevés linéaires et des interpénétrations c'est des analyses statistiques /*

- MA : *oui il y avait des chiffres qu'elle devrait mettre en forme et faire une petite analyse*

- TI : *descriptive donc ça c'est production statistique de 1er niveau est ce que avant ça vous avez récupéré les chiffres sur fichiers constitués /*

- MA : *oui, c'est vous qui avez choisi les méthodes statistiques /*

- Adèle : *non*

- TI : *est-ce qu'il y a eu une phase de nettoyage des données /*

- MA : *non a priori non*

- TI : *après les analyses statistiques pour le mémoire, décider les méthodes statistiques et faire la stat de 1er et 2è niveau pour le mémoire c'est des fichiers déjà constitués ce n'est pas une enquête que vous allez faire qu'en même »* Extrait 2 [5]

Ces opérations de classification ont demandé des moments d'explicitations importants pour arriver à faire le lien entre les missions telles qu'elles sont nommées par le MA dans l'entreprise et les différentes catégories établies dans la typologie de l'outil. Si l'on prend le cas, par exemple, le cas de la mission intitulée « Analyse des relevés linéaires », il est difficile voire impossible, à partir de ce simple intitulé, même pour un statisticien confirmé, d'en déduire qu'il s'agit, sur le plan des opérations statistiques, de **production statistique de 1er niveau**. L'extrait ci-dessus (Extrait 2) illustre la nécessité d'expliciter pour rendre compréhensible ce qui est réalisé comme mission en entreprise au-delà du langage qui lui est spécifique. Dans cet extrait, c'est le tuteur IUT qui entraîne le maître d'apprentissage à quitter les systèmes d'activité de ce laboratoire pharmaceutique pour aller vers les systèmes d'activité de l'université (modules enseignés). Ce mouvement ne se fait pas directement (par la relation r0 sur la figure 4 ci-dessous). Il se fait à travers les relations dans le sens r2 vers r1 de la figure 4 (ci-dessous), en plusieurs opérations où le tuteur IUT amène le MA à expliciter les missions prescrites à son apprentie pour être classifiées sur la grille de l'outil (en se positionnant dans le système d'activité apprentissage).

Il est donc logique que la mise en lien et la classification nécessitent un échange et des clarifications importantes. Mais c'est aussi un intérêt de l'outil que de provoquer ce type d'échanges de mouvement entre systèmes d'activité de l'université (IUT) et le milieu professionnel (entreprise) pour aider l'apprenti à mobiliser les connaissances enseignées en entreprise.

[3] Le MA a prescrit trois missions à l'apprentie Adèle à réaliser dans un langage spécifique au métier dont en voici deux : 1. Activité sur les Primes ; 2. Analyse des relevés linéaires.

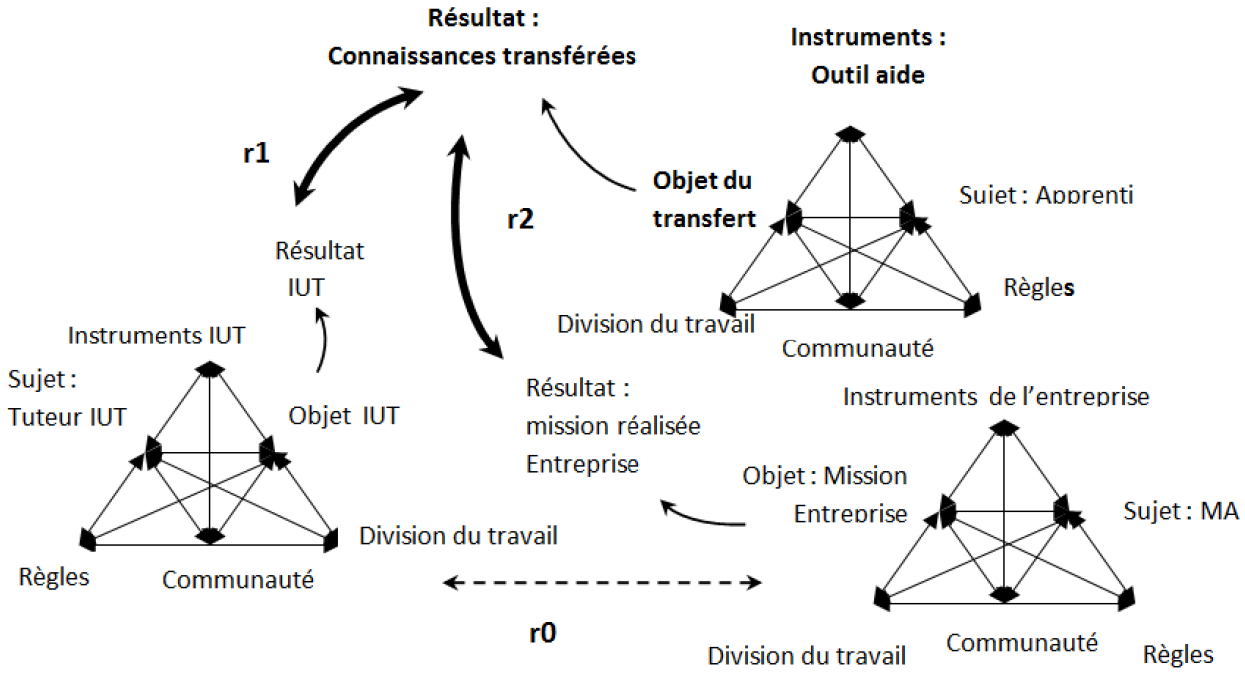

Figure 4 : Tuteur IUT et MA en interaction par l'Outil d'aide au transfert pour l'apprentie

Dans les autres cas d'entreprise (Chambre des métiers de l'artisanat ; Hôpital psychiatrique ; Service départemental d'incendie et de secours : SDIS), les mouvements entre systèmes d'activité du tuteur IUT et maître d'apprentissage, pour aider l'apprenti au transfert de connaissances enseignées en entreprise ont été possibles grâce à des moments d'explicitation. Et l'expertise horizontale du tuteur IUT (université) est fondamentale, pour pouvoir naviguer entre les systèmes d'activité de l'université et l'entreprise à travers l'outil d'aide, pour amener le maître d'apprentissage à expliciter les missions prescrites à l'apprenti. La nécessité de cette expertise a été observée dans le cas du service DIM d'un hôpital psychiatrique qui a reçu un apprenti dont le tuteur IUT une enseignante d'anglais. Malgré sa fonction de directrice des études de la formation DUT STID, elle n'a pas pu participer à la classification des missions prescrites à l'apprentie (Juliette) par son MA. C'est le chercheur qui a initié l'utilisation de l'outil d'aide au transfert dans cette entreprise (extrait 3 ci-dessous).

«- Che (Chercheur) : « *on va prendre la mission actualisation de la carte ça correspond à quoi /*

- MA (Maître d'apprentissage): *vas-y tu sais (s'adressant à l'apprentie Juliette) tu sais bien*

- Juliette: *c'est un fichier que moi j'ai conçu et j'ai ajouté les nouvelles données de l'INSEE (Institut national de la statistique et des études économiques)*

- Che: *OK si c'est un fichier qui existe ça doit correspondre à quoi dans cette grille si on regarde un peu*

- MA: *c'est un peu de la statistique descriptive*

- Che: *si on se met dans statistique, est ce qu'on va se mettre dans étude statistique sur fichiers constitués ou bien enquête /*

- MA: *c'est fichier constitué, tu vas le réutiliser*

- Che: *si on s'est positionné dans étude statistique sur fichiers constitués, on va regarder les détails énumérés qu'est ce qui est pris en compte /*

- MA: *pour méthodes statistiques je dis non, même l'apurement je dis non, écriture de programme non, T1.1.4 Ecriture de documentation - mode opératoire là je dis oui.*

- Che: *là on peut souligner*

- MA: *T1.1.5 Production statistique de 1er niveau, là oui même s'il n'y a pas écart-type mais il y a des pourcentages, des taux* » Extrait 3 [5]

Il est aussi intéressant de relever dans cet extrait 3 la progression des échanges : le chercheur initie le processus de classification en se positionnant dans l'un des systèmes d'activité de l'entreprise « Mission1 : actualisation des cartes …» qui est formulé dans un langage spécifique au métier. Le maître d'apprentissage se tourne vers l'apprentie Juliette pour tenter de lui faire expliquer la mission et de lui faire dire à quelle catégorie cela correspond dans la grille de l'outil d'aide au transfert. Ainsi, le maître d'apprentissage, quitte ses systèmes d'activité habituels en entreprise pour se mettre dans le système d'activité Apprentissage (de l'outil d'aide). Voyant les difficultés de Juliette, il reprend la main pour valider les catégories correspondantes. Ce maître d'apprentissage est médecin de santé publique et dispose les connaissances en statistique pour pouvoir classifier les missions, les intitulés de la grille ont du sens pour lui. D'où il navigue (à travers les interactions dans le sens r2 vers r1) entre les systèmes d'activité de l'entreprise vers l'université (IUT). Cela ne se fait pas directement (par la relation r0, difficile à construire sans l'outil, expliqué lors du diagnostic de l'organisation pédagogique initiale DUT STID). Il est aidé de la grille de l'outil d'aide en se mettant dans son système d'activité apprentissage (SA apprentissage) qui joue le rôle de passage frontière (une sorte de boundary-crossing) entre les systèmes d'activité de l'université et de l'entreprise. Plus largement, il convient d'observer aussi, que ce processus d'explicitation a amené le maître d'apprentissage à identifier l'apport de l'outil, non pas d'abord pour améliorer le transfert mais avant tout pour enrichir les activités de l'apprentie Juliette :

- MA: « *moi je pense tu vois (s'adressant à l'apprentie Juliette) on va trouver plein de chose à faire c'est bien c'est bien très bien cette grille (parlant de la grille de l'outil d'aide au transfert) ; on a un conseil de DIM, ça sera une présentation devant le conseil de DIM allez hop* » [5]

Les interactions entre les deux tuteurs (université et entreprise) à travers l'outil ont pour objectif d'aider l'apprenti à mobiliser les connaissances enseignées à l'université (IUT) pour mieux réussir les missions qui lui sont prescrites en entreprise.

4.4 APPRENTISSAGE EN ALTERNANCE COMME ACTIVITÉS DE PASSAGE FRONTIÈRE (BOUNDARY-CROSSING)

L'analyse que nous faisons dans cette partie est relative à des étudiants qui ont reçu une formation universitaire à travers les systèmes d'activité d'un IUT et qui doivent la mobiliser dans les systèmes d'activités de l'entreprise durant l'alternance. Nous utilisons ici, le cas de l'apprentie Juliette qui a réalisé son apprentissage en alternance dans le service DIM d'un hôpital psychiatrique au cours de laquelle, son maître d'apprentissage aidé du tuteur IUT, lui ont prescrit des missions à réaliser. Trois missions (formulées dans un langage métier)[4] ont été classifiées par ceux-ci dans la grille d'un outil d'aide au transfert. Mais pour le besoin de l'analyse, nous présentons une seule dans le tableau 2 (ci-dessous).

Tableau 2 : Missions réalisées et classifiées par l'apprenti dans Outil aide au transfert - Evaluation 1ère période d'apprentissage service DIM d'un hôpital – décembre 2009.

Missions réalisées	Type de mission (Grille)		Ressources identifiées lors de la 1ère séance à partir de la grille	Ressources mentionnées par l'apprenti lors de la 2ème séance
	Niveau 2	Niveau 3		
Fabrication de maquette de tableau de bord pour les responsables de pôles	T2.1 Traitement de données à Usage unique	T212 Conception d'indicateurs	Statistiques descriptives	Indicateurs synthétiques
			Communication écrite	
		T213 Implémentation - tests des indicateurs	BO ; Base de données Cortexte (logiciel dossiers patients)	Interrogation des BD sous Cortexte par les programmes SPSS
		T214 Ecriture documentation/mode opératoire	Communication écrite	

Nous analysons l'apport de l'outil dans la mobilisation de connaissances enseignées en entreprise à travers les systèmes d'activité de l'université et ceux de l'entreprise. Le tableau 2 (ci-dessus) restitue deux grandes phases :

[4] Deux autres missions ont été prescrites classifiées par le MA et réalisées par l'apprentie à l'aide de l'outil : Actualisation des cartes représentant la répartition par âge et par sexe de la population desservie par l'hôpital ; Elaboration du rapport d'activités du DIM sous SPSS.

- la grille d'aide au transfert a été présentée par le tuteur IUT et utilisée par le maître d'apprentissage pour classifier les missions de l'apprentie, et associer les ressources (Ressources identifiées lors de la 1ère séance à partir de la grille). C'est la première partie du tableau 2 (ci-dessous).
- l'apprentie a rempli la dernière colonne pour indiquer les ressources qu'elle a réellement utilisées. C'est la deuxième partie du tableau 2 (en gris).

De ce tableau, notre analyse va porter principalement sur la mission « Fabrication de maquette de tableau de bord pour les responsables de pôles » pour mieux expliquer les systèmes d'activité dans lesquels l'apprentie Juliette a navigué pour la réaliser à l'aide de l'outil. Cette mission a été classifiée par le maître d'apprentissage (MA) sur cet outil en « T2.1 Traitement de données à Usage unique » et détaillée en trois sous-missions (tableau 2):

- T212 Conception d'indicateurs ;
- T213 Implémentation - tests des indicateurs ;
- T214 Ecriture documentation / mode opératoire

De ces missions prescrites, les ressources potentielles (Ressources identifiées lors de la 1ère séance à partir de la grille) ont été associées par le MA. Un premier constat confirme que la typologie est fonctionnelle puisque toutes les missions proposées par le MA ont pu être classifiées sans grande difficulté. Les ressources effectivement mobilisées par l'apprentie Juliette se présentent de la façon suivante :

- T212 Conception d'indicateurs : Ce sont des « Indicateurs synthétiques » qui ont été élaborés, avec la connaissance tirée du module enseigné dans cette formation DUT STID qui est « Statistiques descriptives ».
- T213 Implémentation - tests des indicateurs : Il s'agit d'une « Interrogation de Base de données (BD) sous Cortexte (un logiciel métier : dossiers patients). Cela a été fait à partir de programmes du logiciel enseigné SPSS. Néanmoins, c'est la connaissance enseignée portant sur le logiciel « BO (Business object) qui a été identifiée initialement pour sa réalisation.

Les résultats de cette expérimentation, sont mieux illustrés sur la figure 5 ci-dessous en termes de systèmes d'activité interconnectés.

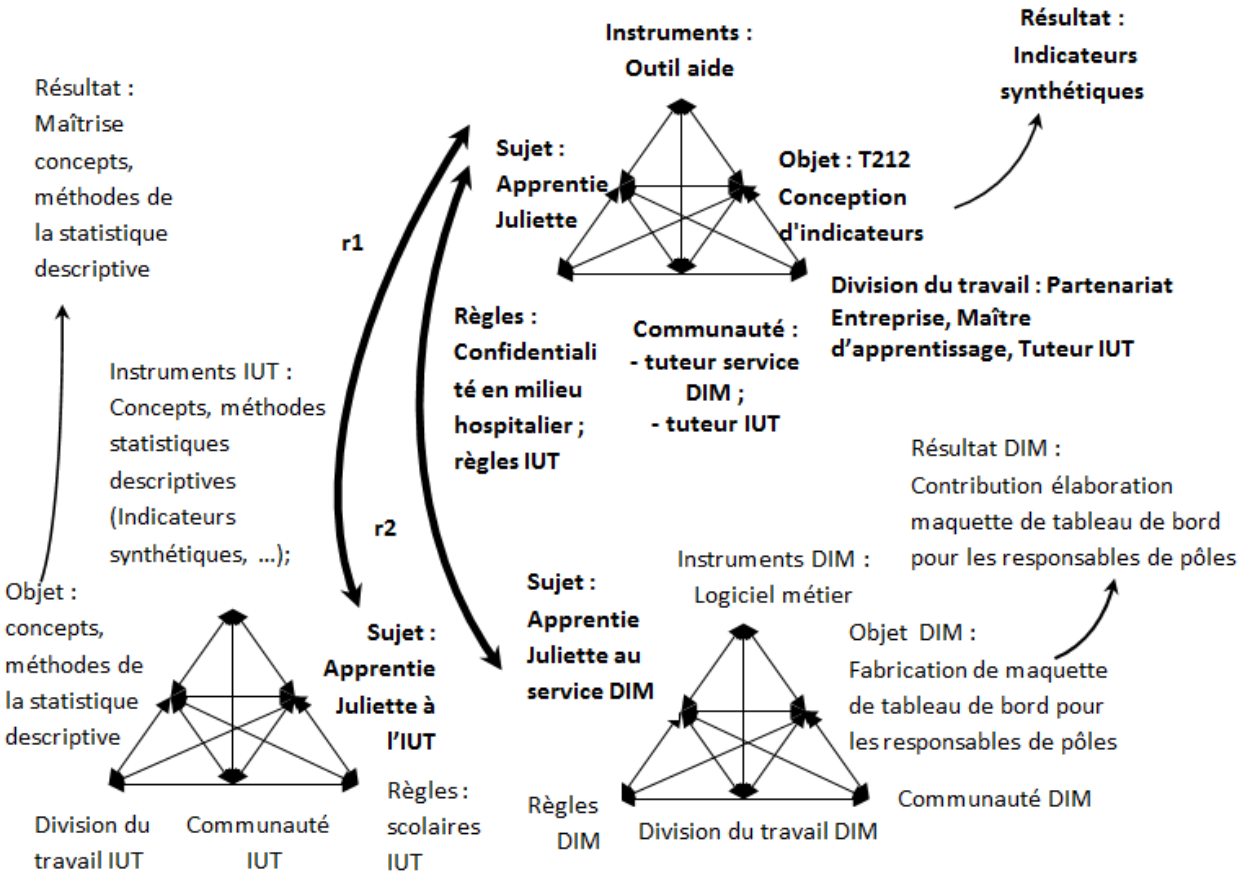

Figure 5 : Apprentie Juliette navigant dans des systèmes d'activité par l'Outil d'aide au transfert

L'apprentie Juliette est en apprentissage dans un hôpital (service DIM). Pour mieux exploiter l'outil d'aide au transfert de connaissances se positionne dans le système d'activité associé que nous avons nommé SA Apprentissage (de l'outil d'aide). Ainsi, Juliette ne se limite pas au système d'activité du service DIM (où elle réalise son apprentissage). Elle s'en détache par la relation r2 (Figure 5) pour chercher à travers la grille de l'outil d'aide (SA Apprentissage) les explicitations de la mission qui a été prescrite par son maître d'apprentissage et classifiée sur celle-ci.

L'apprentie en se positionnant dans le système d'activité de l'outil d'aide, navigue par boundary-crossing et à la fois dans le SA IUT (exemple : module enseigné statistique descriptive, interaction r1) et le SA DIM (interaction r2) de cette mission spécifique (figure 5). Cela se fait par le recours à des instruments (concepts et méthodes, logiciels) propres à chaque système d'activité et appropriés pour réussir son apprentissage (tableau 2 ci-dessus). Nous signalons que sans cet outil, rien n'était disponible dans l'organisation pédagogique initiale de cette formation DUT STID pour faciliter le transfert de connaissances enseignées à l'université (IUT) pour la réalisation des missions en entreprise durant l'alternance de l'étudiant de cette formation (tel qu'expliqué dans le diagnostic). L'apprentie ne peut réussir à assurer des activités de passage frontière tout seul sans l'encadrement du tuteur IUT et le maître d'apprentissage. Surtout si le tuteur n'a pas la compétence suffisante sur les systèmes d'activité de l'université (modules enseignés à l'IUT) pour aider le maître d'apprentissage à détailler et classifier sur la grille de l'outil les missions prescrites à l'apprenti formulées dans un langage spécifique au métier. Dans tous les quatre cas d'entreprise analysés, en général les apprentis ont bien fonctionné dans un processus de passage frontière à travers l'outil d'aide pour réaliser les missions qui leur ont été prescrites par leurs tuteurs par la mobilisation de connaissances enseignées à l'université (IUT).

L'expérimentation qui a été réalisée dans le service informatique d'une chambre régionale des métiers de l'artisanat (un des quatre cas d'entreprise) illustre encore l'apport de l'outil (MA : maître d'apprentissage une socio-économiste ; TI : tuteur IUT, Enseignante Informaticienne, ancienne directrice des études et ancienne responsable partenariat entreprise ; AL : apprentie en alternance au service informatique d'une chambre régionale des métiers de l'artisanat):

« *- MA: « je pense que c'est intéressant, en début d'apprentissage le maître d'apprentissage a déjà votre vision. D'habitude les cours on n'a aucun regard ; c'est assez difficile par rapport au programme d'avancement*

- TI: et pourtant c'est ce que je vous explique en PPP(module enseigné IUT : projet personnel et professionnel) dans des entreprises on fait une réunion le lundi matin dans les plus grandes structures le lundi matin quand l'apprenti revenait de l'IUT il fait une présentation sur ce qu'il a fait pendant les 2 semaines à l'IUT en prenant des cas qui peuvent intéresser l'entreprise on est en train de travailler sur un syllabus des enseignements une présentation détaillée des enseignements

- MA: mais on n'a pas de réunion tous les lundis c'est bien d'avoir ce support

- TI: Aujourd'hui on a ce support ….

- MA: oui, il est vraiment très bien fait

[…]

- Che (à l'apprentie) : par rapport à a grille pour la typologie de missions tu penses que c'est faisable /

- AL: C'est même intéressant pour les étudiants » Extrait 4 [5]

5 DISCUSSIONS

Les expérimentations, menées dans différents contextes professionnels, mettent en évidence que l'outil d'aide au transfert qui a été conçu pour tenter de répondre à ce problème possède des caractéristiques qui le rapprochent bien d'un objet-frontière. Dans les cas étudiés, il a suscité un réel intérêt, malgré sa complexité, tant du côté des tuteurs universitaires, des maitres d'apprentissage que des apprentis, tous y voyant des possibilités nouvelles pour leur propre activité. Par exemple, les apprentis sont souvent inquiets d'un éventuel manque de cohérence entre les tâches qui leur sont confiées en entreprise et les objectifs de la formation. Ils peuvent avoir l'impression, à tort ou à raison, que les missions prescrites sont trop marginales, trop restreintes ou de niveau de responsabilité trop faible. Cela peut même les conduire à se démobiliser en situation de travail. Cette inquiétude est partagée par certains maitres d'apprentissage et tuteurs universitaires qui craignent de mal jouer leur rôle. La typologie fournit une référence commune et complète sur les tâches types qu'il est possible et souhaitable de prescrire à un apprenti. Le processus de classification aide à initier des discussions sur le lien entre prescriptions confiées et périmètre de la formation. Si les tâches confiées aux apprentis sont trop restreintes, il peut conduire à une prise de conscience de la part du maître d'apprentissage et à un enrichissement des missions.

Les cas étudiés montrent aussi que le processus de classification débouche très souvent sur des prescriptions de travail plus détaillées que celles fournies initialement par le maître d'apprentissage. Si on se réfère à plusieurs études, ce genre d'explicitation des sous-buts de l'action joue un rôle très important de facilitation de l'engagement de l'apprenti dans les tâches confiées et, partant, de développement de son autonomie ([16], [17]). L'outil peut répondre à une préoccupation fréquente des maitres d'apprentissage, qui réclament d'être mieux informés sur ce qui est enseigné à l'IUT. Il faut rappeler ici que l'intérêt de nombreuses entreprises pour cette formation en alternance vient des connaissances en statistique ou traitement de données que les apprentis peuvent leur apporter. L'outil propose des ressources ciblées en fonction de chaque type de tâches et peut ainsi orienter la sélection des notions et méthodes plus pertinentes.

L'outil d'aide au transfert n'est nullement pas un instrument automatique. La classification des missions puis la sélection des ressources nécessitent une bonne expertise (horizontale) des contenus d'enseignement et des activités en entreprise des apprentis. Ces opérations ne sont d'ailleurs que les premières étapes du processus de transfert qui nécessite ensuite un travail de transposition des savoirs enseignés pour pouvoir les mobiliser en situation de travail. L'outil conçu a une fonction d'incitation et d'orientation vers certaines ressources, mais ne remplace pas l'expertise nécessaire pour accompagner les apprentis dans le processus de mobilisation des connaissances enseignées en situation de travail. En résumé, cet objet-frontière nécessite des acteurs frontières (courtiers) dotés de capacités à faire des liens entre des contextes d'apprentissage différents. La mise en place de formation à l'outil ne peut véritablement solutionner ce problème (on ne devient pas expert horizontal en quelques jours).

6 CONCLUSION

La mise en œuvre de l'outil a donc conduit à interroger une organisation du dispositif de suivi en situation de travail qui attribue formellement au tuteur universitaire un rôle d'aide au transfert de connaissances enseignées. Mais cet objectif rentre en contradiction avec une politique de répartition du tutorat dans cet établissement qui ne tient pas compte du degré d'expertise horizontale de chaque enseignant (tout enseignant est tuteur académique à l'IUT). Cette contradiction a été (et reste) un moteur intéressant pour repenser une organisation du tutorat plus collective, sur la base de la constitution d'un collectif professionnel des tuteurs universitaires. Nous pensons qu'un tel collectif pourrait se réunir deux à trois fois par an pour : 1) se former à l'utilisation de l'outil en début d'année universitaire ; 2) débriefer collectivement une ou deux séance de suivi en entreprise. Outre un partage des classifications de missions et des propositions de ressources réalisées dans les différentes entreprises et des difficultés rencontrées par certains tuteurs dans cette opération, ce type de collectif permettrait un suivi fin des évolutions des missions réalisées et des connaissances mobilisées par les étudiants. Ce suivi pourrait s'avérer fort utile à des responsables de formation pour faire évoluer le cursus et le ciblage des entreprises partenaires. Cela pourrait aussi contribuer à mieux reconnaître le rôle très important des tuteurs universitaires en complément de celui des maîtres d'apprentissage, et leurs besoins de formation propre pour bien assurer cette fonction.

REFERENCES

[1] Coppé, S., & al., *Etude de routines et régulations dans la pratique professionnelle d'un professeur des écoles.* In J. -L. Dorier, Artaud, M., Artigue, M., Berthelot, R., Floris, R. (Eds), Actes de la 11ème Ecoles d'Eté de la Didactique des Mathématiques. Corps - 19-30 Août 2001. Grenoble: La Pensée Sauvage, 2002.

[2] Eraut, M., *Transfer of knowledge between education and workplace settings*. In A. Fuller & A. Munro H. Rainbird (Ed.), Workplace learning in context (pp. 201-221). London: Routledge, 2004.

[3] Tuomi-Gröhn, T., &, Engeström, Y., *Between School and Work: New Perspectives on Transfer and Boundary-crossing*. Oxford: European Association for Learning and Instruction / Pergamon, 2003

[4] Veillard, L. , "Transfer of Learning as a specific case of transition between learning contexts", *a French work-integrated learning program.Vocations and Learning, vol. 5, no. 3*, 251-276, 2012.

[5] KOUAMÉ, K. D., *Conception et expérimentation d'un outil d'aide au transfert de connaissances enseignées. Cas d'une formation en alternance de Techniciens supérieurs en statistique et traitement informatique de données*, Thèse de doctorat, Université Lumière Lyon 2, 2013. Récupéré de http://theses.univ-lyon2.fr/documents/lyon2/2013/kouame_k/pdfAmont/kouame_k_these.pdf (22 octobre, 2014)

[6] Leontiev, A., N., *The problem of activity in psychology.* In J.V. Wertsch (Ed.) The concept of activity in Soviet psychology (pp. 37-71): Armonk, NY: Sharpe, 1979.

[7] Engeström, Y., *Learning by expanding: An activitv-theoretical approach to developmental research,* Helsinki: Orienta-Konsultit, 1987.

[8] Guile, D., & Young, M., *Transfer and transition in vocational education: Some theoretical considerations.* In T. Tuomi-Gröhn, Engeström , Y. (Ed.), Between school and work: New perspectives on transfer and boundary-crossing (pp. 63-81). Oxford, England: Pergamon, 2003.

[9] Engeström, Y., Engeström, R., & Kärkkäinen, M., Polycontextuality and boundary crossing in expert cognition: learning and problem solving in complex work activities. *Learning and Instruction,* no. 5, 319-336, 1995.

[10] Star, S. L., & Griesemer, J. R., Institutional ecology, "translations" and boundary objects: Amateurs and professionals in Berkley's Museum of Vertebrate zoology, 1907-1939, *Social Studies of Science,* no. 19, pp. 387-420, 1989.

[11] Wenger, E., *Communities of practice. Learning, meaning, and identity,* Cambridge: Cambridge University Press, 1998.

[12] Tuomi-Gröhn, T., Engeström, Y., & Young, M. (2003b), *From Transfer to Boundary-crossing Between School and Work as a Tool for Developing Vocational Education: An Introductio*, In Tuomi-Gröhn, T., &, Engeström, Y. (Ed). Between School and Work: New Perspectives on Transfer and Boundary-crossing (pp. 1-15). Oxford: European Association for Learning and Instruction / Pergamon, 2003.

[13] Veillard, L., & Kouamé, K. D., ''Collaboration chercheurs – formateurs pour la conception d'un outil d'aide au transfert de connaissances en formation par alternance '', *Travail et apprentissages*, no. 9, pp. 41-61, 2012.

[14] Tynjälä, P., *Connectivity and transformation in work-related learning. Theoretical fundation,* In M.-L. Stenström & P. Tynjälä (Ed.), Towards integration of work and learning. Strategies for connectivity and transformation, New-York: Springer, pp. 11-37, 2009.

[15] Veillard, L., & Kouamé, K. D., '' Conception collaborative d'un outil d'aide au transfert de connaissances enseignées en formation par alternance'', *Education et francophonie*, vol. 42, no. 1, 42-64, 2014.

[16] Filliettaz, L., ''Le discours de consignes en formation professionnelle initiale : une approche linguistique et interactionnelle'', *Education et Didactique*, vol. 3, no. 1, 91-122, 2009.

[17] Kunegel, P., *Les maîtres d'apprentissage. Analyses des pratiques tutorales en situation de travail,* Paris: L'Harmattan, 2011.

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Structure de la sismicité de la Branche occidentale des Rifts Valleys du système des Rifts Est-africains : de 1954 à 2010

[Structure of the seismicity of the Western Branch of the Rifts Valleys of Rifts system East African : from 1954 to 2010]

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ABSTRACT: Analysis of seismic parameters calculated such as spatial and temporal distribution of epicenters, seismic energy released, maximum magnitude recorded or calculated, in different zones under consideration of the western rift valleys branch classifying in many under zones (south Sudan, lake Albert, lake Edouard, lake Kivu, lake Tanganyika, Upemba rift, north of Zambia, lake Rukwa and lake Malawi) leads up to the establishment of the advanced seismic zoning map of seismic areas. In this study we observed:
- The major seismic activity is located faults zones;
- The seismic zoning shows that the seismic activity of western rift valleys is focused into three main zones:
1°) In the western north of south Sudan;
2°) In the lake Kivu, lake Tanganyika and lake Rukwa;
3°) In lake Malawi. The seismic activity of the Lake Malawi show many similarities with the seismic activity of the lake Rukwa.
- The seismic zoning shows low seismic activity in inter basins zones where the high volcanoes activity is localized;
- The major earthquakes are correlated at the high seismic activity;
- The seismic zoning shows the real possibility to indicate the fault location, when the zone is subdivised into four groups;
- The seismic activity is not equitably repartee in the zone;
The seismic energy released is moderate but, the Lake Kivu and the Lake Tanganyika shows the high seismic activity comparatively at an others zones. We can imagine the complex mineralogy and permanent features.

KEYWORDS: characterization, seismicity, western branch, seismic zoning, rift valleys, faulting.

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RESUME: L'analyse des paramètres sismiques calculés tels que la distribution spatiale et temporelle des épicentres, l'énergie sismique libérée, l'activité sismique, la magnitude maximale enregistrée ou calculée sur les zones de la branche occidentale subdivisées en sous zones (Sud – Soudan, lac Albert, lac Edouard, lac Kivu, lac Tanganyika, rift de l'Upemba, Nord–Zambie, lac Rukwa et le lac Malawi) débouche essentiellement à l'établissement de la carte de zonage sismique. L'étude a révélé que :
- L'activité sismique est intense tout au long (ou dans) des zones de fractures ;
- Le zonage sismique montre que la sismicité de la branche occidentale se concentre en trois endroits principaux :
1°) au Nord, dans la zone Sud – Soudan ;
2°) au centre, dans l'axe lac Kivu - lac Tanganyika – lac Rukwa ;
3°) au sud : au lac Malawi avec une forte ressemblance entre le lac Rukwa et Malawi.
- Le zonage sismique montre enfin que l'activité sismique de la branche occidentale est faible dans les zones interbassins qui, souvent, sont le siège d'une activité volcanique intense.
- Aux grands séismes correspond une fréquence élevée ou une activité sismique élevée.
- Le zonage sismique laisse entrevoir la possibilité d'identifier l'orientation des failles dans une zone subdivisée en, au moins, quatre sous zones
- La subdivision de chaque zone en sous zones a révélé la diversité de leur activité sismique
Bien que leur énergie libérée soit relativement faible, néanmoins, le lac Kivu et Tanganyika présentent une activité sismique plus intense que d'autres zones, indicatrice d'une fracturation persistante de la structure peut être également d'une minéralogie assez particulière.

MOTS-CLEFS: structure, sismicité, branche occidentale, zonage sismique, fracturation, rifts – Valleys.

1 INTRODUCTION

Le système des Rifts Est-africain se présente comme une extension continentale du système mondial des fractures lithosphériques qui serpentent au milieu des océans Atlantique et Indien d'où il se prolonge dans le Golf d'Aden et la Mer Rouge, il s'étend entre le parallèle 3°N et 10°S. Enfin, du détroit d'Afar, le système des fossés tectoniques s'étend en Afrique de l'Est où il se subdivise en deux branches (Fig.1) :

- la branche orientale qui couvre l'Ethiopie, le Kenya et la Tanzanie : est nommée « rift Kenyan » ou « rift Grégory » et ;
- la branche occidentale aussi appelée « Rift Ouest Africain» ou « rift des grands lacs» dans l'axe Nord – Sud, dont le lac Kivu occupe la partie centrale. Cette branche révèle plusieurs spécificités aussi bien du point de vue géologique que géodynamique.

De la mer Rouge au Zambèze, les Rifts Est-Africains couvrent plus de 6000 km de long sur 40 à 60 km de large. Notons que les deux branches orientale et occidentale qui se séparent en deux au niveau du linéament d'Assouan font une jonction au niveau du lac Malawi [1].

Le Rift Ouest Africain constitue un phénomène géodynamique composé d'un alignement de plusieurs fossés d'effondrement séparés par des failles au niveau desquels se sont formés les grands lacs alignés suivant un arc comprenant du Nord au sud: le lac Albert (altitude 617m), le lac Edouard (altitude 912 m), le lac Kivu (altitude 1462 m), le lac Tanganyika (altitude 780 m), le lac Rukwa (782 m), le lac Malawi (Nyassa) (altitude 460m), [2] , [3].

L'activité sismique enregistrée dans la zone système des Rifts Est-africain (Fig.2) et l'étendue des zones qu'elle affecte révèle la nécessité de sa caractérisation en vue de l'évaluation du potentiel en risque sismique. Cette évaluation doit être constamment et régulièrement actualisée aux vues de nouvelles données et traduite sous forme de carte de zonage sismique. Dans ce travail, nous nous intéressons à la branche occidentale.

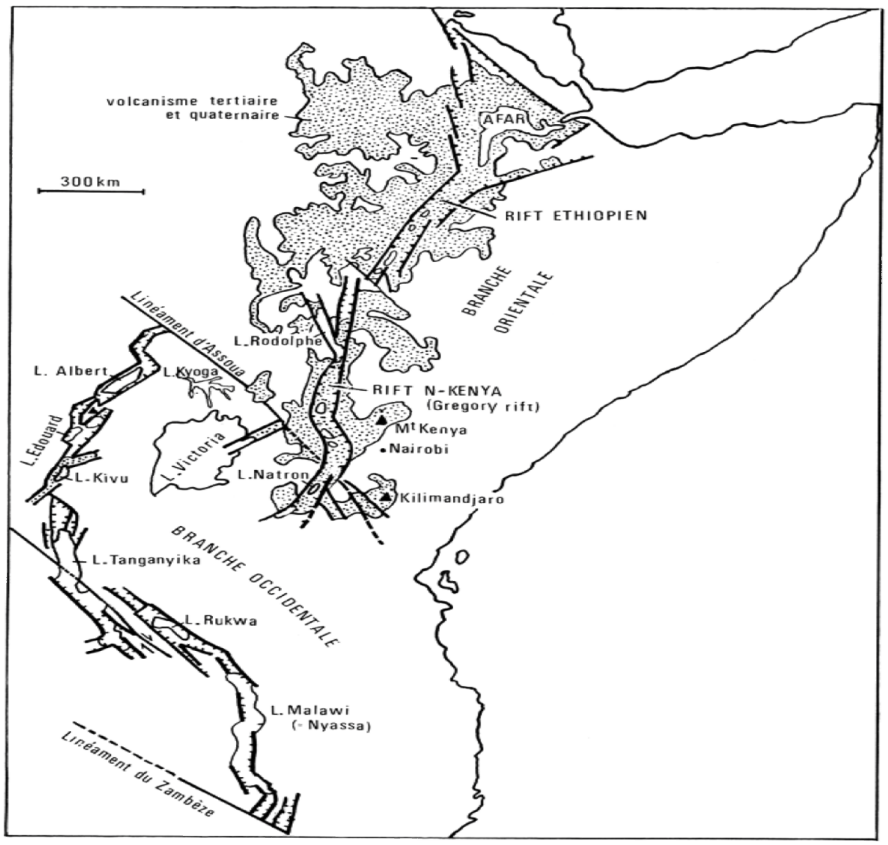


Fig.1: Le système des rifts Est-africain

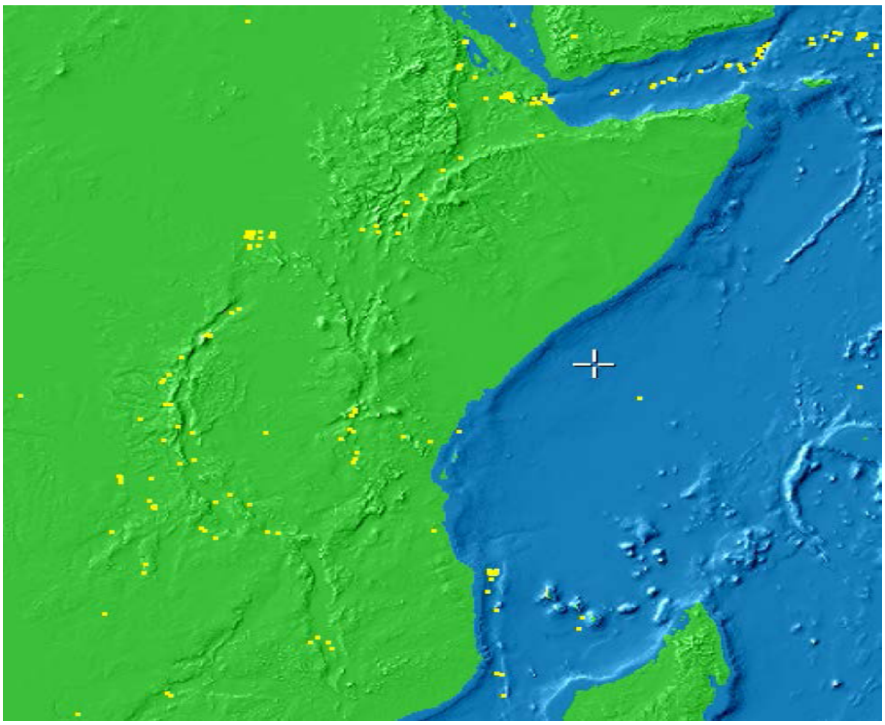


Fig. 2: Distribution des épicentres dans le Rift [1]

La structure de la branche occidentale du rift est-africain (Figure 2.3) est marquée par trois principales directions structurales, le NE-SW (lac Albert, lac Edouard, lac Kivu), le N-S (partiellement les uns et les autres) et le NW-SE (lac Tanganyika, lac Rukwa, lac Malawi). Toute l'orogenèse des lacs s'explique par le jeu mutuel de divers compartiments de ces copeaux de la lithosphère tassés au fond du rift et inégalement affaissés [4]. Ce nœud, ou s'opère la rencontre de toutes les fractures de deux systèmes conjugués, fut le siège d'importantes éruptions volcaniques. Les failles bordières des bassins sont généralement normales et les provinces volcaniques (Fig.3) se localisent dans les zones interbassins ; le rift Ouest Africain compte trois principales provinces volcaniques : la province du Toro-Ankole, la province du Sud-Kivu et la province des Virunga (avec, en l'occurrence, les volcans Nyiragongo et Nyamulagira), [5].

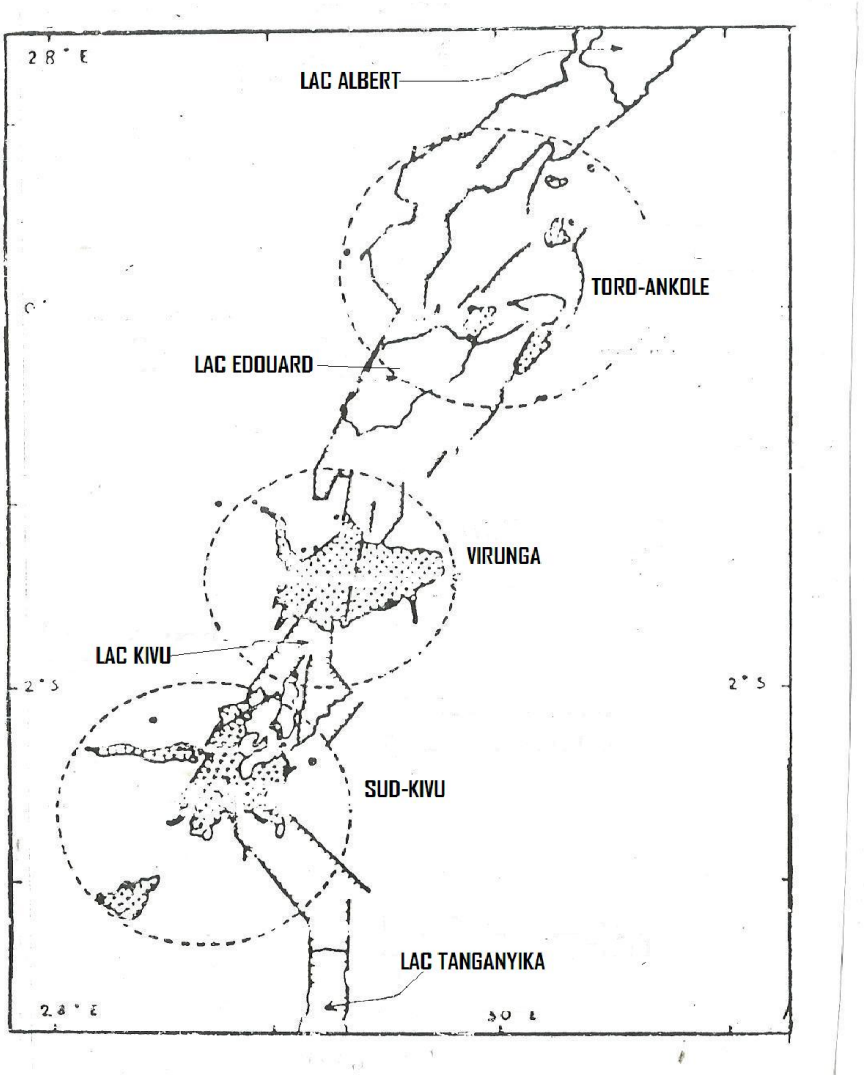


Fig. 3: Les aires volcaniques du rift congolais.

De manière générale, l'activité volcanique du rift Est – Africain est représentée dans la figure ci – dessous :

Fig.4. Activité volcanique du Rift

2 DONNEES ET METHODE D'ANALYSE

2.1 DONNÉES D'ANALYSE

Les données sismiques analysées dans cette étude sont celles obtenues sur le site de l'United States Geological Survey, USGS en sigle, [6] ainsi que celles tirées des bulletins CRSN / LWIRO (IRSAC) pour la période allant de 1954 à 2010 pour les séismes de magnitudes mb≥4.0. Le choix de la magnitude des ondes de volume, notée m_b, est justifié d'abord par le fait que la quasi-totalité des magnitudes est exprimée dans cette échelle, et que cette dernière montre peut d'écart entre les valeurs fournies par diverses institutions géophysiques. La zone étudiée s'étend de latitude 4°N à 14°S et de longitude 12° à 35°E (Fig.2).

La zone étudiée a été subdivisée en sous zones tel que illustre la Figure et tableaux suivants :

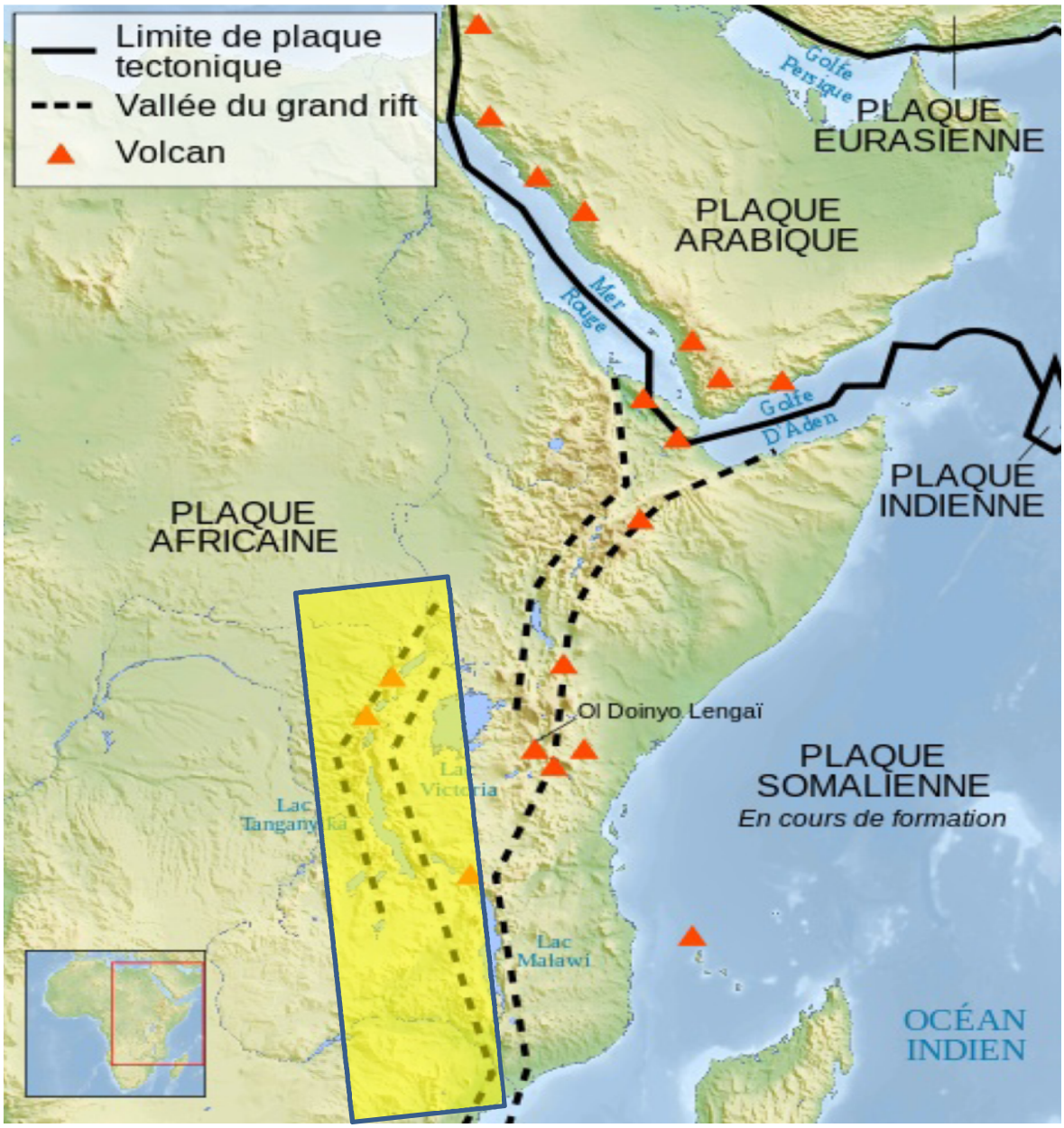


Fig.5 : Présentation des limites de la zone à l'étude en jaune

Les trois tableaux ci-dessous présentent les détails relatifs à chaque zone.

Tableau 1.a : Description des zones étudiées

Zones	Delimitation de la zone		Nombre de séismes enregistrés
	Longitude (°)	Latitude (°)	
SUD –SOUDAN (SS)	30,0 E – 34,0 E	LAT. 3,6 N – 6,0 N	84
LAC ALBERT (A)	28,3 °E – 33 °E	3,7 °N - 1,6 °N	58
LAC EDOUARD (E)	28,3 °E – 32 °E	0,5 °S- 1,51 °N	199
LAC KIVU (K)	26 °E – 30 °E	3,7°S – 0,5 °S	373
LAC TANGANYIKA (T)	29 °E-31,3°E	9 °S – 3 °S	390
ZONE MIXTE (RIFT DE L'UPEMBA) (M)	24,12 E – 31,33E	5,17 S – 14,6 S	183
LAC RUKWA (R)	31,0 E – 32,3 E	7,0 S – 9,0 S	46
LAC MALAWI (M)	32,0 E – 35,0 E	14,0 S – 9,0 S	47

Les différentes zones decrites ci-dessus sont ensuite subdivisées chacune en sous zones (Tableau 1.b) :

Tableau 1.b : Description des sous zones de chaque zone.

Sous zones du Lac Tanganyika (T)	**Délimitation approximative de la zone.**		**Nombre de séismes enregistrés.**
	Longitude (°)	**Latitude (°)**	
T_O	29 °E - 30,15 °E	9 °S – 3 °S	234
T_E	30,15 °E - 31,3 °E	9 °S – 3 °S	156
T_{NO}	29 °E - 30,15 °E	5 °S – 3 °S	122
T_{NE}	30,15 °E - 31,3 °E	5 °S – 3 °S	16
T_{CO}	29 °E - 30,15 °E	7 °S – 5 °S	89
T_{CE}	30,15 °E - 31,3 °E	7 °S – 5 °S	58
T_{SO}	29 °E - 30,15 °E	9 °S – 7 °S	23
T_{SE}	30,15 °E - 31,3 °E	9 °S – 7 °S	82
Sous zones du Lac Kivu (K)	**Délimitation approximative de la zone.**		**Nombre de séismes enregistrés.**
	Longitude (°)	**Latitude (°)**	
K_O	26 °E - 28 °E	3,7 °S – 0,5 °S	66
K_E	28 °E - 30 °E	3,7 °S – 0,5 °S	307
K_{N-O}	26 °E - 28 °E	2,1 °S – 0,5 °S	46
K_{N-E}	28 °E - 30 °E	2,1 °S – 0,5 °S	133
K_{S-O}	26 °E - 28 °E	3,7 °S – 2,1 °S	20
K_{S-E}	28 °E - 30 °E	3,7 °S – 2,1 °S	174

Tableau 1.b (suite) : Description des sous zones de chaque zone.

Sous zones du Lac Edouard (E)	Délimitation approximative de la zone.		Nombre de séismes enregistrés.
	Longitude (°)	Latitude (°)	
E_O	28,3 °E – 30,15 °E	0,5 °S- 1,51 °N	141
E_E	30,15 °E – 32 °E	0,5 °S- 1,51 °N	58
E_{N-O}	28,3 °E – 30,15 °E	1,51 °N - 0,5O5 °N	69
E_{N-E}	30,15 °E – 33 °E	1,51°N - 0,5O5 °N	42
E_{S-O}	28,3 °E – 30,15 °E	0,5 °S - 0,5O5 °N	72
E_{S-E}	30,15 °E – 32 °E	0,5 °S - 0,5O5 °N	16
Sous zones du Lac Albert (A)	**Délimitation approximative de la zone.**		**Nombre de séismes enregistrés.**
	Longitude (°)	**Latitude (°)**	
A_O	28,3 °E – 30,65 °E	3,7 °N - 1,6 °N	5
A_E	30,65 °E – 33 °E	3,7 °N - 1,6 °N	53
A_{N-O}	28,3 °E – 30,65 °E	3,7 °N - 2,65 °N	1
A_{N-E}	30,15 °E – 33 °E	3,7 °N - 2,65 °N	10
A_{S-O}	28,3 °E – 30,65 °E	2,65 °N - 1,6 °N	4
A_{S-E}	30,65 °E – 33 °E	2,65 °N - 1,6 °N	43

NB : O signifie Ouest signifie Est, N signifie Nord et S signifie Sud

Tableau 1.c : Description des autres zones

Sous zones de la zone SUD – SOUDAN (SS)	**Délimitation approximative de la zone.**		**Nombre de séismes enregistrés.**
	Logitude (°)	**Latitude (°)**	
NORD – EST(SS_{NE})	32,1 E – 34,0 E	4,81 N – 6,0 N	33
NORD – OUEST(SS_{NO})	30,0 E – 32,0 E	4,81 N – 6,0 N	23
SUD – EST (SS_{SE})	32,1 E – 34,0 E	3,6 N – 4,8 N	10
SUD –OUEST(SS_{SO})	30,0 E – 32,0 E	3,6 N – 4,8 N	18
Sous zones de la zone ZONE MIXTE (RIFT DE L'UPEMBA)	**Délimitation approximative de la zone**		**Nombre de séismes enregistrés.**
	Longitude	**Latitude**	
NORD – EST (M_{NE})	27,73 E – 31,33 E	9,89 S – 5,17 S	60
NORD – OUEST (M_{NO})	24,12 E– 27, 72E	9,89 S – 5,17 S	17
SUD – EST (M_{SE})	27,73E – 31,33 E	14,6 S – 9,88 S	26
SUD –OUEST (M_{SO})	24,12 E – 27,72 E	14,6 S – 9,88 S	80
Sous zones de la zone LAC RUKWA	**Délimitation approximative de la zone**		**Nombre de séismes enregistrés.**
	Longitude	**Latitude**	
NORD – EST (R_{NE})	31,66 E – 32,3 E	7,99 S – 7,0 S	13
NORD – OUEST(R_{NO})	31,0 E – 31,65 E	7,99 S – 7,0 S	14
SUD – EST (R_{SE})	31,66 E – 32,3 E	9,0 S – 8,0S	8
SUD –OUEST (R_{SO})	31,0 E – 31,65 E	9,0 S – 8,0 S	11

Sous zones de la zone LAC MALAWI	Délimitation approximative de la zone		Nombre de séismes enregistrés.
	Longitude	Latitude	
NORD – EST (ML_{NE})	33,51 E – 35,0 E	11,49 S – 9,0 S	17
NORD – OUEST (ML_{NO})	32,0 E – 33,5 E	11,49 S – 9,0 S	11
SUD - EST(ML_{SE})	33,51 E – 35,0 E	14,0 S - 11,5 S	14
SUD -OUEST(ML_{SO})	32,0 E – 35,0 E	14,0 S – 9,0 S	5

Les données recueillies sur la sismicité de la région sous étude ont permis de déduire, dans chaque zone, pour la période allant de 1954 à 2010, les paramètres suivants :

- la distribution spatiale et temporelle des épicentres,
- la distribution des énergies libérées,
- la fréquence de séismes et la période de récurrence,
- la magnitude maximale possible calculée ou enregistrée dans chaque zone,

2.2 MÉTHODE D'ANALYSE

Pour la mise en évidence de la spécificité de la sismicité de la branche occidentale, les données collectées sont analysées en faisant usage d'artifices mathématiques couramment exploitées en sismologie. Les paramètres étudiés dans chaque zone sont :

2.2.1 LA DISTRIBUTION TEMPORELLE DES PARAMETRES SISMIQUES

Une série chronologique est une série statistique obtenue en étudiant l'évolution d'un phénomène ou paramètre en fonction du temps. Dans un repère cartésien, on représente la série statistique à deux variables par les points M_i de coordonnées x_i et y_i .L'ensemble de ces points constitue ce qu'on appelle nuage de points [7]. Dans notre cas, x_i représente l'année ou le mois et y_i le paramètre à l'étude (nombre de séismes, magnitude maximale, énergie, activité sismique…) ; il s'agit des paramètres ci-dessous.

a) Le nombre de séismes : il s'agit de déterminer le nombre total de séismes enregistrés par année ou par mois cumulé sur 36 ans dans chaque zone à l'étude; nous avons ainsi procédé au comptage cumulé d'événements survenus dans chaque zone.

b) La magnitude maximale possible: la magnitude maximale possible, notée m_{bmax}, est définie comme étant la magnitude la plus élevée enregistrée par année ou par mois.

c) La fréquence relative de séismes : La fréquence relative des séismes est le rapport entre le nombre total (N) des séismes qui se sont produits dans une zone donnée par la période considérée ; ce paramètre fournit aussi une indication sur l'activité sismique, c'est-à-dire le taux d'accumulation d'énergie.

d) La période de récurrence :

La période de récurrence (T) mesure le temps, en année, qui sépare l'occurrence d'un séisme de même magnitude ; c'est en fait le rapport entre la période (P) considérée et le nombre total(N) de séismes enregistrés dans une zone donnée pour la même période. Nous pouvons l'écrire:

$$T = \frac{P}{N} \qquad (1)$$

La période de récurrence est l'inverse de la fréquence. Nous pouvons la calculer de deux manières:

- **Suivant les statistiques** nous exploitons la relation courante établie par Gutenberg(1930)

$$logN = a - b.m_b \qquad (2)$$

Cette relation peut encore s'écrire de la manière suivante en fonction de la magnitude des ondes de surface:

$$log = a' - b'.M_s \qquad (3)$$

Ces relations permettent d'obtenir le nombre total(N) de séismes de magnitude égale ou supérieure à m_b pour une zone et période P données ; d'où

$$N = 10^{a-b.m_b} \quad (4)$$

- **Suivant les données d'observation** : Dans ce cas, N est le nombre de séismes enregistrés par classe(C_i) de magnitude dans la zone considérée en exploitant les données d'observation les résultats figurent dans le Tableau 4.

e) L'activité sismique : l'activité sismique moyenne est le rapport entre le nombre total de fois qu'il y a eu occurrence d'au moins un séisme et la période considérée (nombre de mois ou d'années) ; c'est donc le rapport entre les cas favorables sur les cas possibles [8], 36 ans ou 12 mois dans notre cas. Nous avons considéré l'activité **sismique moyenne annuelle** et l'**activité sismique moyenne mensuelle.**

f) L'énergie sismique libérée : l'énergie sismique (E, en erg) libérée par le séisme de magnitude égale à m_b, dans une zone donnée est obtenue à l'aide de la formule ci-dessous [9]:

$$logE = 5{,}8 + 2{,}4m_b \quad (5)$$

qui peut encore s'écrire en fonction de la magnitude des ondes de surface (M_s) :

$$logE = 11{,}8 + 1{,}5M_s \quad (6)$$

Pour ce faire, l'énergie sismique totale libérée dans une zone et pour une période déterminée est la somme des énergies libérées par chaque séisme.

2.2.2 LA DISTRIBUTION SPATIALE DES MAGNITUDES

La distribution spatiale des magnitudes consiste à étudier la répartition de ces magnitudes en fonction de la longitude ou de la latitude à partir des données d'observation. Ainsi, chaque point du repère cartésien aura pour abscisse la longitude ou la latitude et la magnitude en ordonnée [10].

2.2.3 LES STATISTIQUES DE SÉISMES

Soit N le nombre total de séismes qui se sont produits dans une zone déterminée et pour une période précise. A chaque séisme i, appelé aussi événement, on associe une magnitude m_{bi} et un moment sismique M_{oi} .Il en est de même au point 2.2.4,2.2.5 et 2.2.6.

Les études statistiques faites sur la sismicité par divers auteurs et dans diverses zones du globe reposent sur la relation de Gutenberg(1930):

$$logN = a - b.m_b \quad (7)$$

où N représente le nombre de séismes de magnitude supérieure ou égale à la magnitude m_b. Nous considérons les événements de magnitude m_b supérieure à quatre par pas de 0,1 jusqu'à la valeur maximale de la magnitude. Les constantes a et b sont obtenues par application de la loi des moindres carrés aux résultats obtenus à partir du tableau statistique ($m_{bi,}$ $logN_i$). Cette dernière relation permet d'évaluer la période de récurrence et la magnitude maximale possible calculée (m_b) que nous pouvons enregistrer dans une zone sismique donnée, tel que :

$$m_b = \frac{a}{b} \quad (8)$$

Cette magnitude est notée par la suite m_{b1} pour la différencier de celle observer instrumentalement, c'est-à-dire enregistrée à la station, notée m_{b3}. La valeur élevée de la constante b, qui est généralement inférieure à 1, traduit l'existence d'une activité sismique intense ou présence d'essaims dans la zone à l'étude [11].

La relation (7) permet d'évaluer le nombre total, N, de séismes de magnitude supérieur à m_b :

$$N = 10^{a-b.m_b} \quad (9)$$

3 RESULTATS ET DISCUSSION

Les différents résultats obtenus se présentent de la manière suivante :

3.1 LA DISTRIBUTIONS PATIO- TEMPORELLE DES PARAMETRES SISMIQUES

Les résultats obtenus en rapport avec le nombre de séismes, la magnitude maximale, l'énergie sismique en fonction du temps sont repris, à titre illustratif, dans le Tableau 2 ci-dessous.

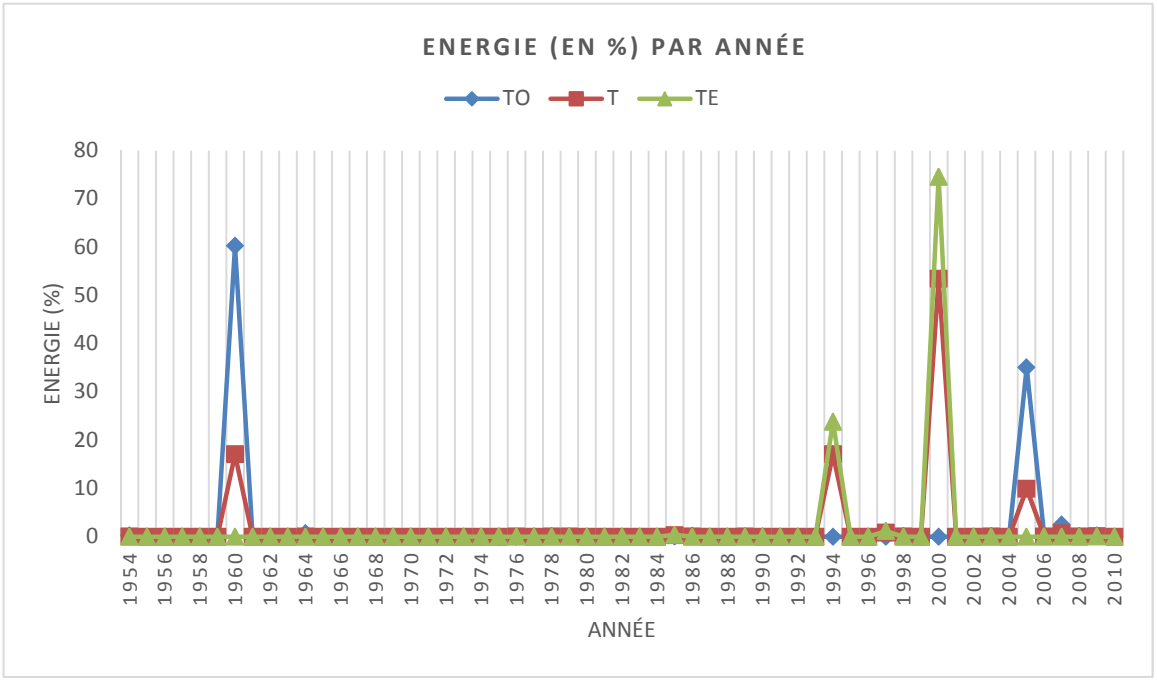
Tableau 2.a : Extrait des résultats des paramètres temporels calculés pour sous zones de la zone Tanganyika

MOIS	Nombre cumulé de séismes de 1954 à 2010			M_{bmax} Observée (m_{b3})			Energie ($\times 10^{17}$ ergs)		
	T_O	T	T_E	T_O	T	T_E	T_O	T	T_E
JANVIER	9	25	16	5,3	5,3	5	100,245	112,092	11,847
FEVRIER	19	25	6	5,2	5,7	5,7	26,8872	429,205	402,318
MARS	13	21	8	5,8	5,8	5,1	1087,66	1100,35	12,6959
AVRIL	16	27	11	5,2	5,1	4,8	40,5885	46,6704	6,08184
MAI	15	25	10	4,7	4,7	4,7	2,24418	4,6164	2,37222
JUIN	19	31	12	5,4	5,4	4,6	68,3606	70,2425	1,88183
JUILLET	26	47	21	5,5	5,5	5	139,322	154,165	14,8432
AOUT	14	27	13	4,7	5,2	5,2	3,32491	25,1853	21,8604
SEPTEMBRE	20	40	20	6,5	6,5	5,9	25150,6	26387,3	1236,69
OCTOBRE	17	34	17	5,2	6,7	6,7	24,8768	103764	103739
NOVEMBRE	33	45	12	5,4	5,4	4,9	117,573	127,596	10,0235
DECEMBRE	33	43	10	6,4	6,4	4,9	14951,9	14957	5,10647

Tableau2.b : Extrait des résultats des paramètres temporels calculés pour sous zones de la zone Tanganyika

Année	Nombre de séismes (1954-2010)			Magnitude maximale (M_{bmax}) Observée			Energie ($\times 10^{17}$ ergs)		
	T_O	T	T_E	T_O	T	T_E	T_O	T	T_E
1954	2	2	0	5,5	5,5	0	100,025	100,25	0
1955	3	4	1	4,6	4,6	4,3	0,867308	0,999134	0,131826
1956	6	8	2	4,6	4,6	4,5	1,24115	1,66438	0,423226
1957	7	7	0	4,7	4,7	0	1,73778	1,73778	0
1958	6	9	3	4,4	4,7	4,7	0,53066	1,8339	1,30324
1959	2	4	2	4,2	4,3	4,3	0,100977	0,364628	0,263651
1960	27	29	2	6,5	6,5	4,1	25133,5	25133,6	0,087303
1961	13	17	4	4,7	4,7	4,6	1,91547	3,12492	1,20945
1962	10	15	5	4,8	4,8	4,2	2,50465	2,73658	0,231931
1963	8	13	5	4,6	4,6	4,6	1,41626	2,2271	0,810839
1964	4	12	8	5,7	5,7	4,4	302,96	30,3578	0,617963
1965	3	6	3	4,5	4,5	4,2	0,466878	0,630039	0,163161
1966	5	10	5	4,6	4,6	4,2	0,861578	1,10718	0,245605
1967	5	8	3	4,2	4,9	4,9	0,296344	4,64407	4,34773
1968	7	14	7	4,2	4,3	4,3	0,328049	0,837305	0,509256
1969	7	19	12	4,3	4,7	4,7	0,559995	3,80595	3,24596
1970	1	7	6	4	4,4	4,4	0,0251189	0,630279	0,60516
1971	0	0	0	0	0	0	0	0	0
1972	0	1	1	0	4,6	4,6	0	0,691831	0,691831
1973	1	6	5	4,2	4,7	4,7	0,0758578	2,14311	2,06725
1974	2	2	0	4,6	4,6	0	0,767689	0,767689	0
1975	1	4	3	4,4	5,1	5,1	0,229087	12,24398	12,2107
1976	1	3	2	4,2	5,2	5,2	0,0758578	21,2198	21,1439
1977	2	4	2	5,1	5,1	4,8	12,167	14,3322	2,16515
1978	1	1	0	5,3	5,3	0	33,1131	33,1131	0
1979	4	4	0	5,2	5,2	0	25,0038	25,0038	0
1980	1	3	2	3,8	4,4	4,4	0,0083176	0,281056	0,272738
1981	3	4	1	4,7	4,7	4,6	1,28957	1,9814	0,691831
1982	3	6	3	4,1	4,1	4	0,0664236	0,0998601	0,033437
1983	1	2	1	3,7	3,8	3,8	0,0047863	0,0131039	0,008318
1984	2	5	3	4,7	4,7	4,6	1,24592	1,96287	0,71695
1985	3	8	5	5,1	5,7	5,7	11,2697	413,519	402,249
1986	6	9	3	5,4	5,4	4,8	70,6049	73,1682	2,56326

Les résultats du tableau 2 ci-dessus sont représentés de la manière suivante sous forme de courbes.



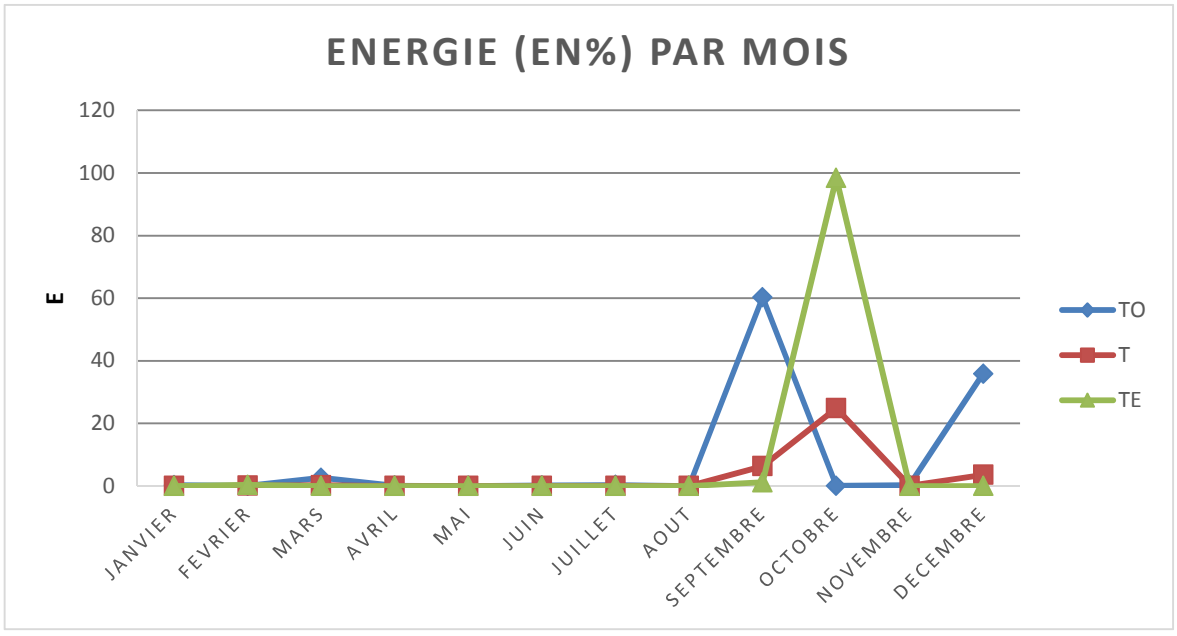


Fig.6: Courbes relatives au Tableau 2: en haut et en bas, respectivement, l'évolution de l'énergie en fonction de l'année et l'évolution de l'énergie cumulée en fonction du mois pour les sous zones du lac Tanganyika

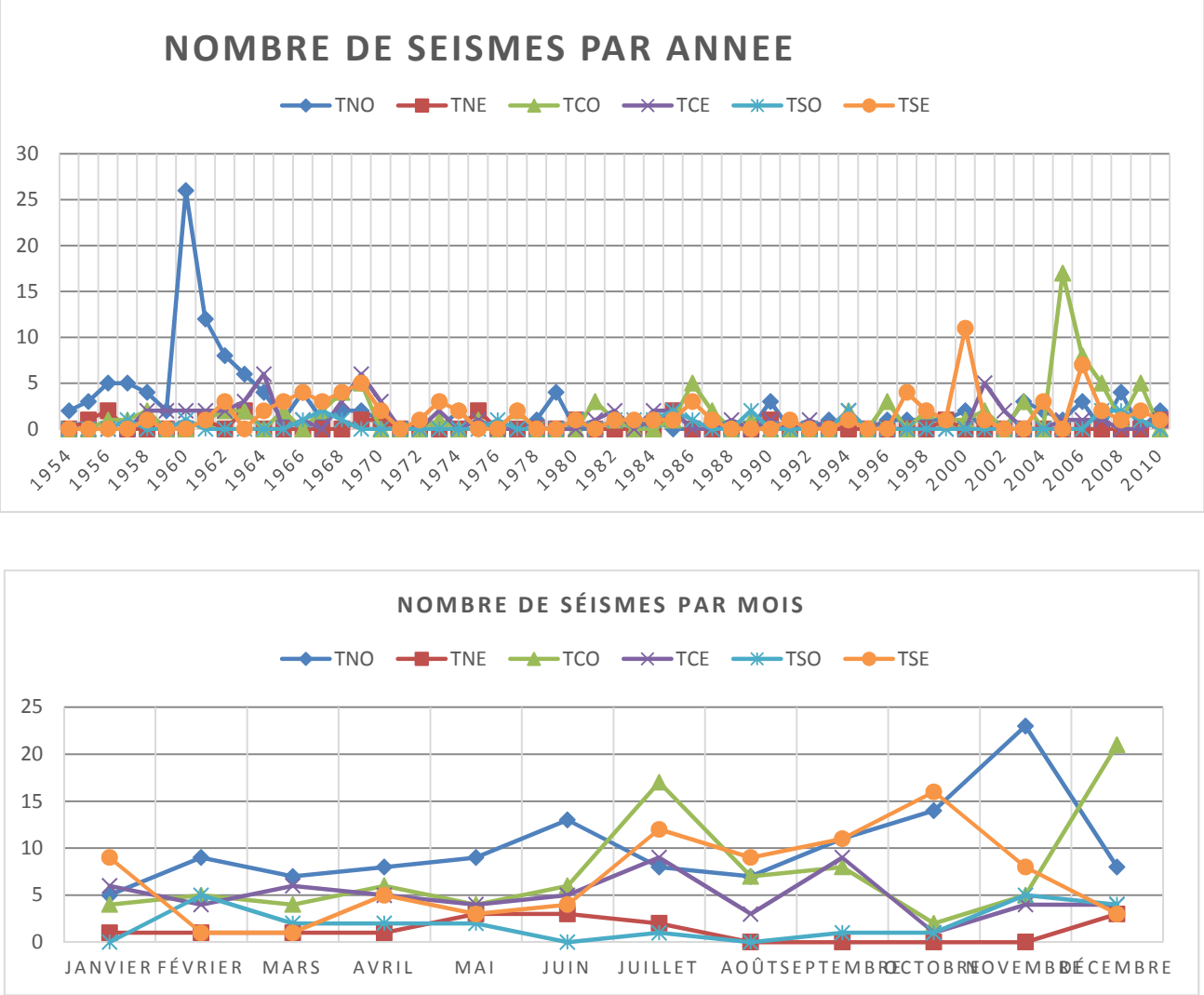


Fig.7 : Courbes relatives au Tableau 2: en haut et en bas, respectivement, l'évolution du nombre de séismes en fonction de l'année et en fonction du mois pour les sous zones du lac Tanganyika

3.2 ZONAGE SISMIQUE

En exploitant les résultats des différents paramètres calculés, nous parvenons à établir la carte de zonage sismique en attribuant le niveau de zonage sismique à chaque sous zone suivant les caractéristiques ou principes ci –dessous :

a) Le niveau de zonage I est caractérisé par les séismes de magnitude$4 \leq m_b \leq 4{,}9$. Elle contient les zones qui sont peintes en vert.
b) La zone II comprend tous les séismes de magnitude$5 \leq m_b \leq 5{,}9$. Elle est représentée par la couleur bleu avec toutes ses nuances.
c) La zone III contient les événements de magnitude$6 \leq m_b \leq 6{,}9$. Ces zones sont colorées en orange, violet, jaune ou rouge.
d) La zone IV, elle comprend tous les événements de magnitude$7 \leq m_b \leq 7{,}9$. Elle est peinte en rouge foncé.

Deux ou plusieurs séismes peuvent avoir un même niveau de zonage, mais différer sur d'autres aspects ou paramètres calculés.

D'où l'importance d'adjoindre d'autres paramètres distinctifs à chaque niveau de zonage ; une sorte de structure (hyper) fine ou de dégénérescence. Ainsi, par exemple si on écrit le niveau $X_{123\,(4)}$, ce ci signifie :

X est le niveau de zonage (I, II, III ou IV) décrits ci – dessus.

Les indices traduisent ce qui suit :

- 1 est liée à l'énergie libérée
- 2 est liée à l'activité sismique annuelle
- 3 est liée à l'activité sismique mensuelle
- (4) au cas où deux ou plusieurs zones sont identiques, on peut enfin les distinguer comme suit en fonction de l'indice (4) qui est lié à la fréquence des séismes de magnitude $5 \leq m_b \leq 5{,}9$ pour les zones de magnitude maximale observé comprise entre 6 et 6,9 et la fréquence de séismes de magnitude $6 \leq m_b \leq 6{,}9$ pour les séismes de magnitude $m_b \geq 7$

D'une façon générale, ces indices ne peuvent prendre qu'une seule valeur a ou b pour les indices 1,2 ou 3.

a correspond à une valeur de paramètre $< 50\ \%$

b correspond à une valeur de paramètre $\geq 50\ \%$

quand à l'indice (4), permettant de distinguer deux sous zones identiques, a <b en fonction de la fréquence des séismes de magnitude$5 \leq m_b \leq 5{,}9$.

Par exemple : la zone T_{NO} et la zone T_{CO} (cfr Tableau 3) ont le même niveau de zonage III_{abb} c'est-à-dire que : III=$6 \leq m_b \leq 6{,}9$.

$a = l'énergieliberée\ est\ inféreiure$ à $100\%\ de\ l'energielibérée\ partoute\ la\ zone$

$$Tanganyika\ subdivisée\ en\ 6\ sous\ zones.$$

$$b = l'activité\ sismique\ est\ >$$ à $50\ \%$

Toutefois, la zone T_{CO} connait une fréquence de séisme de $5 \leq m_b \leq 5{,}9$ supérieure (22,6 %) à celle de T_{NO} (7 %) d'où $III_{abb\ (b)}$ pour T_{CO} et $III_{abb\ (a)}$ pour T_{NO}.

A titre illustratif, nous présentons ci-dessous le tableau synoptique de la sismicité du lac Tanganyika

tableau 3: tableau synthétique des paramétres sismiques de la zone du lac tanganyika

ZONES	DENOMINATION / PARAMETRES CALCULES PAR ZONE	MAGNITUDE MAXIMALE OBSERVEE ET MAGNITUDE MAXIMALE CALCULEE		NOMBRE DE SEISMES ET MAGNITUDE		ENERGIE LIBEREE	ACTIVITE SISMIQUE		CLASSE (MAGNITUDE)						CONTRIBUTION		NIVEAU DE ZONAGE
									I: $4 \leq m_{bo} \leq 4{,}9$		II: $5 \leq m_{bo} \leq 5{,}9$		III: $6 \leq m_{bo} \leq 6{,}9$		Nombre de séismes	Fréq. de Seismes	
	SYMBOLES DES PARAMETRES CALCULES	m_{bo}	m_{bc}	a	b	E_T (en %)	Mensuelle	Annuelle	N	T	N	T	N	T	N_T (%)	f	
									Taux		Taux		Taux				
T	Zone du Lac Tanganyika	6,7	6,9110265	5,8101	0,8407	100%	100%	97%	137	0,42	40	1,42	5	11,4	100%	7	IIIbbb
									76%		**22%**		**2%**				
T_O	Partie Ouest de T	6,5	6,5309	5,8824	0,9007	28,34%	100%	88%	180	0,32	31	1,8	2	28,5	60%	4,2	IIIabb
									84,50%		**14,6**		**0,9**				
T_E	Partie Est de la zone T	6,7	6,669	4,9571	0,7433	71,66%	100%	81%	129	0,44	9	6,3	3	19	40%	2,8	IIIbbb
									91,50%		**6,40%**		**2,10%**				
T_{NO}	Partie Nord-Ouest de T	6,5	6,1107	5,6322	0,9217	17,64%	100%	63,20%	110	0,52	8	7,1	1	57	31,28%	2,2	IIIabb
									92%		**7%**		**1%**				
T_{NE}	Partie Nord-Est de T	5	4,9262	6,8055	1,3815	0,01%	67%	21,10%	14	4,1	1	57	0	0	4,10%	0,3	IIaab(a)
									93,30%		**6,70%**		**0%**				
T_{CO}	Partie Centre-Ouest de T	6,4	6,2954	5,2623	0,8359	10,86%	100%	58%	64	0,9	19	3	1	57	22,82%	1,6	IIIabb(b)
									76,20%		**22,60%**		**1,20%**				
T_{CE}	Partie Centre-Est de T	5,7	5,616	5,6969	1,0144	0,29%	100%	49,10%	49	1,2	3	19	0	0	14,87%	1,04	IIaab(c)
									94,20%		**5,80%**		**0%**				
T_{SO}	Partie Sud-Ouest de T	5,2	5,8795	3,854	0,6555	0,04%	83%	30%	14	4,1	4	14,3	0	0	5,90%	0,4	Iiaab(b)
									77,80%		**22,20%**		**0%**				
T_{SE}	Partie Sud-Est de T	6,7	6,7003	4,2674	0,6369	71,30%	100%	57%	66	0,9	5	11,4	3	19	21,03%	1,5	IIIbbb
									89,00%		**6,80%**		**4,20%**				

De cette nomenclature ou légende, nous obtenons la carte de zonage sismique suivante :

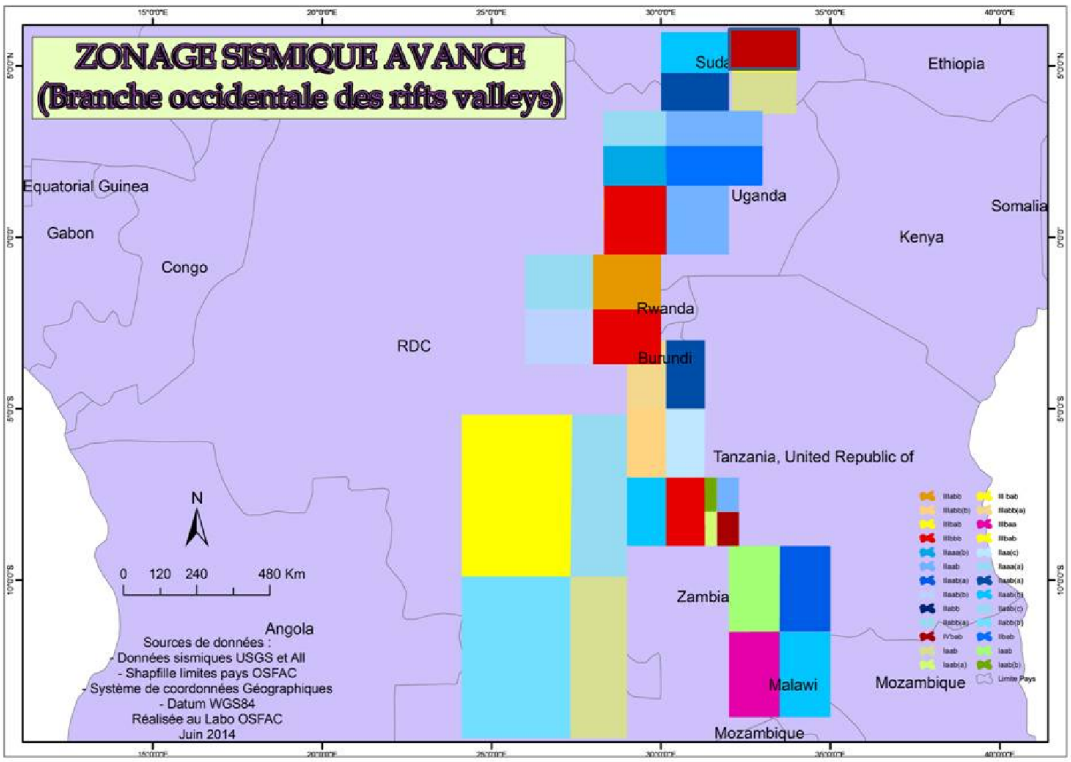


Fig.7 : Carte de zonage sismique de la branche occidentale du rift Valleys

Tableau 4. Légende des niveaux de zonage et code de couleur associé pour la Fig.7, 8,9

Niveau de zonage codé	Niveau de zonage	couleur
1	$I_{aab\ (a)}$	Vert clair
2	$I_{aab\ (b)}$	Vert foncé
3	$II_{aaa\ (a)}$	Bleu - w
4	$II_{aaa\ (b)}$	Bleu - x
5	$II_{aab\ (a)}$	Bleu - y
6	$II_{aab\ (b)}$	Bleu - z
7	$II_{aab\ (c)}$	Bleu clair
8	II_{abb}	bleu
9	II_{bab}	Bleu foncé
10	$III_{abb\ (a)}$	orange
11	$III_{abb\ (b)}$	orangé
12	III_{baa}	violet
13	III_{bab}	jaune
14	III_{bbb}	rouge
15	$IV_{bab\ (a)}$	Rouge foncé
16	$IV_{bab\ (b)}$	Rouge sang

Avec I< II < III< IV (relatif à la magnitude maximale observée) et a< b(relatif à l'activité sismique annuelle ou mensuelle)

Cette même carte peut se traduire sous forme de graphique, où l'axe des abscisses reprend les en zones partant du nord vers le sud, alors que l'axe des ordonnées reprend le niveau de zonage (codé suivant le Tableau 4) associé à chaque zone.

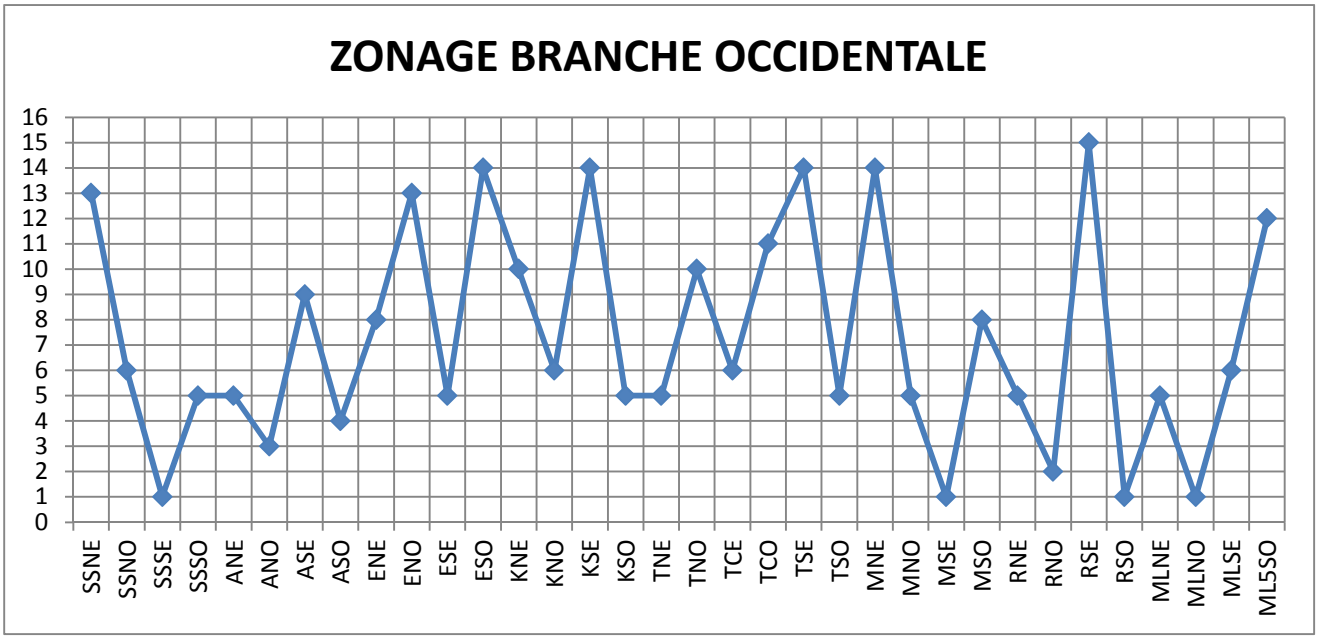


Fig.8 : Evolution du niveau de zonage du nord au sud pour la branche occidentale

De même, au lieu du niveau de zonage codé en ordonnée, nous remplaçons par la magnitude maximale observée pour chaque sous zone en abscisse,

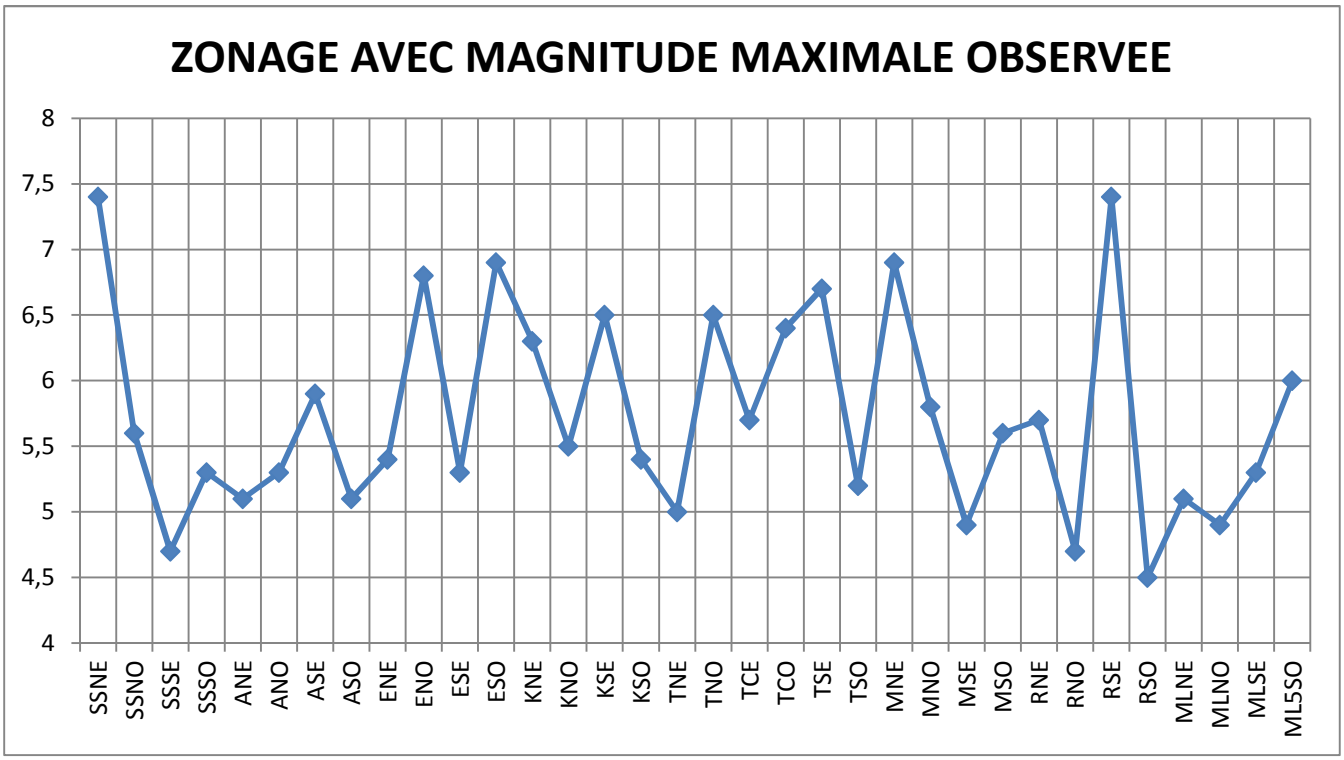


Fig.9 : Evolution de la magnitude maximale observée du nord au sud pour la branche occidentale

La comparaison des différentes zones à partir des différents tableaux et figures ci- dessus en fonction de la b – value et du niveau de zonage débouche sur un regroupement des sous zones tel exprimé par le tableau suivant :

Tableau 5 : b – value pour chaque sous zone

B-VALUE > 1	ZONES	A_{NO}	E_{NE}	K_{NO}	K_{NE}	T_{NE}	T_{CE}	R_{SO}	R_{NO}	ML_{NO}	ML_{SE}	ML_{NE}	
	VALEURS	5,3	1,0059	1,2837	1,0109	1,3815	1,0144	1,5	1,643	1,313	1,1667	1,1273	
$B\ VALUE$ < 1	ZONES	SS_{NE}	SS_{NO}	SS_{SE}	SS_{SO}	A_{NE}	A_{SE}	A_{SO}	E_{NO}	E_{SE}	E_{SO}	K_{SE}	
	VALEUR	0,5321	0,62	0,89	0,68	0,7728	0,8592	0,6114	0,676	0,7398	0,649	0,7112	
	ZONES	K_{SO}	T_{NO}	T_{CO}	T_{SE}	T_{SO}	M_{NE}	M_{NO}	M_{SE}	M_{SO}	R_{NE}	R_{SE}	ML_{SO}
	VALEURS	0,7958	0,9217	0,8359	0,6369	0,6555	0,6481	0,8786	0,78	0,8654	0,6875	0,391	0,44

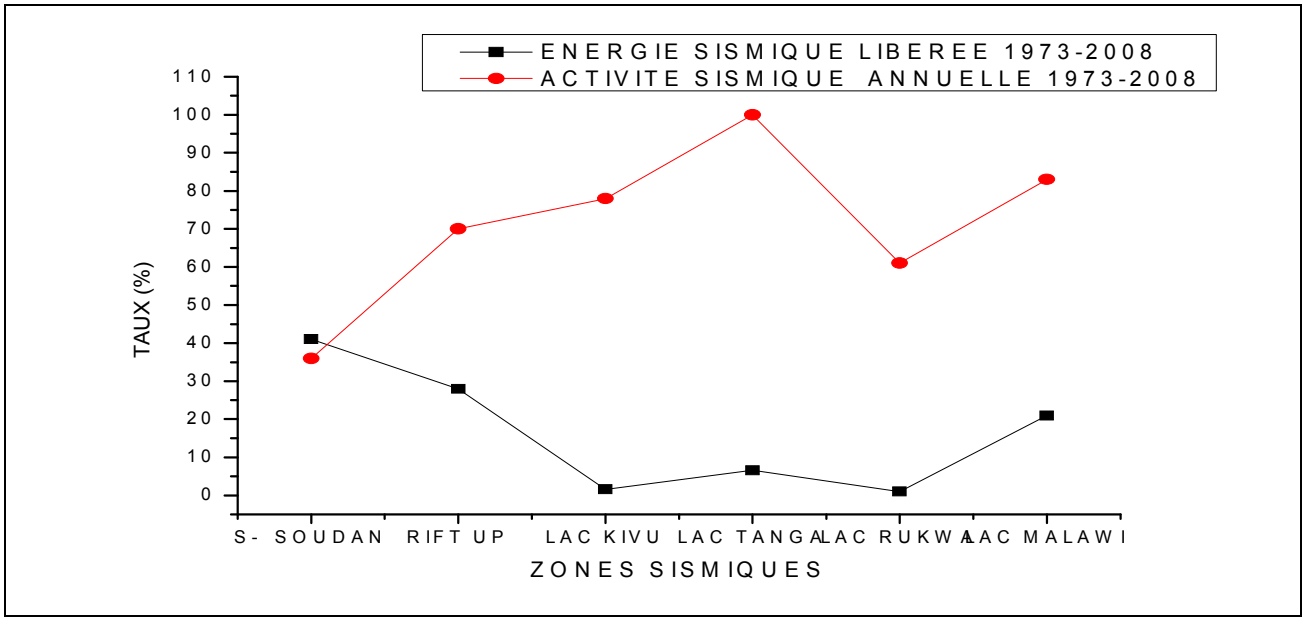


Fig.10: Courbes comparatives entre l'énergie sismique libérée et l'activité sismique annuelle pour certaines zones (en abscisse) de la branche occidentale, de 1973 à 2010

Des résultats précédents,Il s'avère que :

- La plus grande magnitude enregistrée vaut 7,4 au Sud – Soudan (SS_{NE}) et au lac Rukwa (R_{SE}), avec une b – value presqu'égale, mais l'énergie libérée au Sud – Soudan est supérieure à celle libérée au lac Rukwa. Cela est dû à l'enregistrement de plusieurs séismes de magnitude égale à 6.
- L'activité sismique (annuelle et mensuelle, b – value) est élevée dans le lac Kivu et le lac Tanganyika(Fig.10)
- La Fig.10 montre que l'activité sismique est faible dans les zones ayant pourtant libéré beaucoup d'énergie (Sud – Soudan, lac Rukwa et rift de l'Upemba (zone mixte : M_{NO} et M_{SE})).
- Bien que l'activité sismique soit élevée dans le lac Tanganyika et Kivu, néanmoins elle n'est pas conforme :
  - Elle est d'abord concentrée dans la partie extrême Sud – Est, puis le Nord et Centre Ouest du lac Tanganyika.
  - Quand au lac Kivu, elle est concentrée dans sa partie Sud – Est et faible dans sa partie Ouest en générale.
- Quand à la zone Mixte, l'activité sismique est élevée au Nord – Ouest et au Sud – Est.
- Pour le lac Malawi, l'activité sismique est élevée au Sud 6 Ouest et faible au Nord – Ouest.
- Pour le lac Rukwa, l'activité est élevée au Sud – Est et faible à l'Ouest.
- Pour le lac Albert, l'activité sismique est élevée au Sud – Est et faible à l'Ouest.
- Pour le lac Edouard, l'activité sismique est élevée au Sud – Ouest et faible au Sud – Est.

4 CONCLUSION GENERALE

L'étude de la structure de la branche occidentale des rifts Valleys faisant partie intégrante du système des rifts Est – Africain débouche sur l'établissement de la carte de zonage dite avancée de laquelle ressortent, d'une façon générale, les aspects suivants :

- L'activité sismique est intense tout au long (ou dans) les zones de fractures ;
- Le zonage sismique laisse entrevoir la possibilité d'identifier l'orientation des failles dans une zone subdivisée en quatre sous zones au moins,
- Le zonage sismique montre la sismicité de la branche occidentale se concentre en 3 endroits principaux :
  - au Nord, dans la zone Sud – Soudan ;
  - au centre, dans l'axe lac Kivu - lac Tanganyika – lac Rukwa ;
  - au sud : au lac Malawi avec une forte ressemblance entre le lac Rukwa et Malawi.
- L'activité sismique n'est pas toujours identique pour les sous- zones d'une même zone.
- Bien que leur énergie libérée soit relativement faible, néanmoins, le lac Kivu et Tanganyika présentent une activité sismique plus intense que d'autres zones, indicatrice d'une fracturation persistante de la structure peu être également d'une minéralogie assez particulière.
- Le zonage sismique montre enfin que l'activité sismique de la branche occidentale est faible dans les zones interbassins qui souvent sont le siège d'une activité volcanique intense.
- Aux grands séismes correspondent une fréquence élevée ou une activité sismique élevée.
- L'étude de la sismicité basée uniquement sur les magnitudes observées ne suffit pas à elle seule pour la caractérisation de la sismicité d'une zone.
- La subdivision de chaque zone en sous zones a révélée la diversité de leur activité sismique (Mukange et Zana, 2012).

REFERENCES

[1] Aki K. and G. Richards.1980.*Quantitative seismology. Theory and methods*.vol1.U.S.A: Ferman W.H. and Company.
[2] Borden J-P.1988.*Biologie-Géologie*. Première S. Paris: Bordas.
[3] Bormann P, 2009, New Manuel of seismological Observatory Practice, volume 1, GeoferschungsZentrum Postdam, Berlin
[4] David P; La géophysique du système du Rift d'Afrique de l'Est, Earth and Space Sciences ;
[5] Debelmas J, Basile C et Macle G, 2008, les grandes structures géologiques, 5ème édition, Dunod, Paris ;
[6] Doser I. Diane and B. Robert Smith.1982.Seismic Moment rates in the Utah region. *Bulletin of the Seismological Society of America*, 73(3), pp 525-547.
[7] Gacôgre G. et G. Frugier .1990. *Probabilités et statistiques, cours de maths*. Tome4. Paris : Eyrolles.
[8] Grais B..1992. *Méthodes statistiques*.3è édition. Paris : Dunod.
[9] Hamagushi H; volcanoes Nyiragongo and Nyamuragira: geophysical aspects, Tôhoku University Sendai 1983;
[10] Lay T. et T. Wallace.1995. *Modern Global seismology*. New-York: Academic Press
[11] Mavonga T..2009. *Seismic hazard assessment and volcanogenic seismicity for the Democratic Republic of Congo and surrounding areas, western rift valley of Africa*. Thèse de doctorat: University of the Witwatersrand (Johannesburg), Faculty of Sciences.
[12] Mukange, 2011, caractérisation de la sismicité de la République Démocratique du Congo, mémoire de DEA, Université de Kinshasa,
[13] Ramananda Charrabarti, Asissh R. Basu, Alba P. Santa, Dario Tedesco, Orlondo Vaselli ; Isotopic and geochemecal evidence for a eterogenous mantle plume origin of Virunga volcanics, Western rift, East Rift System ; vol.259, 2009.
[14] Vuyst A ; la nouvelle conception de la dérive des continents, ciel et terre 1969 ;
[15] Wafula M D, Activité volcano-sismique dans la région volcanique des Virunga, Rift Ouest-Africain et son implication dans la prédiction des éruptions volcaniques, thèse de doctorat : Université de Kinshasa 2011.
[16] William L, fundamentals of geophysics, Cambridge University Press 2007;
[17] Zana N ; M.Kamba ; S. Katsongo and Th. Jansen; Recent seismic activity of Kivu province; western Rift valley of Africa, Elsivier Science Publishers B.V, Amsterdam 1988;
[18] Zana N, Cours de géophysique générale, Université de Kinshasa 2014;
[19] http://www.usgs.gov, le 3 /2/ 2010

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The Political Situation in the North of the Arabian Peninsula and Its Impact on the Yemen and Indian Trade

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ABSTRACT: Played the Arabian Peninsula site an important role in trade, between India sources the commercial products, and her Consumer the world old. Increased of importance of the site, because the Dealers became in southern Arabian Peninsula monopolized that trade for several centuries, they have gained the great wealth of this trade, which helped them build their kingdoms, made famous in the ancient world. The trade was oscillating between the boom and collapse, depending on the political events, which were witnessing areas that experienced by the trade routes, especially north of the Arabian Peninsula, which has seen a lot of competition between the ancient kingdoms and empires (Sassanid, Greek and Roman) for control of the trade, which ends in the cities and ports of the Northern Arabia countries (Gaza, Palmyra, Petra) Has dominated economic nature of these wars. Where hastened those empires and kingdoms to send campaigns land, and sea, order to explore the ancient trade sources. Reached those campaigns to the coast of the Arabian Peninsula, and the coast of the West Indies, the Persians was the pioneers in this domain, followed by campaigns Alexander the Macedonians exploratory, But all these attempts did not bear fruit, only in the era of the Romans, who discovered that India is the source of that wealth, As Thanks in this discovery to the navigator Hippalus which discovered the movement of the monsoon in the Indian Ocean, and the consequent this discovered, positive results for some and negative on some others.

KEYWORDS: Arabian Peninsula, Trade, India, kingdoms, Red Sea.

1 INTRODUCTION

There were many relations between the ancient kingdoms and Empires that contributed making remarkable change on the history that led to the appearance of new kingdoms instead of the old ones. The Macedonians and their leader Alexander the great invaded the old eastern part. There were some successors of Alexander who appeared after his death, namely the Seleucia and the Ptolemy. They were defeated by the Romans because the Romans were the dominating power in the east. All these groups had different relations that had a great influence on the economical status. The important geographical location of the Arab peninsula[1] was the corner stone to make direct and indirect relations between southern Arab kingdoms and Empires and kingdoms of the ancient world. Since the researcher is concerned to study the commercial relations between the south Arab peninsula and West India, the researcher will try to expose the political situation in such countries. It is also important to examine to what extent the political situation affects trade development or declining at that time. Some disputes and fighting took place in the northern part of the Arab peninsula and this affected the political, commercial and economical life. One may assume that the political, commercial and economical situations were affected by these disputes, whereas only the economical status of different countries was influenced due to such events. In addition, the commercial activities were very much affected by such events and problems that might happen at any point of the trading road around the world. The commercial activities are based on two important components; producer and consumer and their attitudes and civilizations that may determine the developing or declining some caravans cities.[2] Since the Arabian peninsula was the connector between east and west and was the ending point of most trading roads coming from India, China and south Arab

countries, the researcher will throw some lights on the disputes that took place there and its impact on the commercial activities between the east as producer and the west as consumer

2 RESULT AND DISCUSSION

To shed the light on the political changes from the appearance of the Seleucia and Ptolemy until the appearance of the Romans and their dominance on the south Arab peninsula, there are some overlapping relations that can be summarized below:

Hellenistic Era

Different dominating powers tried to control over the trading roads some of these groups are Seleucia in Asia and Mesopotamia, Ptolemies in Egypt, Levant, Mediterranean and Arabian Kingdoms of Nabataeans and Palmira in Jordanian Plateau and Levant. The Macedonians and their leader Philip II appeared in the middle of the fourth century (382-336 B.C) and united the Greek states and became their king[3]. After his death, his son Alexander (356-323 B.C) was the king and his age was less than 20 years. He was able to reunite the Greek states and defence his land from the Eastern attacks[4]. He could bring the peace to his land and send the fighting to the Empires of Achaemenid[5], the Empires of Achaemenid were controlling middle Asia and north India, ancient nearest and Egypt for many centuries. At the time of Empire Darius III (380-330 B.C) who was the last king of Achaemenid Empire from 336 to330 B.C, couple of battles took place in four years between him and Alexander the great during which Empire Darius III was defeated[6]. The first victory made by Alexander was made in 334 B.C near Granicos River in Asia. All of these battles ended with killing Darius III in 330BC[4]. Alexander continued his victories until he arrived to the kingdoms in miner Asia which were belonging to Darius III[7], after controlling these kingdoms, he headed to the south and obtained lots of tribes and places whom he met on his way towards Indus river. In his last battle Hydaspes with Porus was Ancient Hindu king of Paurava in 327 king Porus was arrested and then appointed by Alexander to be the king of all Indian lands belonging to Alexander[8]. At this point of time, Alexander decided to go back to Babylon according to his army and their willingness to go back to their home lands[9]. On their way to home, they faced different lots of obstacles that obliged him lose lots of his soldiers[10]. After a long and difficult journey, he arrived to Babylon in 324 BC and then arranging his Emperor which is considered one of the most famous on in the ancient nearest. After making these adventures in only 12 years, he died because of fever in Babylon at the age of 32 years[11]. The sudden death of Alexander caused the appearance of three new kingdoms in the east namely, Seleucia kingdoms in Mesopotamia, north Syria, Armenia, Anatolia and north India, Ptolemy kingdom in Egypt, Palestine, south Syria and Cyprus island, and Macedonia kingdom in Macedonia and Thrace[12]. After the Alexander death the Hellenistic Era started from 323 to 30 B.C[13].

Conditions in the era of the Seleucids 312-64 B.C

The kingdom of the Seleucids, named after the founder of Seleucus I (312-280 B.C) who was called Nikator[14]. He did not prompt any position when dividing the states after Babylon conference[15], but he took his share of government in Babylon after the conference of Triparadeisos[16], after the death of Perdiccas[17]. The recent years of the fourth century B.C have witnessed many wars by Seleucus I to have control, and saving his kingdom, but he was surprised by Antigonus I[18] the king of Macedonia who had a campaign to subjugate Asia Minor and Mesopotamia. He managed in 315 B.C to enter Babylon, the capital of the Seleucids. Seleucus run away to Egypt, but he returned to Babylon, with the help of Ptolemy I in 312 B.C. And he announced the beginning of his own jurisdiction[19]. Lysimachus (306-281B.C) became an ally to the Seleucids, and thanks to this alliance they had a victory over Antigonus I in the Battle Ipsus 301 B.C[20]. He represented the main threat to Alexander friends in the nearest, which was the last battle witnessed elimination of the dream of bringing Alexander's empire again. Seleucus I could manage include Armenia and northern Syria, to become the largest country was founded on the ruins of the kingdom of Alexander the Great[21]. Seleucids did not make any change in the administrative system which was in place during the reign of Alexander the Great. But they had a limited change to cancel the previous calendar, and they considered that 312 B.C was the date of their kingdom and the beginning of their history and used for recording their events[22]. In order to renew the kingdom structure, Seleucus I created the city of Seleucia on the right side of the Tigris River, and away from Babylon about 63 kilometres. This city became the capital of the Kingdom (312-300 B.C), and when King Seleucus moved to this city, many of the inhabitants of Babylon,[23] went with him. After this city became famous, people from corners of the earth came to it to be one of the most important commercial cities, where the trade routes of land and sea meet together, and became famous more than the city of Babylon. It was selected for its economical importance. It is located on the trade caravans that pass in Mesopotamia[24], and remained the capital of the kingdom of the Seleucia for a period of twelve years[25]. The first years of the third century B.C were the most powerful stage in the era of the kingdom of the Seleucids, where they were able to extend their influence and control over large areas of Asia Minor. The weakness of the local governments and the power of their young kingdom[26] helped them to do so. After the entry of northern Syria under the rule of Seleucus I, he started to build a new city on the Orontes River called it Antioch on the name of his father. He moved there in 300 years B.C

to be the new capital, the seat of government. It was known as Antioch[15]. The goal of changing the capital is the proximity of the coast of the Mediterranean Sea for its strategic, economical and political importance. Then becoming a port to promote the trading with the lands of the Mediterranean and its proximity to the area of conflict with other powers. All this make it easier for their arms to move quickly in case of wars. In addition Greek communities living in these areas was also one main reason[27]. With all these victories made by Seleucus I in the West, he wanted to broaden his kingdom to India, and the elimination of independent kingdoms that appeared between 315-305 B.C, along with the original ruler Chandragupta Maurya, where these kingdoms made their money from gold, silver and zinc to show its independence[28]. But the failure of Seleucus to control these cities he made an agreement with Chandragupta Maurya, during which the marriage took a place as a sign of good intention in which Seleucus I got a gift rewarding up to 500 elephants. He used them in the wars later on[29]. He went to in Macedonia in 281 B.C to control Thrace and then he was killed in the battle of Corupedium[24,30] . The Kingdom of the Seleucids was weak in the era of the successors of Seleucus I when some areas were lost especially in the reign of Antiochus II (263-247 B.C), where the region of Parthia (Khorasan) got independence in 248 B.C under the leader Arsacid. He found the state of Parthian and took over many areas and attached them to his kingdom[31]. At the time of Antiochus III (223-187 B.C), the Seleucid state took back its power and control over what former kings lost. He had the fourth Syrian war against Ptolemy IV at the Battle of Rafah, in the year 217 B.C, was a victory in which the Ptolemy who were able to control some parts of " Syria Coele" [32]. Antiochus III went towards the north and east, where he managed to re-control some parts of Anatolia down to Armenia, and all of Asia Minor, including coastal areas. The Kingdom was controlling until the borders of Thrace[33], which led to their entry in fighting with the Romans in the period between 191-188 B.C, which ended with a loss of Antiochus III in the Battle of Magnesia in 190 B.C. After that he was forced to accept the agreement and leave each country in Asia, which is located behind the Taurus Mountains[34], and at the end of this long journey from war, it was ended the killing of the king in 186 B.C[35]. After the death of Antiochus III, Territory was independent and limited its borders to the Mesopotamian and western Iran, and the Romanian Emperor began and the Kingdom of Parthia to control of some parts of the Kingdom of the Seleucids in the absence of powerful rulers. After the rule of Antiochus IV, (174-164 B.C) the situation began to change in favour of the Seleucids, where they entered the war with the Ptolemies, known as the Syrian war sixth in 170 B.C in which Ptolemies were defeated and the Seleucids could dominate a big part of Egypt, but that did not last long. The Romans interfered and sent envoy to Antiochus IV to inform them to leave Egypt and Cyprus[36], without any conditions. Antiochus preferred to withdraw from Egypt to save himself from opening a new war with the Romans at such time[37]. The situation in the east of the kingdom was instable. Antiochus IV went in a campaign in 165 B.C to the country of Anatolia and brought it back under the Seleucids control[38]. With the death of Antiochus IV the Kingdom conditions were bad because of the conflicts and fights between the family members, where their enemies could benefit from such conflicts to eliminate them[39]. In 143 B.C, the conditions were worst and this gave an opportunity for Parthia who controlled Babylon and send the Seleucids out. The sent them out to Syria, but they have gathered their strength and regained Babylon again, and the war continued between the two parties until Parthian could control Babylon. In 126 B.C, Mesopotamia left the era of Seleucids to the rule of Parthian[40]. The rule of Seleucids was limited in Syria, where they were fighting a war for survival but that did not last for long. In the era of Pompeii, Romans could regain Syria to become a Roman province in 63 B.C[41]. Seleucids gave great importance to trade from both land and sea, but the trade coming through land had greater importance at the beginning because of the appropriate conditions in terms of the excellent location, the area space as the Kingdom controls over vast areas in Asia Minor, Mesopotamia and the Levant. All these conditions helped in the presence of an active commercial movement[42], accompanied by the emergence of commercial cities, which became important in economic terms[43]. With the expansion of the Kingdom and the control of security, a number of trade routes flourished, which were up between the capital Seleucia on the Tigris, and the trade routes coming from India, and China[44]. Seleucids increased their importance to the commercial ways linking all parts of the Kingdom, and focus on its maintenance, and have made a great effort to ensure the security of these roads and established some forts to protect them from the dangers that may be exposed to commercial convoys, which led to the prosperity to become a strong source to bring the goods from the east to the west[45].

Some of the most important trade routes in Mesopotamia:

1. Royal Road:

This road has two types as below.

A. The first road which was Sousse its most important stations from which it moved towards the west to the Mediterranean, passing those of Ashnuna when the valley of the Tigris, and up to Jarablos, then Aimar, and then to Aleppo, it passes them traders to Alalakh, and Ugarit, or even towards the south of Hama and then to Qatna and then heading to the Mediterranean coast, and continue towards the south to Gaza, and ends with the Nile Delta[46]. where many commercial cities appeared on this road[47].

B. The second road; trade routes coming from East Asia, and India meet in the capital Seleucia on the Tigris River[48], and keep moving to Antioch, and then to Aleppo to meet the road coming from Egypt, and then to Damascus. Although the ways across the Levant are closer to the Mediterranean ports, it was more dangerous because of Ptolemaic control. Seleucids were obliged to use longer roads to save their goods from the Ptolemaic, They used by the Euphrates large[49] , which begins from Seleucia, north to Nineveh in front of the city of Mosel, then cut the steppes of the island from east to west- the land between Tigris and Euphrates- passing a number of cities , including a Shaher-Bazaar, to Tal-Halfa and then to Harran, then cut the Euphrates at Jarablos, or at Masknah, passing from Aleppo, or close to it, and ends at the valley of the Orontes River where it has some sub-roads to the Mediterranean coast, and central Syria. Some branches came out from the main road to different places such as Cilicia and Anatolia, and Nineveh can reach Armenia and eastern Anatolia, and continues across the Tigris until Diyarbakir, then pass the Taurus Mountains through the narrow passages[50].

2. Northern Road:

This road was passing through cities of Kabul and Balkh, and continues to the mouth of the river Oxus (river Jayhoun)[54], then crosses the Caspian Sea to the Black Sea, but the location of this road from the centre of the Kingdom decreased its importance[51].

3. Silk Road:

It is one of the most important trade routes in ancient history, which begins from east Asia (China), breaking the deserts, plains and mountains in Asia to Mesopotamia and the Levant and then to the Mediterranean countries[52]. Seleucids made their best to facilitate all difficulties that may face trade coming from the countries around them, to go through their country, in order to take advantage of them[53], and prevent as much as possible to arrive in the kingdom of the Ptolemies, and worked to consolidate their business relationships with the Mediterranean islands to find markets for goods coming from the east, with emphasis on the production of the Seleucid cities which led to a large area of the diversity of their territories, climate, and hence to the diversity of commercial materials produced locally, as well as commercial interest in materials brought in by traders from different countries[54]. One of the most important products is Seleucids wine, cooking oil, cheese, dried figs, prunes, products, linen, and wool, perfume, and cosmetics, and ointments, and soothes[55]. while the commercial materials that were brought by traders from neighbouring countries, papyrus from Egypt, and glass from Sidon, gum, and timber from Asia Minor, and leather from the Syrian coast. Other products such as wood perfume smell and cotton yarn, spices, ivory, rubies were brought from India, silk from China, and the Arab Gulf was extracted pearls, and incense from the southern Arabian Peninsula[56].

3 CONCLUSION

All these goods contributed to reap large profits which increased the state's income[57]. The political situation changed with the mid-second century BC, where the succession of weak kings. All these led to the large number of internal and external conflicts, which influenced the boom, and a weak Seleucids' trade. The business conditions changed when the weakness began in the kingdom, especially after the defeat of the Seleucids in the battle of magnesia (190 BC) [58]. This led to the existence of trade powers compete with them, such as Altadmrien and the Nabataeans in the southwest of the kingdom, and the Romans from the north, the west and the emergence of the Parthians in the east who took descend from the highlands to the plains, and what caused by their presence of instability[59], and their control over the eastern part of the kingdom of the Seleucids, which led to banditry business coming from East Asia, and turned toward the south to India, and then transported by sea to the port of Gerrha on the Persian Gulf, and on to the Mediterranean[60]. Seleucids were forced as a result to the search for new roads to trade, they found only the sea route through the Persian Gulf, which represented one of the most important trade routes marine coming from India, and the southern Arabian peninsula[61], which was for them a kind of control over the trade of the Persian Gulf, and was commercial fleet transports trade from India to Mesopotamia[62], has become their permanent representative in India during the reign of King Chandra Gupta[63]. With the beginning of the interest of Seleucids on trade in the Gulf, this led to the rise commercial competition with the Ptolemies, who was not at least as important for military rivalry, where Seleucids were fast to trend towards the south, and gaining control of different cities on the Persian Gulf as Alexandria charax (Maysan) [64], at the head of the Persian Gulf which was also one the most important ports there[65]. They also made military campaigns on the commercial cities on the west coast of the Gulf and tried to control the port Gerrha which is one of the most important trading ports in the Arabian Peninsula but they failed to do so[66]. Trade was moved from Gerrha westward to Petra and Palmyra, and then to Gaza on the Mediterranean,[67] This was the reaction to what Ptolemies did as the establishment of many of the important commercial centres, in the western regions of the Arabian Peninsula, along the eastern coast of the Red Sea, in order to control Eastern trade[68]. Transformation of trade routes that were passing in their lands to the west across the Syrian desert to the coast of the Mediterranean Sea[69], this was the reason for the emergence of new business centres including the city of Palmira, which emerged as a rival business in the area since

this era[70], and the Seleucids trade became more weak, with the advent of the Romans in the east, and controlling the trade in the Mediterranean after their victory over Carthage[71], and closing the trade of Seleucia , where the Romans became the dominating power of the caravan trade routes in Mesopotamia and the Levant[72], Syria turned out to be a Romanian state in the era of Pompey (64 BC)[73]. After the severe weakness in the Kingdom of the Seleucids, and the accompanying chaos, and the independence of the states, all these led to weaken its ability to benefit itself, but this was reflected weakness on the economy, where it has no ability to take advantage of this vital resource, which is one of the most important sources of income for Seleucids, in addition to turning the trade routes coming from the east towards the south, to India, specially the Silk Road. South of the Arabian Peninsula was not affected by Mesopotamia conflicts, but on the contrary, these areas had some benefits more than the other areas where the conflicts took place. It is found that the kingdom of Chandragupta in India has benefited from these conflicts, as the Silk Road which was going towards the Mediterranean turned to the south to India, where such goods were transferred through the ports of western India to the Persian Gulf and the southern Arabian Peninsula, then to the country's Mediterranean basin, by trade caravans[72, 74]. Accordingly, the kingdoms of the south of the Arabian Peninsula benefited from the events in Mesopotamia. The events that emerged after the death of Alexander the Great, and the conflict between successors in the far east that destroyed the project, that Alexander the Great had prepared for controlling the South Arab Peninsula which was known for its wealth, as a result of its involvement in the trade, which provided them with profits and this what made the kings of the West to come and occupy these areas[75]. With the deterioration of the situation in the north, and the disruption of commercial caravan routes and turning it into other areas has increased the importance of the commercial goods coming from south Arabian Peninsula. The traders of these countries monopolized aromatic substances, and they continued their trading as intermediaries in the ancient world, as long as they could maintain the secret of production of these materials. The trade became stronger than it was before rising prices of commercial materials, depending on their importance as it was find that the Incense and Myrrh as important commercial materials in all aspects of daily life in the West, where they used it in most of the religious rituals, and in the funerals of the deaths, and entered in the pharmaceutical industry and ointments, and it was used by the ancient Egyptians in the mummification process, all this led to the significant rise in the price of those goods. The price of the amount which can be carried up by a camel was about 688 dinars[86]. This camel was leaving from the Kingdom of Hadhramaut in the south, to the port of Gaza on the Mediterranean Sea. As a result, the kingdoms of the south of the island reaped huge profits sparked other old emperors to get such products.

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REFERENCES

[1] E. V. Dyck, *History of the Arabs and their Literature before and after the rise of Islam*, Cairo, 1894, p.1.
[2] M. Rostovtzeff, *Caravan Cities, Tr*. D.T, Talbot Rice, UK. Oxford, Clarendon Press, 1932, pp.4-7.
[3] H. Waldemar, *The Conquests of Alexander the Great*, New York, Cambridge University Press, 2008, pp.15-20.
[4] Diodorus Siculus, *Diodorus of Sicily*, Vol.12, Tr. C. H. Oldfather, London, Harvard University Press, 1989, Book, XVI, 94, 2.
[5] Arrian, *The Anabasis of Alexander or the History of the Wars and Conquests of Alexander the Great*, London. forgotten books press, 2014, pp.41-50.
[6] J. Roisman, I. Worthington, *A Companion to Ancient Macedonia*, USA, Blackwell, 2011, pp. 4-5.
[7] A. B. Bosword. *Alexander the Great*, Part 1, The fourth century B.C ,Vol. 6,UK, Cambridge University Press, 2006, pp.791-810.
[8] J. W. M'crindle, *The Invasion of India by Alexander the Great*, Cornell University Library, 1893, pp. 40- 44.
[9] A. Burjor, *India: The Ancient Past*, USA & Canada, Routledeg, 2007, p. 92.
[10] M. Grant, *from Alexander to Cleopatra the Hellenistic World*, London, 1928, p.4.
[11] H. Waldemar, *The Conquests of Alexander the Great*, Cambridge University Press, 2007, pp.127-141; F. Mkawy, *The History and Civilization of the Greece World*, Morocco, Casablanca, Centre Modern Studies,1980, pp.225-227.
[12] F. W. Walbank, A. E. Astin, *The Hellenistic World*, part 1,Vol ,VII, UK, Cambridge University Press, 2006, pp.23-29
[13] P. Sabin, H.V. Wees, M. Whitby, Greece, "*The Hellenistic World and the Rise of Rome"*, The Cambridge History of Greek and Roman warfare, Vol. I, UK, Cambridge University Press, 2007,pp.304; D. C. Braund, '*After Alexander: the Emergence of the Hellenistic World*, 323-281 B.C; A. Erskine, *A Companion to the Hellenistic World*, USA, Blackwell publishing, 2003, pp. 19-34.

[14] Y. L. Abdulwahab, *Studies on the Hellenistic Period,* Alexandria, Dar Almarfah Alalmiah, 1997, p.47. ; I. Nushi, Egypt *at the Era of Ptolemy*, Part I, Cairo, The Anglo Egyptian Bookshop press, 1976, pp.39-40.
[15] H. Philip, *The History of Syria*, Lebanon and Palestine, part.1, Tr. George Hadad ,Beirut, culture house, 1957, p 259.
[16] K. Amelie, W. Susan*, Hellenism in the East,* London, Duckworth, 1987 . p.16; Baqer, T. *Babylon*, Iraq, Baghdad, 1959, p.2.
[17] Diod Sic, 18. 28, 2-3; 36.6-7; 39,1-4; H. F. Lee, *Alexander the Great and Bactria*, USA. Houston.Taxas, Brill Archive, 1988,p.93.
[18] D. Paul, *Alexander the great: The Death of a God*, UK, Hachette, 2013, p.117.
[19] A. Ali Dharif, History of the Greek State and Persian in Iraq, Egypt, Pur Said, Library of Religious Culture . 2001. p.13, 14.
[20] S. L. Helen, *Lysimachus: A Study in Early Hellenistic Kingship*, USA. Routledge Press, 1992, p.20.
[21] F. B. Rosalie, C. F. Baker III, *Ancient Greeks: Creating the Classical Tradition*, New York. Oxford University Press, 1997, p. 197; I. Spence, *Historical Dictionary of Ancient Greek Warfare*, Scarecrow Press, 2002, p.341
[22] T. Baqer, *The Introduction in the History of Ancient Civilizations*, Baghdad. Dar Al Bayan Press Events, 1973, p. 592.
[23] Pliny, *Natural History*, Books 3-7,Tr ,H. Rackham, London, Harvard University Press, 1999, V. XXI.88-xxii; Strabo, *The Geography of Strabo*, Tr. H. L. Jones, London, Loeb Classical Library, 1930 , XVI, 2:5
[25] M. H. Ferza, *Cultural Interaction on the Silk Road Between China And the Levant, Journal of Historical Studies*, Vol. 39-40, Syria, 1991, p. 101.
[26] R. Trudy, M. Robert, B. Sharon, *International Dictionary of Historic Places: Middle East and Africa*, Vol. 4, USA, Taylor & Francis, 1996, pp.636-637.
[27] C. E. Fant, M. G . Reddish, *A Guide to Biblical Sites in Greece and Turkey*, New York, Oxford University Press, 2003, p.143.
[28] D. Musti, "*Syria and the East*" The Cambridge Ancient History, vol.7, part .1 , Cambridge University Press,1984, p.179.
[29] M. Mitchiner, *Indo-Greek and Indo-Scythian Coinage*, vol. 1, London, Hawkings press , 1975, pp. 23- 24; F. Dyakov, S. Kovalev, *Ancient the Civilizations*, part 1, Tr. nasim,wakim al-yazji, Syria. Damascus, Dar Alaa uldin Press, 2000, p. 214.
[30] Strabo. Op. Cit, XV.2.9؛ G. Nicholas, H. Lemprière, *A History of Macedonia*: 336-167 B.C, USA, New York , Oxford University press,2001, p.240; D. Musti "*Syria and the East*", Op. Cit, p.190.
[31] F. W. Walbank, *The Hellenistic World* , USA, Harvard University Press, 1993, p.56; D. Charles, *Kingship and Community in Early India*, USA. California, Stanford University Press,1962, pp.166-167.
[32] B. J. Elias, "*The Seleucid Period*", Cambridge History of Iran, London & New York. Cambridge University Press, 1983, pp. 3-20; P. Gardner, *The Parthian era ''International Numismata Orientalia* '' Part. V, London, Stephen Austin and Sons press,1877, p.3.
[33] D. Jan, *Aramaic and Hebrew Inscriptions. Gerizim and Samaria Between Antiochus III and Antiochus IV Epiphanes*, Vol. 54, Culture and History of the Ancient Nearest, USA, Brill press , 2012, p.154-55.
[34] C. D. Nellson, *The Political History of Parthia*, New York, The University of Chicago Press, 1938, pp.16-18; F. Muhammad: *History of the Romans*, Egypt, 2012, pp.109-110.
[35] D. Musti "*Syria and the East''* Op. Cit, p.189 ؛A. H . McDonald, F. W. Walbank , "*The Treaty of Apamea (188 B.C)"* The Naval Clauses, The Journal of Roman Studies, vol. 59. No.1-2, 1969, pp.30-39.
[36] Polybius, *The Histories*, Tr. W. R. Paton, Vol. VI, Books 28-29, Loeb Classical Library,1992, p.2,70,6; D. Jan, Op. Cit, p.155.
[37] E. D. William, *Ancient Rome*, UK, Roman & Littlefield Press, 2010, p.86.
[38] Polybius, *The Histories*, Op, Cit, p.27; C. Habicht, *''The Seleucids and Their Rivals*'' The Cambridge Ancient History-2nd ed. Vol. 8, *Rome and the Mediterranean to* 133 B.C, London, Cambridge University Press, 1989, p.384.
[39] Diod. Sic, xxxi.17.
[40] D. Musti,"*Syria and the East*, p.178.
[41] A. A. Dharif, *History of the Persian State in Iraq*, Baghdad, 1928, pp.34-36.
[42] M. Sartre, *The Middle East Under Rome*, Tr. Catherine Porter, Elizabeth Rawlings, USA, Harvard University Press, 2005, p.38-40; J. Robartus, S.Var Der, *The Hellenistic Near East*, p.409 ; D. Musti ,Op.Cit,P.175.
[43] F. Abu Alyusr, *The Near East in the Hellenistic and Roman*, Egypt. Alain for Studies and Research press, 2002, p.186.
[44] W. I. Al-Salhi, The Emergence and Development of the Kingdom of Maysan, Journal of Almawrd, vol.15, NO. 3, Iraq, 1986, pp. 5-18.
[45] N. Ziadh, *Evolution and Commercial Maritime Routes Between the Red Sea and the Arabian Gulf and the Indian Ocean*, SHAP, 69-94, Kuwait, 1975, p 71.
[46] D. Musti, "*Syria and the East*" Op. Cit, p.212.
[47] L. Mark, *Communication Routes in Upper Mesopotamia in the Third Millennium BC*. Tr. Ahmad Farzat, SAJY ,Vol. 43,Syria, 1999, p 270.
[48] E. Robert Jack, *The Outskirts of Baghdad, the Date of Settlement in the Plains of Diyala*, Tr. Ahmed Ali Saleh, IAS, Baghdad, 1984, p. 205; A. Alhalw, *The conflict of Kingdoms in the Old Syria History, Between the Fall of the Kingdom of Sumerians and Palmyra*, Beirut. Bissan Foundation Press, 1999, p.334.

[49] J. F. Salles, *"Achaemenid and Hellenistic Trade in the Indian Ocean" In the Indian Ocean in Antiquity*, ed. J. Reade, London: Kegan press,1996, pp. 258- 260.
[50] A. Alhalw, Op.Cit, pp.319-320.
[51] R. George, *The Ancient Iraq*, Tr. Hussein Alwan Hussein, Baghdad, 1986, p 35.
[52] Medieval Arabic and Muslim sources call this river as Jayhoun (جيحون), which is Derived from Gihon, the biblical name for one of the four rivers of the Garden of Eden, William C. Brice, *An Historical Atlas of Islam* : cartographic Material, Brill Press,1981,p.64.
[53] R. M, Alabed , *The Era of the Seleucids in Syria*, North House , Damascus , 1993, p. 270.
[54] Pliny, *NH*, NI .76-78; B. Philippe, *From Three Possible Iron-Age World Systems to a Single Afro-Eurasian World-System*, Journal of World History, Vol. 21, University of Hawai'i Press, 2010, pp.25-28;p.38.
[55] D.G, Keswani ,*''Indian Cultural and Commercial Influences in the Indian Ocean from Africa and Madagascar to South-East Asia''* in Historical Relations across the Indian Ocean,1980, p.34.
[56] F. Dyakov, S. Kovalev, *Ancient the Civilizations*, p.406.
[57] H. Philip, *the History of Syria, Lebanon and Palestine*,part.1,Tr.George Haddad , Beirut. House of Culture, 1957, p. 329.
[58] A. Alhalw, Op. Cit, p.260.
[59] M. Rostovtzeff. Op. Cit, pp. 453-455.
[60] Diod Sic. 19.113; 20.113-4;33-4; D. Musti "*Syria and the East*" The Cambridge Ancient History, Vol.7, part.1, Cambridge University press.1984, p.189; A. H. McDonald, F. W. Walbank , "*The Treaty of Apamea (188 B.C.)*" The Naval Clauses, The Journal of Roman Studies, Vol.59.No.1-2, 1969, pp. 30-39.
[61] Shaker, *Encyclopaedia of Civilizations and the History of Nations, Ancient and Modern*, part. 1, Amman, Dar Osama press, 2003, p. 257.
[62] M. A. Albakr, *Gerrha Arab Emirate*, JAG, Part.1, Iraq, Basra University press, 1973, p.131.
[64] S. A. Nasri, *History of the Romanian Empire political and civilizational,* 2nd Edit, Cairo, Dar Arab renaissance, 1991, p 75.
[65] D. Musti, Op. Cit, p.181; A. Farah, The Near East in the Hellenistic and Roman Eras, Egypt, Eye for Studies and Research, 2002, p. 187.
[66] M. A. Albakr, *State Maysan*, Magazine Supplier Arab, vol. 15,No. 3,Iraq, Ministry of Culture press,1986, p 22.
[67] J. Ali, *The Detailed in the History of the Arabs Before Islam*, part.2, Beirut, Dara Alalm Llmalaiin, 1969, p.16.
[68] Gerrha is located in the northeastern part of the Arabian Peninsula, and the most important commercial centre in the ancient world, and was controlled by means commercial marine and land next to it, including moving the trade routes in two directions, first toward the north, to Mesopotamia, and the second in the west to the south of Syria and the country Nabataeans, and the east coast of the Red Sea, see, Diod Sic, III.42-45; Strabo, XVI.111.3; Pliny, VI.XXX11.157-148; A. M. Al-Sayed: *The Arabian Peninsula, Egypt and ancient Eastern Commerce*, Alexandria, Almaktab Aljamay al Hadith,1999,p.93.
[69] J. F. Salles, "*Achaemenid and Hellenistic Trade in the Indian Ocean*." The Indian Ocean in Antiquity,edit. J. Reade, 251-267, London, Routledge 1996, p. 260.
[70] S. A. Nasary, *Conflict on the Red Sea in the Ptolemaic Era*, SHAP, Vol. 2 , Riyadh, King Saud University, 1984, p.14.
[71] K. Alsaliby, *The Outer Frame of the Ignorant Arabs*, SHAP, Vol.2, Riyadh. King Saud University press,1984, p. 322.
[72] A. Alhalw, Op. Cit, p.320
[73] B. James Henry, *Ancient Times A History of the Early World* ,USA, Charles Breasted, 1944, pp.621-623.
[74] A. Alhalw, Op. Cit, p.320.
[75] Maurice Sartre , *The Middle East Under Rome*, Tr. Catherine Porter, Elizabeth Rawlings ,USA, Harvard University Press, 2005,p.38-40; J. Robartus, S.Var Der ,*The Hellenistic Near East*, p409 ; D. Musti ,Op. Cit, p.175; Ball, Warwick, *Rome in the East:The Transformation of an Empire*, USA. Routledge, 2002,p.62
[76] N. Ziadh, Op, Cit, p.75; M. T. Abu El Ala, *Geography of the Arabian Peninsula*, Part 2, Cairo, 1972, pp. 125.

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SECONDARY SCHOOL TEACHERS' PERCEPTIONS OF THE FACTORS THAT INFLUENCE THEIR MORALE AND COMMITMENT TO WORK: A CASE OF NAKURU DISTRICT

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ABSTRACT: This study investigated teachers' perceptions of the factors that influenced their morale and commitment to work in public secondary schools. The target population consisted of teachers in public secondary schools in Nakuru District. A sample of 172 teachers was randomly selected for the study. The research design adopted in this study was descriptive survey. Teachers' questionnaires and head teachers' interview schedules were used to collect information on the respondents' perceptions on factors that influenced their morale. The instruments were based on a 5 point Likert scale. The reliability coefficient was computed using Cronbach alpha and stood at 0.86. This was deemed adequate for the study. Pearson Moments Correlation was used to establish whether there was a statistically significant relationship between teachers' characteristics and morale and commitment to work. The study established that teachers perceived remuneration, opportunity for further training, responsibility, social status, a sense of belonging and job security as impacting on the level of morale and commitment to their duties. The study found out no statistically significant relationship between teachers' gender, age, and experience and commitment to work. However, there was statistically significant relationship between the professional qualifications and commitment to work. The study also established no statistically significant relationship between teachers' characteristics and perception of the factors that influenced their morale and commitment to work. In all cases alpha coefficient was equal to 0.05.

KEYWORDS: Teachers Motivation, Job Satisfaction and Job Performance.

1 INTRODUCTION

Many teachers face the constant frustration of knowing that they are giving their professional best efforts yet they do not receive adequate compensation, a fact Mwai (2000) noted was particularly demoralizing to graduate teachers. This cadre of teachers feel that their pay is too low compared to their counterparts in other professions, thus, resulting to the teaching profession suffering great attrition. In demanding for an increase in their pay and improvement of terms of service, teachers were accused of using pupils as pawns and bait in their bid to force the government to implement the 150-200% salary increments awarded in 1997. This was viewed as having eroded public sympathy and respect not only for the teacher but also for the teaching profession. In this case the role of the teacher seemed to have been misunderstood and undervalued both by the public and the government. The government's declaration of free primary and secondary education is a further manifestation of the centrality of formal schooling in Kenya's quest for its human and economic development. This declaration has opened the floodgates to over-enrollment leading to very large class sizes. This has further led to the increase of the teachers' responsibilities and expectations. In addition to all these, teachers are being expected to deal with broader social problems that find their way into the classroom, such as family problems, drug abuse, truancy, teenage pregnancies and absenteeism (Linda, 1998). Despite this, the society is not ready now as it was not even earlier to pay or recompense the teacher proportionately to his/her usefulness as evidenced by the government's reluctance to honour its pledge for higher salaries and continued struggle by teachers (East African Standard Team, 1998; Castle, 1970).

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Teachers are the most important resource in the school and quality of the school depends on the teacher professionalism and commitment. The government of Kenya concurs with this observation and contends that the professional growth of teachers must be ensured to enhance quality at all levels of educational programs. However, many times teachers are often treated like subordinates not as professionals who offer essential service to the society (Sadker & Sadker, 1994). They continue to argue that teaching being such a difficult and demanding job and with the current increased responsibilities vested on teachers, it is very easy for teachers to be discouraged and demoralised. Sergiovanni as cited in Yong (1999) argued that teacher motivation and work commitment are the most important factors that affect school effectiveness therefore there is need to enhance them. Motivated teachers are more likely to motivate students to be participative in the classroom and consequently perform better.

Motivated teachers are more likely to meet the institutional goals and objectives since they are willing to exert their effort to achieve them. In order to boost academic excellence in our secondary schools, factors that enhance teachers motivation hence commitment to work must be identified. Studies have been carried out in Kenya on teachers' perceptions on the relationship between their feeling of professional competence and degree of morale. However, no systematic study has been carried out to determine the range of factors perceived by teachers as important in influencing their morale and commitment to work. An investigation which reveals the factors that affect teacher motivation and ways in which it can be enhanced would be beneficial to the Kenyan Government and educational system as a whole. This study therefore was aimed at identifying such factors that would improve teachers working conditions in order to enhance their morale and work commitment.

2 LITERATURE

2.1 THEORETICAL AND EMPIRICAL REVIEW

The educational system is one of the most important social institutions in any given society. According to Australian Association for Education (AARE, 2004) the effectiveness and efficiency of an educational organization is measured in terms of how well social expectations and needs are met. Teachers have to commit themselves to their schools, students, teaching activities, occupation, colleagues and the community.

It is known that human resource is the most important input of any organization. For any country to achieve the desired economic growth targets and social development, it must place attention on the development of human resource through education and training. Kenya's human resource is central to the country's attaining its goal of industrial development and technical advancement. The maximum productivity of an organization may not be realized unless the human resources responsible for effective and efficient performance are taken into consideration (Davies & Newstrom, 1989; James, 1996; Okumbe, 1999).

The main objective of the teacher as a 'process' is to inculcate values, skills and knowledge to the students as the 'input' (Oluoch, 1982). It is to ensure that learners fit in to 'social' world and acquire adequate knowledge and skills to enable them earn a living (RoK, 2004). Teachers are responsible for arranging the learning experiences whereby the learners can interact effectively with the external conditions in the environment (Tyler, as cited by Shiundu & Omulando, 1992). Teachers are also responsible in preparing the learners to fit in to the society and contribute towards the well being of society and to fit into the world of work. However, the existence of the proper working conditions that can motivate teachers to perform the task of arranging the learning experiences in an institution is the main challenge (AARE, 2004; RoK 2004). Teachers' interests and attitudes towards the students in working environment are determined by the individual teacher's level of work commitment. Organizational commitment consists of the factors such as the workers' belief and acceptance of the organization's goals and values, the employee willingness to exert effort on behalf of the organization, and a strong desire to keep up membership in the organization (Davies & Newstrom, 1989). The extrinsic rewards that the organization supplies and the internal rewards that are supplied by the worker are the most important conditions that encourage workers' professional performance. Consequently, internal rewards are more important in the teaching profession than in any other. The most significant sources of internal reward for teachers are social esteem, job satisfaction, materials and the students' aims and values. Indeed, the question of how to provide teacher motivation and enhance their commitment to the occupation and teaching- learning process is still a problem.

Teachers are primarily motivated by intrinsic rewards such as self-respect, responsibility, advancement, promotion, recognition and a sense of accomplishment (Owens, 1998). He continues to argue that advancement is a force that motivates teachers to lift their performance and utilize their potential fully. Herzberg (1959) argued that advancement and promotion are motivational factors. In his two factor theory these are referred to as motivators, which are associated with

job itself and they tend to lead to job satisfaction. They fulfill individuals' need for psychological growth and even lead to long-term changes (Okumbe, 1999). Teachers are not satisfied with promotion prospects because opportunities for career advancements is only to be a head of department, deputy headmaster or headmaster and such chances are limited considering the number of schools that are in certain country. The hygiene/maintenance/extrinsic factors which include; company policies, administration, supervision, salary, interpersonal relations and working conditions do not lead to job satisfaction but they are prerequisite to motivation. Pager's study (1996) revealed that very few teachers cited salary as an important motivator; however Hoy and Miskel (1996) argue that teachers are motivated by the opportunity to earn more money. Steers and Porter (1991) had earlier reported that money is not an effective motivator. Owen (1995) had also argued that low salary may generate dissatisfaction and teachers may not respond to opportunities for achievement or professional growth. Teachers in England felt that low status, minimal chances for promotion low pay, job security, and low motivational investment resulted in low levels of job satisfaction and low morale. Sergiovanni as cited in Webb and Greev (1987) found out that factors such as advancement and work itself were not significant motivators for teachers; however, Wickstrom (1971) revealed that the top ranking satisfiers for teachers were inter alia; work itself, sense of achievement, good personal relations with subordinates and responsibilities. Pickle (1991) borrowing from Herzberg theory also agreed that teachers are more motivated by factors that include achievement, recognition, work itself responsibility advancement and growth. Nhundu (1994) in his study on perception of the factors that Zimbabwean teachers concerning aspects of their work and employment conditions found out that working condition emerged as the greatest area of dissatisfaction for teachers. Teachers in this study were dissatisfied with low salaries, prospects of promotion, poor accommodation and insufficient resources. However they were satisfied with school holidays, job security, relationship with colleagues and freedom of choosing teaching methods. Abdo (2000) later also reported that poor working conditions pushed teachers from the profession. Kusereka (2003) found out the same, that working conditions impinged on the motivation and satisfaction of teachers. He cited salary, inadequate teaching materials, work load and classroom conditions as some of the factors that demoralized teachers. Theory X and Y posits that one of the most

In the name of professionalism, teachers have been induced to accept poor working conditions and poor salaries writes (Bessant, 1972). Duke (1990) pointed out that one of the criteria of a profession is high earnings. Katz and Khan (1978) had identified salary benefit as one of the drives that motivated workers. Castle, (1970), Ezewu, (1992) and Shiundu and Omulando, (1992) contend that a profession is not marked by remuneration alone but also by exclusiveness of prestigious salaries. Social esteem is measured in terms not only of membership to a recognized professional body but also in terms of remuneration. Ezewu (1992) argues that a characteristic of a professional is that members of the profession have to be seen by the public as enjoying a prestigious salary comparable to other professions. Teachers therefore should secure the esteem of people whose opinion they respect by being paid at least as much as men and women with similar qualifications who play an important role in the society.

In Kenya joining Kenya Union of Teachers (KNUT) is voluntary and not compulsory, that is, members can enter and exit as they wish. The union is not autonomous this means that it is not self-governing and cannot discipline its errant members. The TSC has the responsibility of employment and disciplining members. KNUT members should be free to exercise their judgment in matters relating to their professional expertise and to accept responsibility for the consequences of their judgment, however this is not so.

Teachers in Kenya schools are not free to exercise their own judgment in matters relating to their professional expertise and the classroom. Kenya Institute of Education (K.I.E.) develops the curriculum and even though there are teachers in the various subject panels, the curriculum has to be approved by administrators in Ministry of Education who are not necessarily teachers. The K.I.E. also comes up with prescribed syllabuses, which even have outlined teaching methods and objectives. Teachers seldom have control over even number of children to be admitted, teachers in some instances are even told which subject to teach. This is especially so in primary schools where teachers are trained to teach all primary school subjects irrespective of interest or ability.

Morale and achievement are also related; where morale is high in schools it leads to an increase in students' achievement (Mwangi & Mwai, 2002). Low morale lead to a decrease in teacher's productivity, quality and achievement. High intrinsic motivation, work satisfaction, and high-quality performance depend on three important factors as advanced by Vroom in his Expectancy theory. These include valence, expectancy and instrumentality. This means that people expect that their effort will lead to an outcome such as a reward, that their efforts will be lead to a particular performance and that they will be successful thus obtain the desired reward. The worker is responsible for outcomes and knowledge of results, thus enhancing and maximizing motivation is critical in facilitating workers morale (Githua, 2002).

2.2 CONCEPTUALIZATION

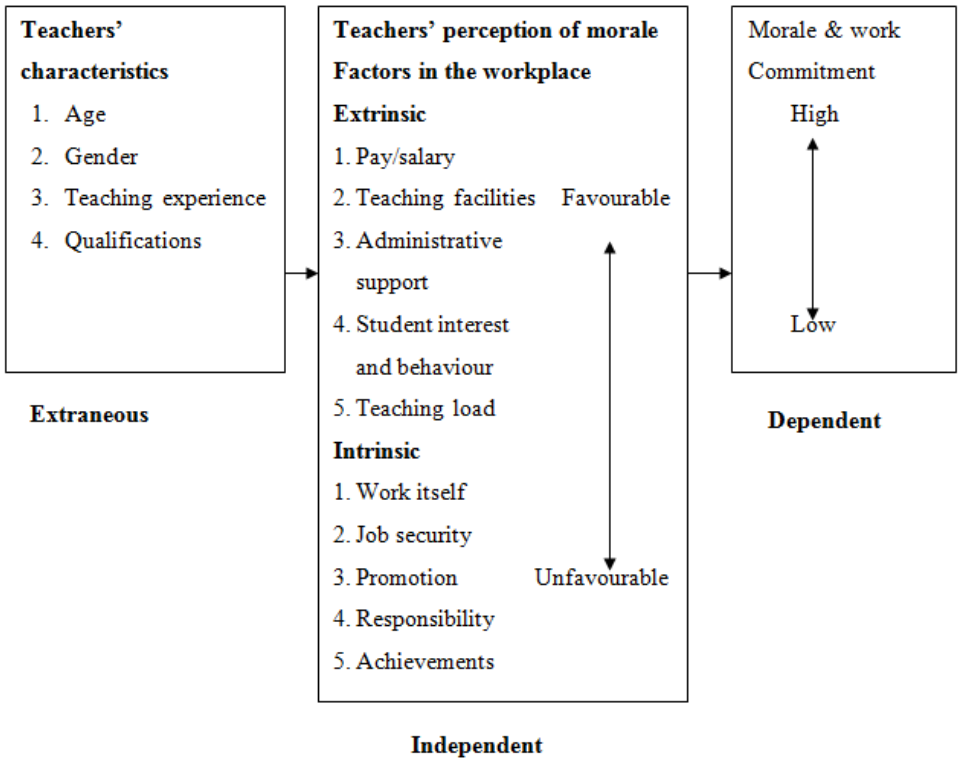

Figure 1: The Relationship between Independent and Dependent Variables

This study was based on the motivational theories such as Hertzberg's two-factor theory; Maslow's hierarchy of needs pyramid and Vroom's expectancy theory. Herzberg's theory advance that workers are motivated by intrinsic and extrinsic factors. The intrinsic factors include: achievement, recognition, work itself, responsibility and advancement that are also referred to as motivators. Maslow calls these higher level needs and their presence increase motivation thus leading to job satisfaction. The extrinsic factors include: organisational policies, supervision, salary, working conditions and interpersonal relations. These are referred to as hygiene factors and their presence prevents dissatisfaction (James, 1996). Vroom on the other hand contends that individual's perceptions of their potential to meet personal and organizational goals act as a valence to arouse them to action. Drawing from these theories, the figure below shows the interaction between the various variables that are related to morale and job satisfaction. Personal characteristics of the teacher and morale factors are assumed to be the independent variables. The level of morale either high or low and work commitment are the dependent ones. Therefore, teachers' level of morale will depend on the extent to which these factors are satisfied or unsatisfied as Maslow and Herzberg expounds, an individual will aspire to satisfy higher level of needs if the lower ones have been satisfied. If a teacher perceives certain morale factors as important and they are consequently satisfied to a certain degree, his/her commitment to work will increase for performance is considered to be a function of ability and motivation (Accel.- Team, 2004).

3 METHOD

The study adopted descriptive survey design. The target population of this study was all teachers in public secondary schools in Nakuru District. It has 16 educational divisions and according to Nakuru District records (2004), it has a total of 109 public secondary schools and a population of 1711 teachers. Purposive sampling was used to select divisions that were included in the study. Proportionate random sampling was used to select the required sample of schools. This was to ensure that actual proportions of the individual stratum in the population were represented and that every sampling unit of the population had a proportionate size (Nachmias & Nachmias, 1997). In descriptive research, a researcher can use 10% or 20% of the accessible population (Mugenda & Mugenda, 1999). In this, study three (3) divisions was purposively selected out of sixteen (16). These were Nakuru Municipality, Naivasha and Bahati. These divisions did not only have a high number of

schools but they were also accessible to the researcher. The three (3) divisions had fifty (50) schools. 20% of these schools were proportionately randomly selected giving a sample of eleven (11) schools. A summary of this information is on Table 1. The three (3) divisions had 862 teachers. A sample of 172 teachers was proportionately randomly selected; the summary of this data is on Table 2. The Table of random numbers was used to determine the sample that was included in the study. A good sample must be representative of the universe therefore it should be adequate in size (Mutai 2001; Young, 2001). Head teachers of the sample schools were also included in the sample. The study used structures questionnaire and interview schedule as the main data collection tool. Pearson Moments Correlation was used to establish the relationships between teachers' perceptions of morale factors, their characteristics and work commitment was also determined at alpha is equal to 0.05.

4 RESULTS

4.1 TEACHERS COMMITMENT TO THEIR WORK IN RELATION TO THEIR STUDENTS

Table 1. Level of Teacher commitment to work in Relation to their Students

Descriptors	N	%
I enjoy teaching when the learners are active and participative	119	99
I work hard because I enjoy seeing my students perform well	119	98
I get concerned when my students do not perform as expected	115	99
I am concerned when my students do not ask questions	118	93
I enjoy working with students	118	95
I feel attached to my students	117	94
I encourage my students to do extra work and enjoy marking it	119	88
I encourage my students to share with me their personal problems	119	85
I like taking students out for co-curricular activities even without being asked to do so by the school head	118	46

Majority of the teachers showed a high commitment to their students. Ninety nine (99%) of the respondents agreed that they got concerned when their students did not perform as expected. Wright & Custer, (1998) argue that secondary school teachers' morale depends in part on their students' achievement. A further 93% were concerned when the students did not ask questions nor completed their homework. The study also revealed that teachers were disappointed when their students did not perform well, indicating that teachers encouraged their students to work hard. Steyn (1996) observed that the relationship between teachers and their students was very important. He argued that teachers derived their greatest satisfaction from positive and successful relationships with their students and observing them succeed.

Meighan, (1996) argues that the teacher must encourage pupils, lead them in the right direction and help them recognize that their allegiance to societal goals and values came before personal concerns. In this study 85% of teachers claimed that they encouraged their students to share their personal problems with them. This implied that teachers were not only concerned with the student as a learner but also as a person. This is in agreement with the RoK, (2004) that, the role of the teacher was not only to impart knowledge but also to help students learn how to be agents of life transformation.

4.2 TEACHERS' LEVEL OF COMMITMENT IN RELATION TO THEIR PERFORMANCE OF DUTIES

Table 2. Teachers' Level of Commitment in Relation to their Performance of Duties

		Rating (%)	Rating (%)
Descriptors	**N**	**A**	**S.A**
I do my work to the best of my ability without supervision	119	33	66
I explore new ideas in teaching methods and subject matter in order to teach effectively	117	39	52
I will enroll for further professional training in order to be a better teacher	118	34	46
I rarely get late to my classes	118	45	36
I prepare lesson plans and schemes of work without supervision	115	57	27
I develop and use teaching aids out of my own choice	116	57	21
I carry school work home to complete it	117	47	18
I don't mind working after school hours	118	39	15

Table 2 shows that 54% of the respondents felt that they did not mind working after school hours. This concurs with the observations of 50% of the head teachers. They were able to judge the commitment of teachers as observed from their willingness to work after school hours or weekends without pay. The study also revealed that 65% of teachers did not mind carrying school work home to complete it. This may be a sign of high commitment to their duties. Eighty one percent (81%) of the respondents indicated that they rarely got late to their classes. These observations are in agreement with the head teachers' observations. Ninety (90%) of the head teachers interviewed pointed out that one of the most important indicator of a committed teacher is punctuality to class or duty. This manifested low level of motivation and low morale of teachers.

4.3 TEACHERS' PERCEPTIONS ON FACTORS RELATING TO THEIR JOB

Table 3. Teachers' Perceptions on Factors Relating to their Job

Descriptor	N	Ratings (%) Agree/Strongly Agree	Frequency Ratings (%) Disagree/Strongly Disagree
I feel well remunerated for the work I do	119	15	78
I am engaged in other income generating activities to supplement my pay	119	49	42
The teaching profession gives me the social status I desire in the community	115	47	38
I feel secure in my job because my employer has adequate policies and guidelines to protect me as a teacher	117	53	32
I feel appreciated and recognized by my employer	118	43	34
I feel appreciated by my school because my opinions are listened to	118	46	45
I like my job because it provides opportunities for to those who seek further training	119	34	50
I love my job because there are many training opportunities provided to help me perform better	119	24	60
I love my job and would not want to leave it	117	34	48
I am satisfied with the progress I am making in my career	118	46	38
I have invested too much in my job to consider changing to another job	118	39	39
I have a strong sense of belonging that I would not consider leaving the current station	118	50	27
I would like to spend the rest of my career life in the teaching	118	34	40

Salary was perceived as a major influencer with only 15% feeling that they were well remunerated for the work they did. Promotion and administrative support were also considered as most important. This study also found out that 47% of the respondents felt that the teaching profession did not give them the social status they desired in the society. Light (1979) claimed that status go with power, money and prestige. Teachers have neither the money nor the power needed to have a high social status they desired in the society. Linda (1998) observed that shared governance or participatory management enhances professional status. There is need therefore to involve teachers in management issues to enhance their status. This recognition satisfies esteem needs according to Maslow's theory of motivation. Hoy and Miskel (1996) agreed that recognition is a motivator which increased job satisfaction. Teachers need also to be recognized for their accomplishments. School heads, parents and the employer should recognize teachers in form of verbal praises or promotions.

4.4 TEACHERS' PERCEPTIONS TOWARDS SELECTED FACTORS RELATING TO THE WORK ENVIRONMENT INFLUENCING THEIR MORALE AND COMMITMENT TO WORK

Table 4. Teachers' Perceptions towards selected Factors relating to the Work Environment Influencing their Morale and Commitment to Work

Item	N	M	SD	Percentages
I enjoy teaching in a school with adequate teaching - learning facilities	118	4.68	0.568	98 %
My work is enjoyable because the Head Master supports me	118	4.64	0.594	96%
I enjoy working in a school with clear roles and a supportive administration	117	4.63	0.535	99%
I feel good when any school head gives me a feedback on my performance	116	4.45	0.623	93%
I love working with a school head that is sensitive to my personal needs	118	4.44	1.812	90%
I have a sense of belonging because of the way staff mates relate with me	118	4.23	0.767	89%
I have a strong emotional attachment to my current station	117	3.68	1.072	69%

Most teachers (99%) perceived the support of administration as well as existence of clear roles in a school as important boosters to their morale and commitment to their duties. Benwell (2004) pointed out that lack of clear roles and responsibilities demotivates teachers, and was likely to result into conflicts. Linda (1998) observed that if school principals created a positive school climate and culture, teachers' morale would be improved. Ninety three percent (93%) of teachers perceived feedback from the head teacher on their performance as an important factor that promoted their morale and commitment to work. Hoy and Miskel (1996) argue that feedback leads to job commitment and satisfaction. Mutshinyani (1997) regards feedback as liable to motivate teachers and encourage them towards achievement of competence. Teachers need adequate, regular and accurate feedback on their performance. Regular feedback is a strong predictor of job satisfaction (Fraser & Sorenson, 1992).

School heads play a vital role in the care for the personal welfare and emotional well-being of teachers. Thus 90% of the teachers indicated that they loved working in a school where the school head was sensitive to their personal needs. This is supported by Abbey and Esposito (1985) who observed that teachers who were supported by their school heads reported less stress and burnout. Most head teachers (78%) in the study observed that they had put into place measures for assisting teachers with personal problems. The assistance was in form of financial and counseling support. The relationships in the workplace may affect teachers for good or bad. It is an important factor that influences their morale and commitment to work. Eighty nine (89%) of the teachers had claimed that they felt a sense of belonging in their schools because of the way colleagues related with them. Kloep and Tarifa (1994) reported that teachers seemed to be motivated and satisfied by congenial relationships at the workplace. Interpersonal relations with colleagues may contribute to job satisfaction and teachers are most satisfied with their co-workers since they have a need to identify themselves with others and enjoy team - work (Steyn, 1994; Wright & Custer, 1998). However, this factor may have contributed to a majority feeling obliged to stay in one school, with 58% feeling that they had an obligation to remain in their current stations. Another 69% said that they had a strong emotional attachment to their schools. The head teachers were also on the opinion that teachers who were committed had good relationships with other teachers. Ninety eight percent (98%) of the respondents pointed out that they enjoyed working in a school with adequate teaching- learning facilities. The government of Kenya also ensured equitable distribution of learning-teaching materials in schools to support curriculum implementation (GOK, 2004). Therefore teaching-learning facilities, administrative support, clear roles, feedback and sense of belonging are among the most important factors that enhance the working environment thereby improving morale and commitment to duty of teachers in public secondary schools.

4.5 RELATIONSHIP BETWEEN TEACHERS' CHARACTERISTICS AND COMMITMENT TO WORK

The study established no statistically significant relationship between teachers' commitment to work and their gender **(p>0.05; r=0.96).** This implied that teachers' commitment to work was the same irrespective of their gender. Secondly, the study established no statistically significant relationship between teachers' commitment to work and their age bracket **(p>0.05; r=0.051).** Third, the study established no statistically significant relationship between teachers' commitment to work and their years of experience **(p>0.05; r=0.070**). Four, the study established a statistically significant relationship between commitment to work and teachers' academic and professional qualifications a teacher has **(p>0.05; r=-0.080).** Five, the study established no significant relationship between teachers' perception of the factors that influenced their motivation and gender (P>0.05; r=0.067). Six, the study established no statistically significant relationship between teachers' perception of the factors that influenced their morale and age. **(p>0.05; r=0.251).** Seven, the study establsished no statistically significant

relationship between teachers' perception on the factors that influenced their morale and their years of experience (**P>0.05; r=0.167**). Eight, the study established no statistically significant relationship between teachers' perception of factors that influenced their morale and the level of professional qualifications (**p=0.05; r=-0.080**). Nine, the study established no statistically significant relationship between teachers' perceptions of the factors that influenced their morale and their commitment to work since **p>0.05.**

5 CONCLUSION AND RECOMMENDATION

5.1 CONCLUSION

The study established that the teachers were highly committed to their work; there was less absenteeism, lower burnout, less dysfunctional classroom behaviour and high productivity. Remuneration, availability of training opportunities, responsibility given in school, participation in decision making, social status and job security were perceived as some of the most important factors influencing the morale and commitment of teachers in their work. There was no significant relationship between teachers' commitment to work and their age. It further found out that there was no significant relationship between experience of the teacher and their commitment to work. Neither was there a significant relationship between teachers' gender and commitment to their work. There was no statistically significant relationship between teachers' gender, age, years of experience and academic and professional qualifications and perceptions of the factors that influenced their morale. Lastly, there was no statistically significant relationship between teachers' perceptions of the factors that influenced their morale and their commitment to work.

5.2 RECOMMENDATIONS

1- Since remuneration was perceived as a major motivator it should be improved further. Policy interventions on salary structures should be undertaken to encourage higher levels of motivation and job satisfaction among teachers.

2- There is need to motivate teachers in order to maintain the high level of commitment in their work. School heads should think of ways of motivating teachers for instance, they should give incentives such as certificates of the 'teacher of the week'.

3- Teachers should be involved in formulation of policies that affect them, that is participatory decision making in order to give them a sense of belonging.

4- There is need for Ministry of Education to organize skill up-grading and in-service training programmes regularly to help teachers cope with emerging challenges in schools.

5- Since responsibility was viewed as a motivator, head teachers should ensure that teachers are given more responsibilities not just classroom teaching.

6- TSC has a responsibility of ensuring that teachers have job security through implementation of schemes of service for all cadres of teachers.

7- Schools should have adequate teaching-learning facilities in order for teachers to enjoy their work.

8- School heads should be sensitive to their teachers' personal needs because it motivated them.

REFERENCES

[1] AARE (2004). Teachers Commitment and Engagement: The Dimensions of Ideology Practice Associated with Teacher commitment and Engagement within an Australian Perspective. [on-line www]. Available: http://www.aare.edu.au/o2pap/cro02522.html.

[2] Abdo H. A. (2000). Teacher Incentives in the Middle East and North Africa Region. The short comings Mediterranean Journal of Ed'nal Studies 6(1); 107 - 122.

[3] Accel -Team (2004). *Employee Motivation, the Organizational Environment and Productivity.* [On-line]. Available: http//www.accel-team.com/motivation.

[4] Bessant, B. (1972). *Teachers in Conflict*. Victoria, Dai Nippon Printing Co.

[5] Castle, E. B. (1970*). The Teacher.* London, Oxford University Press.

[6] Castle, E.B. (1965). *The Principles of Education for Teachers in Africa*. London, Oxford University Press.

[7] Davis, K. & Newstrom, J. N. (1989). *Human Behavior at Work Organizational Behavior*. McGraw-Hill International

[8] East African Standard Team (October 5th 1998) The Government Says it has no more Money to continue paying the Teachers. *East African Standard*, Pg 1,2

[9] Ezewu, E. (1992). *Sociology of Education*. Lagos: Longman Group Limited.

[10] Fraser, L. E. & Sorenson, L (1992) Teacher Motivation and Satisfaction Impact on Participatory Management. NASSP Bulletin 76(540); 37 - 43.

[11] Getzels, J. W. & Jackson P. (1963). The Teachers' Personality and Characteristics in Gage. NY Handbook of Research on Teaching Chicago Rand McNally.

[12] Githua, B. N. (2002). *Factors related to the motivation to learn Mathematics among Secondary School Students in Kenya's Nairobi Province and Three Districts of Rift Valley Province*. Unpublished Phd. Thesis, Egerton University, Njoro.

[13] Herzberg F, Maustner B, Synderman BB (1959). The Motivation to Work. New York: John Wiley.

[14] Hoy, W. K. & Miskel, C. G. (1987). *Theory Research a Practice (3rd ed.).* New York, Random House Inc.

[15] James, P. (1996). *Totally Quality Management. An introductory Text.* London: Prentice-Hall Publishers.

[16] Linda, L. (1998). "Teacher Morale" [Online] http://www.ericfacility.net/ericdigests/ed422601.html [10th September, 2003]

[17] Light, D. (1979). *Sociology.* Indianapolis, Rand McNally and Co.

[18] Katz, H. & Khan, L. (1978) *Workers Motivation*. London: Prentice-Hall Publishers.

[19] Kloep, M & Tarifa, F (1994). Working Conditions, Work Style and job Satisfaction amonu Albanian Teachers. International Review Ed 40 (2); 159 0 172.

[20] Meighan, R. (1986). *Sociology of Educating (2nd Edition*). London Sussex. Holt, Pine heart and Winston Ltd.

[21] Mugenda, O. M. & Mugenda, A. G. (1999). *Research Methods: Quantitative and. Qualitative Approaches.* Nairobi, Acts press.

[22] Mutai, B. K. (2001). *How to Write Quality Proposal*. New Delhi: Thelley publication.

[23] Mutshinyani, A. (1997). Motivation as a aspect of tactful feedback: Implication for the Management of Teacher Competence Med Research Easy Auckland Park. Rand Afrikaans University.

[24] Mwai, K. A. (2000). *Perceptions of Agriculture Teachers on Selected Morale Factors in Machakos District.* Unpublished MSc. Thesis. Egerton University, Njoro.

[25] Mwangi, J. G. & Mwai, K. A. (2002). *Factors Related to the Morale of Agriculture Teachers in Machakos District*. Eastern Africa Social Science Research Review. Vol.18 pp 31-42.

[26] Nachmias, C.F. & Nachmias, D. (1997). *Research Methods in the Social Sciences* (5th ed.). New York. St Martins Press Inc.

[27] Nhundu, T. J. (1994), Facet and Overall Satisfaction with teaching and Employment Conditions f Teachers in Zimbabwe. Journal of Educational Research.

[28] Okumbe, J. A. (1998). *Educational Management: Theory and Practice*. Nairobi, Nairobi University Press

[29] Oluoch, G. P (1982). *Essentials of Curriculum Development*. Nairobi: Elimu Bookshop.

[30] Owens R. G. (1995). Organisational Behaviour in Ed 5th Edition. Needhar Heights, Massachusetts, Allyn and Bacon.

[31] Owens, G. R. (1998). Organizational Behavior in Education (6th ed.). Needham Heights, Allyn and Bacon.

[32] Pager, D. L. (1996). - The culture of learning in Khayelitsa Secondary Schools: Teachers' Perspectives. Masters Thesis Cape Town University.

[33] Sadker, M. P. & Sadker, D. M. (1994) *Teachers, Schools and Society (3rd ed.).* New York, McGraw-Hill inc.

[34] Shiundu, J. S. & Omulando S. J. (1992). *Curriculum Theory and Practice in Kenya.* Nairobi, Oxford University Press

[35] Sifuna , D. N. & Otiende, J. E. (1992). An *Introductory History of Education.* Nairobi, Nairobi University Press.

[36] Steyn, G. M. (1996). Personal Management: Managing the Quality of Working. Literature: ONBL52-G Study Manual Pretoria, University of S.A.

[37] Steyn G. M. (2002). A Theoretical Analysis of Education Motivation and Morale Educare.

[38] Yong B. C. (1999). The Career Commitment of Primary Teachers in Brunei Darussalan Perceptions of Teaching as a Career Research in Education.

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Undercorrection Induces Peripheral Myopic Defocus in School Children in Kumasi, Ghana

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ABSTRACT: The purpose of this study was to determine whether undercorrection single vision lenses altered the peripheral refractive error of myopic school children when targets are viewed at 2m. Seventy four children with mean age of 12.28 ± 1.33 years were assigned to full correction and undercorrection groups. Central and peripheral refraction was measured to 30° in the nasal and temporal retina using a free-space autorefractor. Full correction spectacle lenses caused a hyperopic shift in spherical equivalence (M) in all peripheral locations (all p=0.001) whereas undercorrection caused a myopic defocus at 4 of the 6 retinal locations (all p=0.001). There were temporal–nasal asymmetries in J180 and J45 astigmatism. Undercorrection spectacle lenses induced more against- the- rule astigmatism at 30° nasal retina than with full correction. At temporal retina, full correction induced more against- the -rule astigmatism than with undercorrection. Undercorrection resulted in a myopic shift in the horizontal retina of the myopic eye. Children who wear uncorrected spectacle lenses are more likely to have a reduction in myopia progression.

KEYWORDS: undercorrection, peripheral refractive error, myopia.

1 INTRODUCTION

Myopia is associated with serious sight threatening conditions like glaucoma, cataract and retinal detachment and its prevalence is increasing worldwide. Myopia affects about a third of the adult population in the United States [81]. In Asia, its prevalence is increasing to epidemic proportions: about 84% of children between 16 and 18 years [48] and 80% of young adults are affected [65]. The prevalence of myopia among school children in the Durban area of South Africa, Chile, rural and urban India were 2.74% [57], 12.8% [51], 5% [19] and 9% [53] respectively. In Ghana, its prevalence was 54.2% among those who self-reported to eye care facilities and 69.2% of this number were aged between 10 and 19 years [45].

Consequently, there are attempts to either halt or reduce the rate of myopia progression with optical interventions such as undercorrection single vision lenses [1],[17],[80], bifocal lenses [26], progressive addition lenses [11],[31],[36],[38],[87], novel contact lens designs [2],[62], and Orthokeratology lenses [15],[16],[39],[42],[63],[82]. Most of these studies have assumed that visual signals from the fovea dominate refractive development and progression [83].

Studies of the mechanisms that regulate refractive development and progression, suggest that optical strategies that alter the peripheral retinal refraction might change the rate of axial length elongation and myopia progression [40],[76]. This hypothesis is supported by studies in monkeys which demonstrate that visual signals from the fovea play a minimal role in myopia progression and that peripheral visual signals may independently induce a refractive change [73]. In addition, when

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there are conflicting visual signals in the central and peripheral retina, those in the peripheral retina can dominate and regulate axial growth and myopia progression [72].

In a 2-year study randomized trial, myopic children in the undercorrection group had a 0.23D increase in myopia progression compared to those in the full correction group [17]. Reference [1] found no significant difference between the fully corrected and the undercorrected myopic children. However, in a 3-year randomized study, [31] found a 0.20D reduction in myopia progression among myopia children corrected with PALs. This result probably suggests that PALs cause myopic defocus centrally and peripherally which resulted in reduced myopia progression. The performance of these two optical lenses can be compared because undercorrecting myopia by +0.50 is similar to full correction with PALs with an addition of +0.50D. The studies by [17] and [1] appropriately evaluated the progression when children wore undercorrection spectacles; they did not measure the accommodative state or the peripheral refraction of the children. The relationship between undercorrection and myopia progression is still obscure and needs to be resolved. The purpose of this study therefore was to determine the influence of undercorrection or full correction single vision lenses on peripheral retina of myopic children in Ghana

2 METHODS

The Committee on Human Research, Publications and Ethics of the Kwame Nkrumah University of Science and Technology, School of Medical Sciences and Komfo Anokye Teaching Hospital, reviewed and approved the study. Approval was also obtained from the Ashanti Regional Health Directorate and Education Service. This study conformed to the tenets of the Declaration of Helsinki because benefits and risks involved in the study were explained to the children and their parents. Before assessing eligibility of children to the study, parents and children agreed by signing informed consent forms and by verbal assent respectively.

2.1 SUBJECTS

Seventy four healthy children aged from 10 to 15years (made up of 46 girls and 28 boys) were enrolled in this study. The inclusion criteria were: visual acuity of log MAR 0.20 or better with habitual spectacles, spherical equivalence refraction (SER) of -1.25 to -4.50D in each meridian as measured by autorefractor, astigmatism ≥ -1.25D, anisometropia ≤ 1.00D, normal binocular function (no manifest strabismus or amblyopia) and no ocular pathology.

2.2 PHORIA MEASUREMENT

Distance and near phoria were measured by the prism cover test while the children wore the study spectacles. During measurement of distance phoria, the child fixated a letter, 2 lines above the threshold on the Early Treatment Diabetic Retinopathy Study (ETDRS) distance chart. Near phoria was measured at 40 cm while the child wore the same correction and fixated a crowded N10 standard letter E.

2.3 OBJECTIVE MEASUREMENT OF CENTRAL AND PERIPHERAL REFRACTIVE ERROR

Baseline measurements of central and peripheral refractive error were done by an experienced optometrist who was trained on study protocol. A Shin-Nippon (Grand Seiko) NVision- K5001 was used to measure central and the horizontal meridian of the peripheral retina. Measurements were done while children wore no correction and also when they wore their habitual spectacles. The fixation targets was a 6 -Watts red incandescent bulb fixed on a costume-made straight bar wooden frame that stood 2m away . The red bulb allowed children to maintain fixation even when they did not have their spectacles on. The frame allowed the target to be moved to the required eccentricity within the visual field. Because children viewed the fixation target on a straight bar, the instrument-to-fixation target distance was 2m to 2.5m but will be referred to as 2m in this study.

Five measurements of refraction were taken in both eyes. Measurements were taken at the 0º (foveal), 10º, 20º and 30º in both the temporal (nasal retina) and nasal (temporal retina) visual fields.

Children turned their eyes and kept their heads stationary when they had to view the target in the nasal or temporal field [59],[69]. Measurements were done under ambient lighting conditions between 120 and 130 Lux.

2.4 DATA ANALYSIS

Data analysis was performed using Microsoft Excel and STATA 11 software. Measurements in the right eye only was used for analysis because Pearson correlation coefficient was as high as 0.90 between the two eyes. Sphero-cylindrical refractive error was decomposed into power vector form according to the equation by [79]

$$M = S + C/2 \quad (1)$$
$$J180 = -C\cos 2\theta/2 \quad (2)$$
$$J45 = -C\sin 2\theta/2 \quad (3)$$

S, C and θ are the spherical, cylindrical and cylindrical axis components of the sphero-cylindrical refractive error. M is the mean spherical equivalent refractive error, J_{180} is the with and against- the –rule astigmatism and J_{45} is for oblique angles from 45 to 135 degree.

A relative peripheral refractive error (RPRE) was calculated as the difference between the foveal refraction and the respective peripheral refractive error.

3 RESULTS

One hundred and four school children voluntarily responded to verbal and written advertisements in three schools. 95 of them returned with the signed consent forms. These children were screened between September 13, 2011 and March 5, 2012 and 80 met the inclusion criteria. However, the first 74 children comprising 46 girls (62.16 %) and 28 boys (37.84%) were enrolled because of the calculated sample size. .

The mean age ± SD of the 74 children was 12.28 ± 1.33 years and 40 children entered the study with habitual undercorrection of +0.50D spectacle lenses while 34 wore habitual full corrections. Mean age ± SD of children in the undercorrection and full correction groups was 13.04 ± 1.3 and 12.9 ± 1.2 years respectively (p=0.63). The baseline mean cycloplegic SER of the children was -1.95 ± 0. 57 was -1.89 ± 0.54D and -2.04 ± 0.55D in the undercorrection and full correction groups p= 0.24. However, the habitual spectacle prescription was -2.41 ± 0.55 and -1.89 ± 0.54D in the full correction and undercorrection groups respectively p= 0.0001.

Near phoria was measured at 40 cm while the child wore the same correction and fixated a crowded N10 standard letter E. The children were classified as orthophoric when they exhibited less than 5 Δ or no ocular movement, exophoric when they exhibited 5Δ or more and any amount of Esophoria was esophoric as shown in Table 1, a classification similar to that by [1].

Table 1: Baseline distance phoria when measured with their habitual spectacles

	Full correction	undercorrection
Orthophoria	21	24
Exophoria	12	14
Esophoria	1	2

3.1 MEAN SPHERE POWER (M)

The mean change in spherical equivalence (M) between children in the two groups in the uncorrected and corrected states is shown in figure 1 below. In the uncorrected state there was no significant difference in M between children who wore full correction or undercorrection groups (p=0.86). M was however significantly different by retinal location in all children. This difference did not depend on whether the child was in the full correction or undercorrection group (all p≤ 0.0001). Both groups showed asymmetry between the nasal and temporal groups. Negative values were measured at both visual fields and the values showed relative hyperopia.

In the corrected state, there were differences in M between the 2 groups which depended on the assigned group as shown in figure 1 below. For children in the full correction group M was more hyperopic than in the undercorrection group. The values measured in peripheral retina with full correction was significantly more hyperopic than the measurement at the fovea F $(_{6,210})$ =16.15, p=0.0001.

Negative values were measured at 10º, -10º,-20º and -30º eccentricity in the undercorrection group. Repeated Anova revealed a significant difference between all eccentricities at 2m with undercorrection $F_{(6, 210)} = 18.31$, p=0.001.

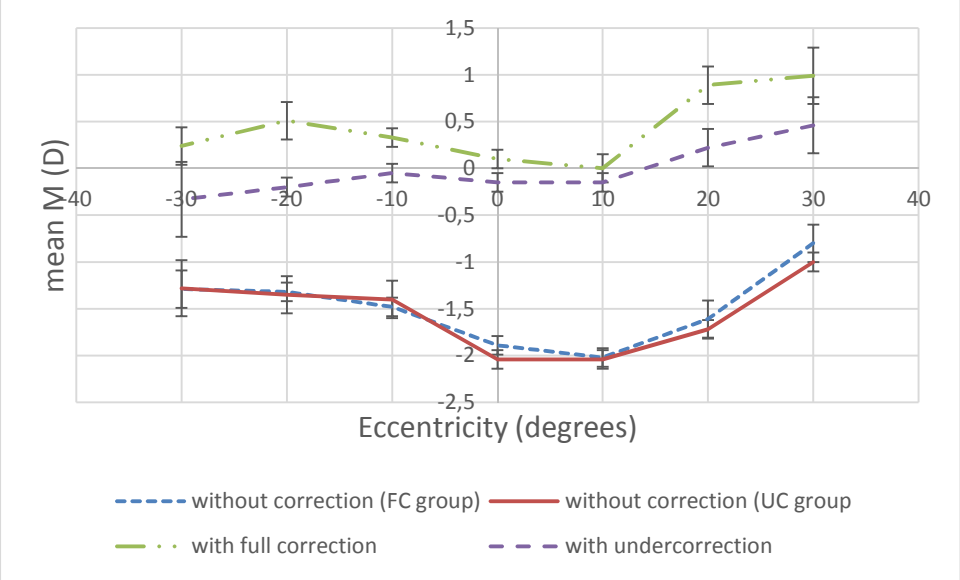

Figure 1: shows the mean spherical equivalence (M) of uncorrected myopic and fully corrected and undercorrected children who viewed a distant target at far (2m). Error bars indicate ± SEM

3.2 PERIPHERAL ASTIGMATISM (J_{180} AND J_{45})

There was no statistical difference between the two uncorrected groups p=0.51. As shown in figure 2, the mean magnitude of J_{180} at all eccentricities was greater than at the fovea in both full correction and undercorrection groups (all p ≤0.05). The magnitude of J_{180} shows temporal-nasal asymmetry in both groups. At 30° nasal retina (temporal field) the J_{180} component in the full correction and undercorrection groups were 0.69D and 0.30D respectively more than the corresponding temporal retina (nasal field). The difference in J_{180} between the two groups was statistically not different (all p ≤ 0.05). There was significant interaction between eccentricity and group (F =5.47; p= 0.0062).

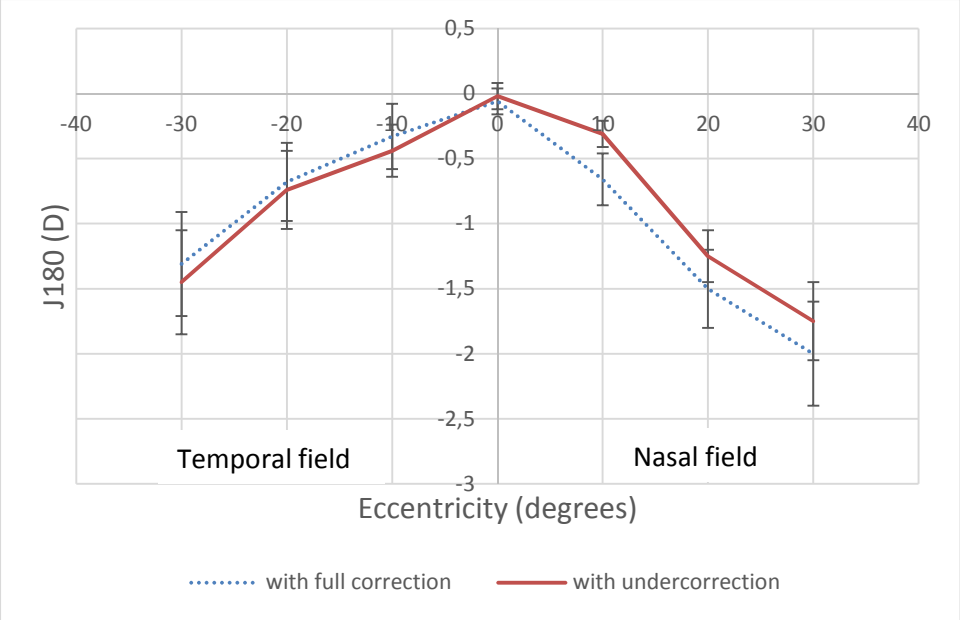

Figure 2: Variation in power vector component J180 with eccentricity at 2m whiles children wore either full correction or undercorrection spectacles. Error bars indicate ± SEM

There was no statistical difference in J_{45} seen between the two uncorrected groups p=0.62 (figure 3). The magnitude of the J_{45} (oblique astigmatism) shows temporal-nasal asymmetry with greater increase in against-the- rule astigmatism on the nasal retina than the temporal retina when corrected. The mean magnitude of J_{45} at all eccentricities was greater than at the fovea in both groups ($p \leq 0.05$). There was no statistical difference in J_{45} seen at all eccentricity between the full correction and undercorrection groups $p > 0.05$. There was no significant main effect or interaction between eccentricity and group $p>0.05$.

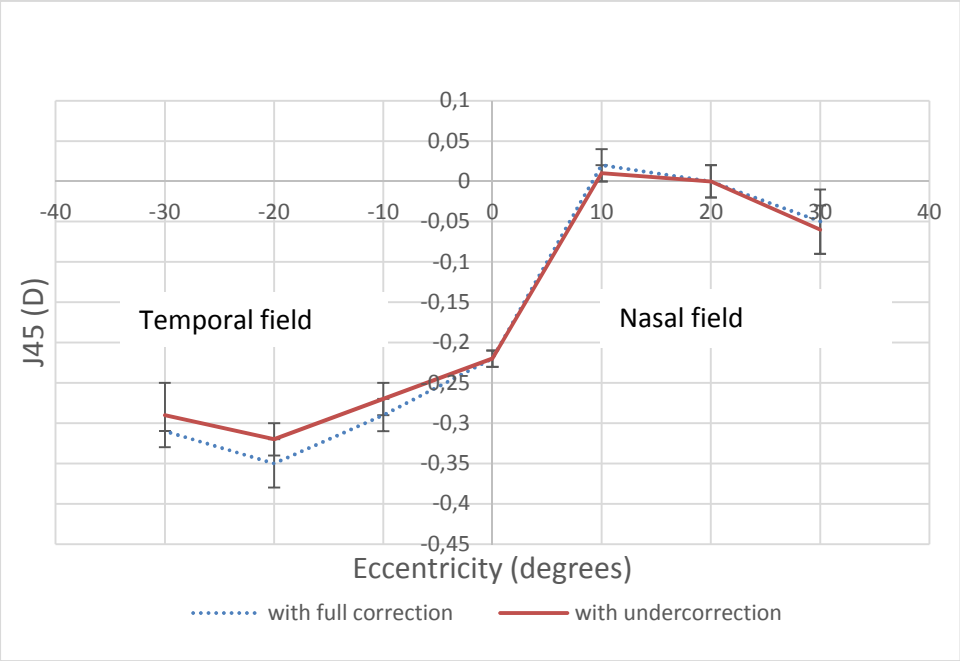

Figure 3: Variation in power vector component J_{45} with eccentricity whiles children wore either full correction or undercorrection and viewed targets at 2m. Error bars indicate ± SEM

Figure 4 shows a comparison between the variation in RPRE as a function of eccentricity in the uncorrected and corrected states during distance viewing. In the uncorrected state, relative hyperopia increased steadily with eccentricity in both groups and there was no significant difference between the two groups at all eccentricities $p>0.05$. When children worn full correction spectacles, the group showed increased relative hyperopia as eccentricity increased but at 10° nasal field myopic defocus was seen. Repeated Anova revealed a statistical significant difference between eccentricities with full correction $F_{(6,511)} = 1060$, $p=0.0001$.

The undercorrection group showed less increased relative hyperopia as eccentricity increased. However, at -20° and -30° in the temporal field negative results were recorded. Eccentricity with significantly different as revealed with repeated Anova $F_{(6,511)} = 2015$, $p=0.0001$.

There was substantial asymmetry seen between the temporal and nasal fields in both groups. The full correction group showed 0.75 more hyperopia 30° nasal field than its corresponding 30° temporal field. Whereas, the undercorrection group showed 0.61 hyperopia in the nasal field and -0.18 myopia in the temporal field, there were no significant main effects or interaction seen in both groups.

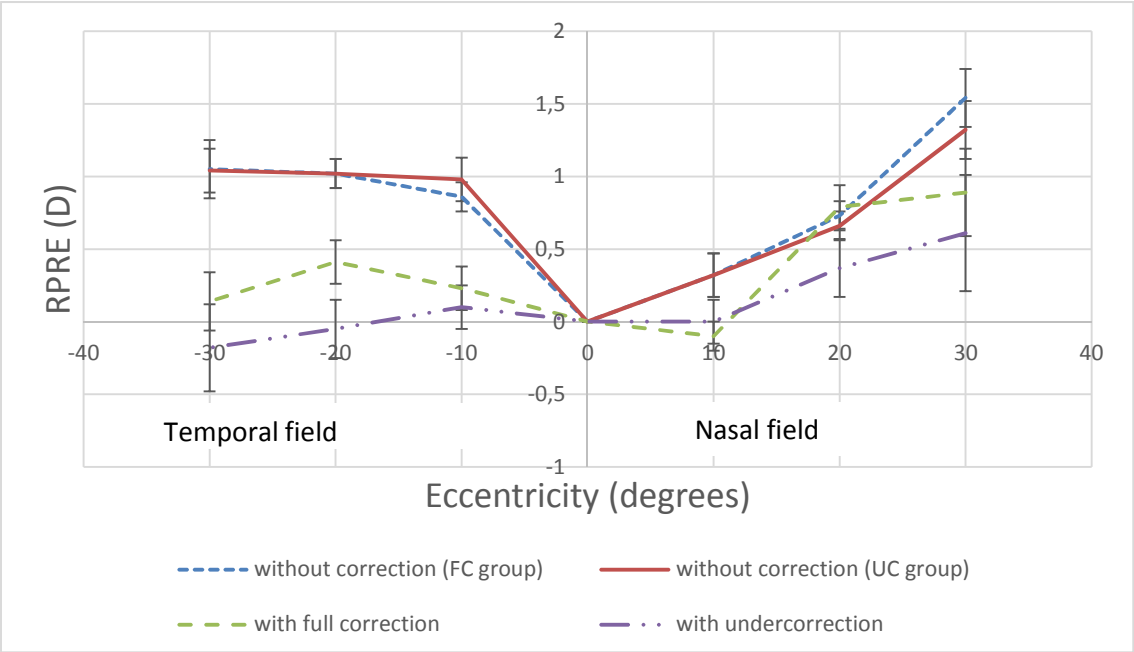

Figure 4: Comparing variations in relative peripheral refractive error (RPRE) profile with eccentricity whiles myopic children either full correction or undercorrection viewed distant target at 2m. Error bars indicate ± SEM

4 DISCUSSION

The uncorrected and corrected myopic eye shown in figures 1 and 4 demonstrate relative peripheral hyperopic defocus within the horizontal peripheral retina. This result is consistent with that seen by [6],[52],[69]. The relative peripheral hyperopic defocus within the horizontal retina suggests that the shape of the uncorrected eye is less oblate during distance viewing. This ocular shape is attributed to an axial length that exceeds the equatorial diameter [7],[54].

When children in this current study wore their full correction spectacles lens, there was significant increase in relative peripheral hyperopic defocus at all measured retinal locations (all $p \leq 0.05$). This finding is consistent with that found by [9],[12],[49]. In contrast, undercorrection spectacle lenses induced relative myopic defocus at 4 (10°,-10°, -20° and,-30°) out of 6 positions in the peripheral retina as shown in figures 1 and 4. The induced relative peripheral myopic defocus and unclear distant vision seen in the undercorrected children might be due to the residual myopia. [78] induced relative peripheral myopic defocus and unclear foveal image with radial refractive gradient (RRG) lenses in myopic adult aged 25 to 30year. RRG lenses were novel lenses designed to have steady increase in power in all radial directions and with no optical power in the center. PALs caused relative myopic shifts in nasal, temporal and superior but not the inferior quadrant. The largest myopic defocus was seen at the superior quadrant because it corresponds to the PAL corridor [12]. Myopic defocus seen in the peripheral retina of undercorrected children is also consistent with results seen by [43]. Reference [43] showed that undercorrection contact lenses induced less hyperopic defocus compared to full and over correction in adults which is in agreement with that seen with undercorrection spectacle lenses.

The central refraction of children in this study was between -1.25 and -4.50D and were not divided into low and moderate myopes. However, [49] and [43] divided their subjects into low and moderate myopes and showed that full correction single vision lenses caused increased hyperopic defocus in the horizontal retina of moderate myopes than in low myopes [9],[49],[78]. Undercorrection spectacle lenses might have caused increased myopic defocus in the low myopic children (-1.25 to -3.00D) and reduced hyperopic defocus in the moderate myopic children. This present study cannot evaluate the effect of peripheral myopic defocus on myopia progression because it is cross sectional. However, that PALs caused statistically significant myopic defocus (less hyperopia) while full correction SVLs caused an increase in hyperopic defocus in the nasal and temporal retina in children. The induced myopic defocus probably resulted in reduced myopia progression with PALs [11]. However, clinical trials evaluating the efficacy of PALs myopia progression in children found inconsistent results [11],[31],[36],[38],[46],[87]. Myopic defocus induced by under correcting myopia might also be protective and reduce the rate myopia progression

Although, the mechanism for PALs treatment effect is not clear, decreasing the lag of accommodation and reducing hyperopic defocus is the rational for fitting myopia children with PALs [11],[14],[28],[30],[31],[35],[38],[87]. In studies that evaluated myopia progression with PALs, fitted children with PALs with the top above the pupils. This fitting protocol was done to encourage the use of near addition portion of the lenses [36],[37],[38]. Children in these previous studies therefore had residual myopia for distance vision which is similar to the experience of the undercorrected in this study.

If relative peripheral myopia reduces the rate of axial length elongation and myopia progression [67],[69],[72],[74] then undercorrection spectacles might be protective against increased myopia progression. Animal studies also suggest that undercorrection could cause myopic defocus and result in a reduction in myopia progression [66],[75],[83].

References [17],[80] appropriately evaluated the effect of undercorrection on myopia progression and found that undercorrecting myopia rather increased myopia progression. This finding is contrary to that found in animals and several humans studies. Positive lenses and multifocal lenses cause myopic defocus and a reduction in myopia progression in animals and human respectively. The studies by [17],[1],[80], suggest reasons to the negative results. .

There is evidence of different rates of myopia progression among children from different ethnic backgrounds [22],[56],[61]. Myopic children of the similar ages, but from different ethnic backgrounds might respond differently to the same magnitude of hyperopic blur. While undercorrection caused myopia progression in Chinese children, there was no difference in myopia progression between the fully corrected and undercorrected Israeli children [1],[17]. Although, [80] did not indicate the ethnic backgrounds of the children they worked on, it is likely that Chinese children were included in their retrospective study. The progression rates of children vary in different countries and different ethnic groups [44],[84],[86]. The cause of the difference is still not clear, as researchers are not certain on whether environmental or genes play a more important role [64]. It is possible that the interaction between environmental and genetic factors is different in different ethnic groups and the difference is responsible for the varied rates of myopia progression.

Several studies suggest that outdoor activity is protective against myopia progression [20],[21],[25],[32],[41],[55],[60]. In addition, animal studies suggest that elevated light levels slow the rate of axial length elongation [4],[5],[70],[71]. In humans, Reference [23] found that the progression of myopia significantly increased in winter than during summer because the illuminance level of being outdoors in summer is much higher than in winter. During summer, the amount of light reaching the retina, while outdoors, is higher than staying indoors [25],[33].

Studies in Asia show a more rigorous schooling system and long hours of studying indoors as being the reason why myopia progression is highest compared to other ethnic groups [8],[18],[47],[88]. Chinese children might therefore have lower levels of light reaching their eyes compared to children of the similar age and school grade in Ghana who typically walk home from school. It is assumed that higher light intensity outdoors might increase the depth of field and reduce the hyperopic blur [58]. The Sydney myopia study found no association between both near work and outdoor activities.

Myopic children with near phoria have faster rate of myopia than those without Esophoria. Esophoric children have reduced accommodative levels and larger hyperopic defocus leading to the suggestion that Esophoric children must relax accommodation to reduce accommodative convergence and attain and maintain single binocular vision [27],[29],[34],[37]. Reference [1] had enrolled esophoric myopic children but did not measure their accommodative responses to near targets. It is therefore difficult to suggest whether the faster progression of 0.55 and 0.60D/ year seen by [1] compared to 0.38 and 0.5D/year for the fully corrected and undercorrected respectively in the study by Chung et al., 2002 is as a result of the interaction between accommodation convergence on lag of accommodation [17],[68]. Three children in this study exhibited Esophoria, however it is not possible to determine whether myopia progression might be influenced because it is a cross sectional study.

In agreement with previous studies, asymmetry was seen in the peripheral retina of the corrected and uncorrected myope [7],[12],[50],[54]. In the uncorrected eye, the temporal retina (nasal field) showed more hyperopia compared to the nasal retina (temporal field) as shown in figures 1 and 4. However, several studies have found no association between uncorrected peripheral defocus and myopia progression [12],[56],[77].

Full correction single vision lenses caused no change in asymmetry in both fields; however, undercorrection lenses induced relative myopia at -30° (nasal retina) and less hyperopia at 30° in the temporal retina. This finding is in agreement with that found by [12] who found myopic defocus in the nasal retina than the temporal retina when children wore PALs. A combination of induced myopic defocus and higher levels of retinal illumination could provide reasons why undercorrection might cause reduced central myopia progression in Ghanaian children. Future studies that would measure the rate of myopia progression in undercorrected children exposed to different levels of retinal illumination is needed.

In agreement with previous studies, the magnitude of J0 and J45 increased with increasing eccentricity in both groups as shown in figure 3 and 4 [6],[13],[85]. The magnitude of J0 and J45 components (figure 2 and 3) showed temporal-nasal asymmetry with measurement taken at 30º in the temporal retina being greater than its corresponding location in the nasal retina. The asymmetry is assumed to be caused by combined aberrations from the cornea, crystalline lens and the retina [3],[6],[10],[24].

Single vision lenses correcting higher magnitudes of myopia resulted in higher relative hyperopic defocus than single vision lenses correcting lower magnitudes of myopia. If higher amounts of peripheral defocus resulted in increased myopia progression, then this present study should have found the influence of undercorrection lenses on moderate and low myopia separately.

5 CONCLUSION

In conclusion, undercorrection by +0.50D resulted in myopic shift in the horizontal retina of the myopic children with mean myopia of -1.95±0.57. The potent effect of outdoor sunlight overrides the effect of central and peripheral hyperopic defocus and renders a reduced myopia progression in undercorrected myopic children. If greater amounts of peripheral hyperopic defocus results in increased myopia progression, then undercorrection reduces peripheral hyperopic defocus and can be considered as an alternative to PALs and bifocal in reducing myopia progression.

REFERENCES

[1] Adler, D. and M. Millodot, "The possible effect of undercorrection on myopic progression in children". *Clinical and Experimental Optometry*. **89** (5): p. 315-321.2006

[2] Anstice, N.S. and J.R. Phillips, "Effect of dual-focus soft contact lens wear on axial myopia progression in children". *Ophthalmology*. **118** (6): p. 1152-1161.2011

[3] Artal, P., A. Benito, and J. Tabernero, "The human eye is an example of robust optical design". *Journal of Vision*. **6** (1): p. 1.2006

[4] Ashby, R., A. Ohlendorf, and F. Schaeffel, "The effect of ambient illuminance on the development of deprivation myopia in chicks". *Investigative ophthalmology & visual science*. **50** (11): p. 5348-5354.2009

[5] Ashby, R.S. and F. Schaeffel, "The effect of bright light on lens compensation in chicks". *Investigative ophthalmology & visual science*. **51** (10): p. 5247-5253.2010

[6] Atchison, D.A., N. Pritchard, and K.L. Schmid, "Peripheral refraction along the horizontal and vertical visual fields in myopia". *Vision research*. **46** (8): p. 1450-1458.2006

[7] Atchison, D.A., N. Pritchard, K.L. Schmid, D.H. Scott, C.E. Jones, and J.M. Pope, "Shape of the retinal surface in emmetropia and myopia". *Investigative Ophthalmology & Visual Science*. **46** (8): p. 2698-2707.2005

[8] Au, E.K., T. Tay, and M. Lim, "Race, culture and Myopia in 110,236 young Singaporean males". *Singapore medical journal*. **34** (1): p. 29-32.1993

[9] Backhouse, S., S. Fox, B. Ibrahim, and J.R. Phillips, "Peripheral refraction in myopia corrected with spectacles versus contact lenses". *Ophthalmic and Physiological Optics*. **32** (4): p. 294-303.2012

[10] Barnes, D., M. Dunne, and R. Clement, "A schematic eye model for the effects of translation and rotation of ocular components on peripheral astigmatism". *Ophthalmic and Physiological Optics*. **7** (2): p. 153-158.1987

[11] Berntsen, D.A., L.T. Sinnott, D.O. Mutti, and K. Zadnik, "A randomized trial using progressive addition lenses to evaluate theories of myopia progression in children with a high lag of accommodation". *Investigative ophthalmology & visual science*. **53** (2): p. 640-649.2012

[12] Berntsen, D.A., C.D. Barr, D.O. Mutti, and K. Zadnik, "Peripheral defocus and myopia progression in myopic children randomly assigned to wear single vision and progressive addition lenses". *Investigative ophthalmology & visual science*. **54** (8): p. 5761-5770.2013

[13] Calver, R., H. Radhakrishnan, E. Osuobeni, and D. O'Leary, "Peripheral refraction for distance and near vision in emmetropes and myopes". *Ophthalmic and Physiological Optics*. **27** (6): p. 584-593.2007

[14] Charman, W., "Near vision, lags of accommodation and myopia". *Ophthalmic and Physiological Optics*. **19** (2): p. 126-133.1999

[15] Cho, P. and S.-W. Cheung, "Retardation of myopia in Orthokeratology (ROMIO) study: a 2-year randomized clinical trial". *Investigative ophthalmology & visual science*. **53** (11): p. 7077-7085.2012

[16] Cho, P., S.W. Cheung, and M. Edwards, "The longitudinal orthokeratology research in children (LORIC) in Hong Kong: a pilot study on refractive changes and myopic control". *Current eye research*. **30** (1): p. 71-80.2005

[17] Chung, K., N. Mohidin, and D.J. O'Leary, "Undercorrection of myopia enhances rather than inhibits myopia progression". *Vision research*. **42** (22): p. 2555-2559.2002
[18] Cohen, Y., M. Belkin, O. Yehezkel, A.S. Solomon, and U. Polat, "Dependency between light intensity and refractive development under light–dark cycles". *Experimental eye research*. **92** (1): p. 40-46.2011
[19] Dandona, R., L. Dandona, M. Srinivas, P. Sahare, S. Narsaiah, S.R. Muñoz, G.P. Pokharel, and L.B. Ellwein, "Refractive error in children in a rural population in India". *Investigative ophthalmology & visual science*. **43** (3): p. 615-622.2002
[20] Deng, L., J. Gwiazda, and F. Thorn, "Children's refractions and visual activities in the school year and summer". *Optometry and Vision Science*. **87** (6): p. 406.2010
[21] Dirani, M., L. Tong, G. Gazzard, X. Zhang, A. Chia, T.L. Young, K.A. Rose, P. Mitchell, and S.-M. Saw, "Outdoor activity and myopia in Singapore teenage children". *British Journal of Ophthalmology*. **93** (8): p. 997-1000.2009
[22] Donovan, L., P. Sankaridurg, A. Ho, T. Naduvilath, E.L. Smith III, and B.A. Holden, "Myopia progression rates in urban children wearing single-vision spectacles". *Optometry and vision science: official publication of the American Academy of Optometry*. **89** (1): p. 27.2012
[23] Donovan, L., P. Sankaridurg, A. Ho, X. Chen, Z. Lin, V. Thomas, E.L. Smith III, J. Ge, and B. Holden, "Myopia progression in Chinese children is slower in summer than in winter". *Optometry & Vision Science*. **89** (8): p. 1196-1202.2012
[24] Dunne, M., G. Misson, E. White, and D. Barnes, "Peripheral astigmatic asymmetry and angle alpha". *Ophthalmic and Physiological Optics*. **13** (3): p. 303-305.1993
[25] French, A.N., R.S. Ashby, I.G. Morgan, and K.A. Rose, "Time outdoors and the prevention of myopia". *Experimental eye research*. **114**: p. 58-68.2013
[26] Fulk, G.W., L.A. Cyert, and D.E. Parker, "A randomized trial of the effect of single-vision vs. bifocal lenses on myopia progression in children with esophoria". *Optometry & Vision Science*. **77** (8): p. 395-401.2000
[27] Goss, D.A. and E. Uyesugi, "Effectiveness of bifocal control of childhood myopia progression as a function of near point phoria and binocular cross-cylinder". *J Optom Vis Dev*. **26** (2): p. 12-7.1995
[28] Goss, D.A. and B.B. Rainey, "Relationship of accommodative response and nearpoint phoria in a sample of myopic children". *Optometry & Vision Science*. **76** (5): p. 292-294.1999
[29] Goss, D.A. and K.L. Wolter, "Nearpoint phoria changes associated with the cessation of childhood myopia progression". *Journal of the American Optometric Association*. **70** (12): p. 764-768.1999
[30] Grosvenor, T. and D. Goss, "The role of bifocal and contact lenses in myopia control". *Acta Ophthalmologica*. **66** (S185): p. 162-166.1988
[31] Group, C.o.M.E.T.S.G.f.t.P.E.D.I., "Progressive-addition lenses versus single-vision lenses for slowing progression of myopia in children with high accommodative lag and near esophoria". *Investigative ophthalmology & visual science*. **52** (5): p. 2749-2757.2011
[32] Guggenheim, J.A., K. Northstone, G. McMahon, A.R. Ness, K. Deere, C. Mattocks, B. St Pourcain, and C. Williams, "Time outdoors and physical activity as predictors of incident myopia in childhood: a prospective cohort study". *Investigative ophthalmology & visual science*. **53** (6): p. 2856-2865.2012
[33] Guo, Y., L.J. Liu, L. Xu, Y.Y. Lv, P. Tang, Y. Feng, M. Meng, and J.B. Jonas, "Outdoor activity and myopia among primary students in rural and urban regions of Beijing". *Ophthalmology*. **120** (2): p. 277-283.2013
[34] Gwiazda, J., K. Grice, and F. Thorn, "Response AC/A ratios are elevated in myopic children". *Ophthalmic and Physiological Optics*. **19** (2): p. 173-179.1999
[35] Gwiazda, J., F. Thorn, J. Bauer, and R. Held, "Myopic children show insufficient accommodative response to blur". *Investigative ophthalmology & visual science*. **34** (3): p. 690-694.1993
[36] Gwiazda, J., L. Hyman, M. Hussein, D. Everett, T.T. Norton, D. Kurtz, M.C. Leske, R. Manny, W. Marsh-Tootle, and M. Scheiman, "A randomized clinical trial of progressive addition lenses versus single vision lenses on the progression of myopia in children". *Investigative Ophthalmology & Visual Science*. **44** (4): p. 1492-1500.2003
[37] Gwiazda, J.E., L. Hyman, T.T. Norton, M.E. Hussein, W. Marsh-Tootle, R. Manny, Y. Wang, and D. Everett, "Accommodation and related risk factors associated with myopia progression and their interaction with treatment in COMET children". *Investigative ophthalmology & visual science*. **45** (7): p. 2143-2151.2004
[38] Hasebe, S., H. Ohtsuki, T. Nonaka, C. Nakatsuka, M. Miyata, I. Hamasaki, and S. Kimura, "Effect of progressive addition lenses on myopia progression in Japanese children: a prospective, randomized, double-masked, crossover trial". *Investigative ophthalmology & visual science*. **49** (7): p. 2781-2789.2008
[39] Hiraoka, T., T. Kakita, F. Okamoto, H. Takahashi, and T. Oshika, "Long-term effect of overnight orthokeratology on axial length elongation in childhood myopia: a 5-year follow-up study". *Investigative ophthalmology & visual science*. **53** (7): p. 3913-3919.2012
[40] Irving, E., M. Callender, and J. Sivak, "Inducing ametropias in hatchling chicks by defocus—aperture effects and cylindrical lenses". *Vision research*. **35** (9): p. 1165-1174.1995

[41] Jacobsen, N., H. Jensen, and E. Goldschmidt, "Does the level of physical activity in university students influence development and progression of myopia?—a 2-year prospective cohort study". *Investigative ophthalmology & visual science*. **49** (4): p. 1322-1327.2008
[42] Kakita, T., T. Hiraoka, and T. Oshika, "Influence of overnight orthokeratology on axial elongation in childhood myopia". *Investigative ophthalmology & visual science*. **52** (5): p. 2170-2174.2011
[43] Kang, P., Y. Fan, K. Oh, K. Trac, F. Zhang, and H. Swarbrick, "Effect of single vision soft contact lenses on peripheral refraction". *Optometry & Vision Science*. **89** (7): p. 1014-1021.2012
[44] Katz, J., J.M. Tielsch, and A. Sommer, "Prevalence and risk factors for refractive errors in an adult inner city population". *Investigative ophthalmology & visual science*. **38** (2): p. 334-340.1997
[45] Koomson, N.Y., S.Y. Lartey, and K.K. Adjah, "Prevalence of myopia among patients with refractive error in the Kumasi metropolis of Ghana". *Journal of science and technology*. **33** (2): p. 75-83.2013
[46] Leung, J.T. and B. Brown, "Progression of myopia in Hong Kong Chinese schoolchildren is slowed by wearing progressive lenses". *Optometry & Vision Science*. **76** (6): p. 346-354.1999
[47] LIN, L.L.-K., Y.-F. Shih, C.-B. Tsai, C.-J. Chen, L.-A. Lee, T. HUNG, and P.-K. Hou, "Epidemiologic study of ocular refraction among schoolchildren in Taiwan in 1995". *Optometry & Vision Science*. **76** (5): p. 275-281.1999
[48] Lin, L.L., Y.F. Shih, C.B. Tsai, C.J. Chen, L.A. Lee, P.T. Hung, and P.K. Hou, "Epidemiologic study of ocular refraction among schoolchildren in Taiwan in 1995". *Optom Vis Sci*. **76** (5): p. 275-81.1999
[49] Lin, Z., A. Martinez, X. Chen, L. Li, P. Sankaridurg, B.A. Holden, and J. Ge, "Peripheral defocus with single-vision spectacle lenses in myopic children". *Optometry & Vision Science*. **87** (1): p. 4-9.2010
[50] Logan, N.S., B. Gilmartin, C.F. Wildsoet, and M.C. Dunne, "Posterior retinal contour in adult human anisomyopia". *Investigative ophthalmology & visual science*. **45** (7): p. 2152-2162.2004
[51] Maul, E., S. Barroso, S.R. Munoz, R.D. Sperduto, and L.B. Ellwein, "Refractive Error Study in Children: results from La Florida, Chile". *Am J Ophthalmol*. **129** (4): p. 445-54.2000
[52] Millodot, M., "Effect of ametropia on peripheral refraction". *American journal of optometry and physiological optics*. **58** (9): p. 691-695.1981
[53] Murthy, G.V., S.K. Gupta, L.B. Ellwein, S.R. Munoz, G.P. Pokharel, L. Sanga, and D. Bachani, "Refractive error in children in an urban population in New Delhi". *Invest Ophthalmol Vis Sci*. **43** (3): p. 623-31.2002
[54] Mutti, D.O., R.I. Sholtz, N.E. Friedman, and K. Zadnik, "Peripheral refraction and ocular shape in children". *Investigative ophthalmology & visual science*. **41** (5): p. 1022-1030.2000
[55] Mutti, D.O., G.L. Mitchell, M.L. Moeschberger, L.A. Jones, and K. Zadnik, "Parental myopia, near work, school achievement, and children's refractive error". *Investigative ophthalmology & visual science*. **43** (12): p. 3633-3640.2002
[56] Mutti, D.O., L.T. Sinnott, G.L. Mitchell, L.A. Jones-Jordan, M.L. Moeschberger, S.A. Cotter, R.N. Kleinstein, R.E. Manny, J.D. Twelker, and K. Zadnik, "Relative peripheral refractive error and the risk of onset and progression of myopia in children". *Investigative ophthalmology & visual science*. **52** (1): p. 199-205.2011
[57] Naidoo, K.S., A. Raghunandan, K.P. Mashige, P. Govender, B.A. Holden, G.P. Pokharel, and L.B. Ellwein, "Refractive error and visual impairment in African children in South Africa". *Invest Ophthalmol Vis Sci*. **44** (9): p. 3764-70.2003
[58] Pan, C.W., D. Ramamurthy, and S.M. Saw, "Worldwide prevalence and risk factors for myopia". *Ophthalmic and Physiological Optics*. **32** (1): p. 3-16.2012
[59] Radhakrishnan, H. and W.N. Charman, "Peripheral refraction measurement: does it matter if one turns the eye or the head?". *Ophthalmic and Physiological Optics*. **28** (1): p. 73-82.2008
[60] Rose, K.A., I.G. Morgan, J. Ip, A. Kifley, S. Huynh, W. Smith, and P. Mitchell, "Outdoor activity reduces the prevalence of myopia in children". *Ophthalmology*. **115** (8): p. 1279-1285.2008
[61] Rudnicka, A.R., C.G. Owen, C.M. Nightingale, D.G. Cook, and P.H. Whincup, "Ethnic differences in the prevalence of myopia and ocular biometry in 10-and 11-year-old children: the Child Heart and Health Study in England (CHASE)". *Investigative ophthalmology & visual science*. **51** (12): p. 6270-6276.2010
[62] Sankaridurg, P., B. Holden, E. Smith, T. Naduvilath, X. Chen, P.L. de la Jara, A. Martinez, J. Kwan, A. Ho, and K. Frick, "Decrease in rate of myopia progression with a contact lens designed to reduce relative peripheral hyperopia: one-year results". *Investigative ophthalmology & visual science*. **52** (13): p. 9362-9367.2011
[63] Santodomingo-Rubido, J., C. Villa-Collar, B. Gilmartin, and R. Gutiérrez-Ortega, "Myopia control with orthokeratology contact lenses in Spain: refractive and biometric changes". *Investigative ophthalmology & visual science*. **53** (8): p. 5060-5065.2012
[64] Saw, S. and T. Wong, "Is it possible to slow the progression of myopia?". *ANNALS-ACADEMY OF MEDICINE SINGAPORE*. **33** (1): p. 4-6.2004
[65] Saw, S.M., G. Gazzard, K.G. Au Eong, and D. Koh, "Utility values and myopia in teenage school students". *Br J Ophthalmol*. **87** (3): p. 341-5.2003

[66] Schmid, K.L. and C.F. Wildsoet, "The sensitivity of the chick eye to refractive defocus". *Ophthalmic and Physiological Optics*. **17** (1): p. 61-67.1997
[67] Schmid, K.L., R.W. Li, M.H. Edwards, and J.K. Lew, "The expandability of the eye in childhood myopia". *Current eye research*. **26** (2): p. 65-71.2003
[68] Schor, C., "The influence of interactions between accommodation and convergence on the lag of accommodation". *Ophthalmic and Physiological Optics*. **19** (2): p. 134-150.1999
[69] Seidemann, A., F. Schaeffel, A. Guirao, N. Lopez-Gil, and P. Artal, "Peripheral refractive errors in myopic, emmetropic, and hyperopic young subjects". *JOSA A*. **19** (12): p. 2363-2373.2002
[70] Siegwart Jr, J.T., A.H. Ward, and T.T. Norton, "Moderately elevated fluorescent light levels slow form deprivation and minus lens-induced myopia development in tree shrews". *Investigative Ophtalmology and Visual Science*. **53** (6): p. 3457.2012
[71] Smith, E.L., L.-F. Hung, and J. Huang, "Protective effects of high ambient lighting on the development of form-deprivation myopia in rhesus monkeys". *Investigative ophthalmology & visual science*. **53** (1): p. 421-428.2012
[72] Smith, E.L., C.-s. Kee, R. Ramamirtham, Y. Qiao-Grider, and L.-F. Hung, "Peripheral vision can influence eye growth and refractive development in infant monkeys". *Investigative ophthalmology & visual science*. **46** (11): p. 3965-3972.2005
[73] Smith, E.L., J. Huang, L.-F. Hung, T.L. Blasdel, T.L. Humbird, and K.H. Bockhorst, "Hemiretinal form deprivation: evidence for local control of eye growth and refractive development in infant monkeys". *Investigative ophthalmology & visual science*. **50** (11): p. 5057-5069.2009
[74] Smith III, E.L., "The Charles F. Prentice Award Lecture 2010: A Case for Peripheral Optical Treatment Strategies for Myopia". *Optometry and Vision Science*. **88** (9): p. 1029.2011
[75] Smith III, E.L., H. Li-Fang, and R.S. Harwerth, "Effects of optically induced blur on the refractive status of young monkeys". *Vision Research*. **34** (3): p. 293-301.1994
[76] Smith III, E.L., L.-F. Hung, and J. Huang, "Relative peripheral hyperopic defocus alters central refractive development in infant monkeys". *Vision research*. **49** (19): p. 2386-2392.2009
[77] Sng, C.C., X.-Y. Lin, G. Gazzard, B. Chang, M. Dirani, L. Lim, P. Selvaraj, K. Ian, B. Drobe, and T.-Y. Wong, "Change in peripheral refraction over time in Singapore Chinese children". *Investigative ophthalmology & visual science*. **52** (11): p. 7880-7887.2011
[78] Tabernero, J. and F. Schaeffel, "More irregular eye shape in low myopia than in emmetropia". *Investigative ophthalmology & visual science*. **50** (9): p. 4516-4522.2009
[79] Thibos, L.N., W. Wheeler, and D. Horner, "Power vectors: an application of Fourier analysis to the description and statistical analysis of refractive error". *Optometry & Vision Science*. **74** (6): p. 367-375.1997
[80] Vasudevan, B., C. Esposito, C. Peterson, C. Coronado, and K.J. Ciuffreda, "Under-correction of human myopia–Is it myopigenic?: A retrospective analysis of clinical refraction data". *Journal of Optometry*.2014
[81] Vitale, S., R.D. Sperduto, and F.L. Ferris, 3rd, "Increased prevalence of myopia in the United States between 1971-1972 and 1999-2004". *Arch Ophthalmol*. **127** (12): p. 1632-9.2009
[82] Walline, J.J., L.A. Jones, and L.T. Sinnott, "Corneal reshaping and myopia progression". *British Journal of Ophthalmology*. **93** (9): p. 1181-1185.2009
[83] Wallman, J. and J. Winawer, "Homeostasis of eye growth and the question of myopia". *Neuron*. **43** (4): p. 447-468.2004
[84] Wang, Q., B. Klein, R. Klein, and S.E. Moss, "Refractive status in the Beaver Dam Eye Study". *Investigative ophthalmology & visual science*. **35** (13): p. 4344-4347.1994
[85] Wang, Y.-Z., L.N. Thibos, and A. Bradley, "Effects of refractive error on detection acuity and resolution acuity in peripheral vision". *Investigative ophthalmology & visual science*. **38** (10): p. 2134-2143.1997
[86] Wu, S.-Y., B. Nemesure, and M.C. Leske, "Refractive errors in a black adult population: the Barbados Eye Study". *Investigative ophthalmology & visual science*. **40** (10): p. 2179-2184.1999
[87] Yang, Z., W. Lan, J. Ge, W. Liu, X. Chen, L. Chen, and M. Yu, "The effectiveness of progressive addition lenses on the progression of myopia in Chinese children". *Ophthalmic and Physiological Optics*. **29** (1): p. 41-48.2009
[88] Zhao, J., X. Pan, R. Sui, S.R. Munoz, R.D. Sperduto, and L.B. Ellwein, "Refractive error study in children: results from Shunyi District, China". *American journal of ophthalmology*. **129** (4): p. 427-435.2000

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Activités antiradicalaires et étude des composés volatils de trois plantes de la médecine traditionnelle du Bénin: *Anchomanes difformis, Parkia biglobosa* et *Polyalthia longifolia*

[Radical scavenging activities and study of volatile compounds of three plants used in traditional medicine in Benin: *Anchomanes difformis, Parkia biglobosa* and *Polyalthia longifolia*]

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ABSTRACT: The present study was devoted to the chemical analysis of three plants (*Anchomanes difformis, Parkia biglobosa* and *Polyalthia longifolia*) commonly used by traditional healers in Benin, for their curative properties in the treatment of certain diseases.

After characterization of large chemical groups present in the leaves of these plants, total polyphenols, condensed tannins, total flavonoids, anthocyanins and anthocyanidins were quantified by spectrophotometric methods. The scavenging activity was evaluated by the DPPH method and the volatile compounds in the powders of these plants were determined by SPME-GC/MS.

The results showed the presence of several secondary metabolites such as saponins, alkaloids, tannin, mucilages, anthraquinones, leucoanthocyanins, anthocyanins and triterpennoids in varying proportions in the three plants. The levels of condensed tannins, total flavonoids and anthocyanins are respectively higher in leaves of *P. longifolia* (22.5 mg/g, 15.69 mg / g and 0.94 mg/g) than in those of *P. biglobosa* (16.48 mg/g, 12.03 mg/g and 0.38 mg/g) and that of *A. difformis* (9.74 mg/g 4.59 mg/g and 0 mg/g).

Against by the total polyphenol content P.longifolia leaves (2.89 mg/g) is between those of A. difformis (2.19 mg/g) and P. biglobosa (4.5 mg/g). It is the same for the contents of anthocyanidins. Three plants studied, P. longifolia proved richest in polyphenols (condensed tannins, total flavonoids, anthocyanidins and anthocyanins) and A. difformis the less rich. This content of polyphenolic compounds would explain the test results of radical scavenging activities with an IC_{50} of 21.66 mg/mL for *P. longifolia*, 23.99 mg/mL for *P. biglobosa* and 26.5 mg/mL for *A. difformis*.

The solid phase micro extraction (SPME) coupled with GC/MS allowed the unambiguous identification of volatile components of each of the three plants.

KEYWORDS: Polyphenols; Radical scavenging activities; SPME; *Anchomanes difformis, Parkia biglobosa, Polyalthia longifolia*.

1 INTRODUCTION

Les plantes médicinales occupent une place importante dans l'arsenal thérapeutique de l'humanité. Selon l'Organisation Mondiale de la Santé (OMS), environ 65-80% de la population mondiale, en raison de la pauvreté et du manque d'accès à la

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médecine moderne dans les pays en développement, utilisent des plantes médicinales pour leurs besoins en soins de santé primaire **[1]**. Avec les nouvelles techniques d'extraction, d'identification et de caractérisation des molécules organiques, plus de 25 à 50% des médicaments prescrits de nos jours ont pour principes actifs les molécules bioactives des plantes médicinales **[2], [3]**. En Afrique en général et au Bénin en particulier, l'exploration des principes actifs des végétaux à usage thérapeutique connait un regain d'intérêt ces dernières années. Néanmoins, l'héritage vert constitue encore un énorme réservoir de composés dont les propriétés phytochimiques et pharmacologiques potentielles attendent d'être découvertes. Par conséquent, la valorisation des ressources végétales naturelles devient une préoccupation nécessaire et importante pour la participation à la recherche de nouvelles molécules médicamenteuses. Au nombre des plantes scientifiquement peu connues mais très utilisées dans la pharmacopée traditionnelle du Bénin pour leurs propriétés curatives dans le traitement de plusieurs pathologies figurent entre autres ***Anchomanes difformis, Parkia biglobosa*** et ***Polyalthia longifolia.***

Appelé aussi ***Amorphophallus difformis, Anchomanes difformis*** *(**Araceae***) est une plante herbacée terrestre à rhizomes. Ses feuilles sont en forme de parapluie (d'où son nom de parapluie de singe) avec les limbes multipartites et le pétiole épineux. Ses tubercules en décocté aqueux sont diurétiques et employé contre le diabète. Les feuilles et les rhizomes sont utilisés pour le traitement des diarhées. **[4]**. Les pulpes fraîches de ses tubercules permettent de traiter les abcès. En association avec les fils de ***Macaranga barteri***, elles forment un médicament dans le traitement des lésions bucco-dentaires (magnan) **[5]**.

Quant à ***Parkia biglobosa*** qui est de la famille des ***Mimosaceae***, il est un Petit arbre haut de 10 à 15 m, à port en parasol, à feuilles bipénnées alternes. Son Rachis est long de 20 à 40 cm et porte 10 à 15 paires de pinnules longues de 12 à 15 cm. Les pinnules portent chacune 30 à 60 paires de folioles oblongues, longues de 7 à 15 mm, larges de 2 à 3 mm, à base dissymétrique auriculée du côté inférieur, à sommet en coin. Le Pétole, long de 4 à 10 cm avant la première paire de pinnules, présente une base épaissie et courte. Les fleurs sont petites, rouges, densement réunies en capitules sphériques larges de 4 à 5 cm, pédonculées de 10 à 30 cm et pendant, parfois en grappes, à l'extrémité des branches de l'arbre. Les fruits sont sous forme de gousses longues de 25 à 30 cm, larges de 15 à 20 mm, applaties, brun foncé à maturité, contenant des graines noires entourées d'une pulpe farineuse jaune qui remplit toute la gousse. Les feuilles de cet arbre sont utilisées pour le traitement de l'état fébriles, la rougeole et les boutons de fièvre. La décoction de son écorce est employée dans le traitement de la bilharziose et de la blennorragie. **[6]**.

Enfin***, Polyalthia longifolia,*** est un arbre tropical de la famille des ***Annonaceae***. Sa forme pyramidale et symétrique ou en colonne élégante lui donne son nom d'arbre mât. Il peut être confondu avec l'ashoka d'où son autre nom commun de Faux ashoka. Il possède des branches pendantes, ce qui lui donne une silhouette conique. Les feuilles sont ovales oblongues à ovales lancéolées, à la base cunéiforme à obtuse ou arrondie, à l'apex acuminé, aux marges ondulées, au pétiole glabrescent. Les jeunes feuilles sont d'une couleur brun-cuivré, elles passent ensuite du vert clair au vert sombre. C'est un arbre à feuillage persistant atteignant 20 m de hauteur et à branches dirigées vers le bas. Les fleurs, solitaires et axillaires, ont des sépales ovales triangulaires et des pétales vert jaunâtre. Ses fruits sont cénocarpiques, ovoïdes et noirs à maturité. **[5]**.

Dans la littérature, très peu d'études ont été consacrées à la détermination de la composition chimique, à la quantification des composés polyphénoliques et à la mesure de l'activité antiradicalaire des extraits de ces trois plantes. Ce travail vise donc à apporter une contribution à la connaissance scientifique de ces plantes à travers leur décryptage chimique et l'évaluation de l'activité antiradicalaire de leur extrait.

***Photo n°1** : Parkia biglobosa (Mimosaceae)*

***Photo n°2** : Polyalthia longifolia (Annonaceae)*

2 MATERIEL ET METHODE

Le matériel végétal utilisé est constitué des feuilles des trois plantes (***Anchomanes difformis, Parkia biglobosa*** et ***Polyalthia longifolia***) récoltés au Bénin. Après collecte et identification par les botanistes à l'herbier national du Bénin, le matériel végétal a été séché à la température du laboratoire (26 et 30°C) jusqu'à stabilisation de sa masse puis réduit en poudre grâce à un broyeur électrique (Marque RETSCH, Type SM 100). L'extraction a été réalisée par macération de 50 g de poudre dans 500 ml d'éthanol pendant 72 h et le surnageant est filtré sous vide grâce à un Büchner. Le filtrat ainsi obtenu a été évaporé à sec, pesé et stocké à 6°C jusqu'à l'analyse conformément à la méthode décrite par ***Adébo et al.*** **[7]**.

2.1 IDENTIFICATION DES MÉTABOLITES SECONDAIRES

La détermination des métabolites secondaires a été faite par des réactions de coloration et de précipitation différentielles des principaux groupes de composés chimiques contenus dans les plantes. Ainsi, la recherche des stérols et terpènes a été faite par le test de Liebermann **[8].** La caractérisation des composés appartenant au groupe des polyphénols a été faite par la réaction au chlorure ferrique **[9].** Les flavonoïdes ont été mis en évidence par la réaction à la cyanidine **[10].** Les composés appartenant au groupe des tanins ont été mis en évidence par la réaction de Stiasny **[11].** Les composés quinoniques libres ou combinés ont été révélés par la réaction de Borntraeger **[12], [13]**. La recherche des saponosides est basée sur la propriété qu'ont les solutions aqueuses contenant des saponosides de mousser après agitation **[12]**. La recherche des alcaloïdes a été faite à l'aide des réactifs de Dragendorff (réactif à l'iodobismuthate de potassium) et le réactif de Bouchardât (réactif iodo-ioduré) **[14], [15]**. Les coumarines ont été mises en évidences par la fluorescence à l'UV à 365 nm **[11].**

2.2 DOSAGE DES COMPOSÉS PHÉNOLIQUES

❖ **Les anthocyanidines**

2 g de poudre de chaque plante sont introduits dans 160 ml de l'acide chlorhydrique de concentration 2 mol/L et portés à ébullition pendant 30 min. Après refroidissement et filtration une extraction liquide-liquide a été réalisée au butanol (3x20 mL). L'extrait butanolique est dosé au spectrophotomètre en balayant la longeur d'onde de 480 nm à 600 nm et l'absorbance la plus élevée est utilisée contre un blanc constitué de butanol pur pour quantifier les anthocyanidines **[2], [16]**.

La teneur est calculée selon la formule suivante :

T_{antho}= **$\alpha.A_{ext}.M.d.V/(\varepsilon.m)$**

T_{antho}: Teneur en anthocyanidines exprimée en mg/g (Cyanidols équivalant)

α : Facteur de correction = 6 ; **A** : Absorbance à la longueur d'onde d'absorption maximale

d : Facteur de dilution ; **ε** : Coefficient d'absorption molaire du leucocyanidol (34700)

m : masse de matière sèche du matériel végétal hydrolysé ;

M : Masse molaire du leucocyanidol (306g/mol) ;

V : Volume de la solution n-butanolique ;

Le blanc est constitué du butanol pur de qualité analytique

❖ **Les anthocyanes**

500 µl d'extrait éthanolique de chaque plante sont mélangés avec 500 µl de solution d'ethanol acidifié à 0,1 % avec de l'acide chlorhydrique pur et 10 ml de HCl à 2% dans l'eau distillée. L'absorbance de 5 ml de ce mélange est lue en présence de 2 ml d'une solution de bisulfite de sodium ($Na_2S_2O_5$ à 150 g/l) au spectrophotomètre à 520 nm contre un blanc contenant 2 ml d'eau distillée à la place du bisulfite **[3], [17].**

La teneur en anthocyanes totaux exprimée en mg de standard par gramme d'extrait est donnée par la formule suivante :

$T_{anthocyanes}$= **$(DO_A - DO_B)$ X P / [extrait]**

DO_A : Densité Optique de la solution témoin (sans bisulfite)

DO_B : Densité Optique du mélange

P : Pente de la droite obtenue à partir du standard ; P=875 pour la malvidine-3-glucoside

❖ **Les flavonoïdes totaux, les tanins condensés et les polyphénols totaux**

La méthode du trichlorure d'aluminium ($AlCl_3$) a été utilisée pour quantifier les flavonoïdes totaux **[18], 19]** ; les tanins condensés ont été dosés par la méthode à la vanilline sulfurique **[20], [21]** et les polyphénols totaux ont été dosés par la méthode de Folin **[22], [23]**.

2.3 DÉTERMINATION DES ACTIVITÉS ANTIRADICALAIRES

L'activité antiradicalaire est déterminée par la méthode au DPPH. Le DPPH est solubilisé dans l'éthanol absolu pour avoir une solution de 0,3 mg/ml. Differentes gammes de concentrations de l'ordre du microgramme de chaque extrait sont préparées. L'éthanol absolu a servi de solvant de dilution. Dans des tubes secs et stérils, on introduit 2,5 mL de solution d'extrait à analyser et 1 ml de solution de DPPH. Après agitation, les tubes sont placés à l'abri de la lumière pendant 30 min, puis l'absorbance du mélange est mésurée à 517 nm contre un blanc constitué de 2,5 mL d'éthanol pur et 1 mL de solution de DPPH **[3], [24].** Le pourcentage de piégeage de radicaux libres DPPH est calculé suivant la formule :

$I = [(A_b - A_e)/A_b] \times 100$ [25], [26]

I : pourcentage d'inhibition **; A_b :** absorbance du blanc **; A_e :** absorbance de l'échantillon

2.4 DETERMINATION DES COMPOSES VOLATILS PRESENTS DANS LES POUDRES DES PLANTES

L'extraction en phase solide a pris au fil des années une place importante dans la préparation des échantillons. Ce mode d'extraction permet de réaliser facilement des extractions de composés difficilement extractibles par des solvants organiques et qui n'étaient donc analysables qu'après une simple précipitation **[27], [28]**. Elle est utilisée, en association à la chromatographie en phase gazeuse, pour identifier et doser des substances volatiles dans de nombreux domaines comme la biologie, l'oenologie, la cosmétologie, l'étude des essences essentielles des plantes **[29]** etc.

Ainsi, les composés volatiles de nos échantillons de plantes ont été identifiés par micro extraction en phase solide (SPME) couplé avec la GC/MS. Les expériences par SPME ont été effectuées en utilisant 75 mm de fibre en divinylbenzène/Carboxen/ polydiméthyl siloxane (Supelco, Bornem, Belgique). L'extraction et la désorption ont été réalisées par un échantillonneur automatique (Gerste lMPS). Pour la préparation des échantillons, 1 g de chaque poudre de plante a été incubé à 30°C pendant 2 min avec une vitesse d'agitation de 250 trs/min. Pour calculer les concentrations des composants, la fibre a été exposée à l'espace de tête pendant 60 min à 35°C.

Les analyses des extraits en GC/MS ont été réalisées avec un CPG Agilent 6890 couplé à un spectromètre de masse quadripôle 5973 MSD (Agilent Technologies, Diegem, Belgique), équipé d'un appareil Varian CP-Q Pora BOND, d'une colonne capillaire (longueur : 25 m; diamètre : 0,320 mm; épaisseur du film : 5 µm). L'injecteur a été réglé à 250°C, la ligne de transfert du MSD a 250°C, le gaz vecteur est l'hélium (1 mL /min); la désorption par SPME a été faite en mode split avec l'injecteur CIS-4 PTV(Gerstel) durant 120 s et l'ionisation à 70 eV. La température du four a été programmée de 60 à 350°C **[28].** L'identification des composés volatils de chacune des plantes a été faite par comparaison de leurs indices de retention (IR) et de leurs spectres de masse à ceux des composés de référence de la littérature **[29], [30]**.

3 RESULTATS ET DISCUSSION

3.1 IDENTIFICATION DES MÉTABOLITES SECONDAIRES

Divers métabolites secondaires ont été mis en évidence dans les plantes étudiées par une série de réactions de coloration ou de précipitation plus ou moins spécifiques à chaque classe de principes actifs comme le montre le tableau **1**. De ce tableau nous pouvons retenir que :

Les feuilles de ***A.difformis*** contiennent en abondance les alcaloïdes, les saponosides, les flavonoïdes, les mucilages, les composés réducteurs, les tanins aussi bien catéchiques que galliques. Mais les triterpènoïdes et les anthocyanes sont présents en faible quantité alors que les anthraquinones (libres et combinés) ainsi que les leuco-anthocyanes y sont absents. Nos résultats sont conformes à ceux de ***Abah et al*** **[4]** d'une part et à ceux de ***Peter et al*** **[31]** d'autre part pour ce qui concerne la présence des tanins et des saponosides. Mais ce dernier auteur révèle l'absence des alcaloïdes et des flavonoïdes dans son échantillon récoltés au Nigéria.

Les feuilles de ***P.biglobosa*** contiennent en forte proportion les alcaloïdes, les saponosides, les anthraquinones libres, les tanins catéchiques et galliques ainsi que les flavonoïdes, les triterpénoïdes, les anthocyanes, les anthraquinones combinés (C-hétérosides) et les mucilages. Ces résultats sont conformes à ceux de ***Tokoudagba*** **[6]** pour ce qui concerne la présence des tanins, des flavonoïdes et des anthraquinones combinés C-hétérosides. Cependant les composés réducteurs, les leuco-anthocyanes, les coumarines et les O-hétérosides à génines réduites présents dans les résultats ***Tokoudagba*** **[6]** sont absents dans notre échantillon. Par ailleurs, nos résultats sont conformes à ceux de ***Al-Mahamood et al*** **[32]** quant à la présence des saponosides, des tanins et des alcaloïdes dans les extraits aqueux de la même plante récoltée au Nigéria.

Les feuilles de ***P. longifolia*** quant à elles contiennent en abondance les mucilages, les saponosides, les anthraquinones libres, les anthraquinones combinés, les composés réducteurs, les tanins, les anthocyanes, les triterpénoïdes, les flavonoïdes et les coumarines ainsi que les alcaloïdes. Mais les leuco-anthocyanes et les coumarines y sont absents. Nos résultats sont conformes à ceux obtenus en Inde en 2011 par ***Rajesh et al*** **[33]** pour ce qui concene les Terpénoïdes, les anthraquinones, les saponosides, les tanins et les composés réducteurs. Cependant, les alcaloïdes présents dans les résultats de ce dernier sont absents dans notre extrait. De même, nos résultats sont conformes également à ceux obtenus par ***Pradhan et al*** **[34]*,*** dans la Région de Jaipur en Inde en 2011, à l'exception de la présence des alcaloïdes et des saponosides.

Tableau 1 : Métabolites secondaires présents dans les feuilles de Anchomanes difformis, Parkia biglobosa et Polyalthia longifolia

Métabolites secondaires		***A. difformis***	***P. biglobosa***	***P. longifolia***
Alcaloïdes		+	+	+
Saponosides		+	+	+
Flavonoïdes		+	+	+
Tanins galliques		+	+	+
Tanins Cathéchiques		+	+	+
Mucilages		+	+	+
Composés réducteurs		+	-	+
Anthraquinones libre		-	+	+
Anthraquinones combinés	**Anthraquinones combinés (O-hétérosides)**	-	-	+
	Anthraquinones combinés (O-hétérosides à génines réduites)	-	-	+
	Anthraquinones combinés (C-hétérosides)	-	+	+
Coumarines		-	-	-
Triterpénoïdes		+/-	+	+
Anthocyanes		+/-	+	+
Leuco-anthocyanes		-	-	-

+ présence **;** **+/-** trace **;** **-** Absent**.**

A. difformis : *Anchomanes difformis****;*** ***P. biglobosa :*** *Parkia biglobosa****;*** ***P. longifolia :*** *Polyalthia longifolia*

3.2 DOSAGES DES COMPOSES POLYPHENOLIQUES DES PLANTES ETUDIEES

- **Teneur en flavonoïdes totaux et en tanins condensés**

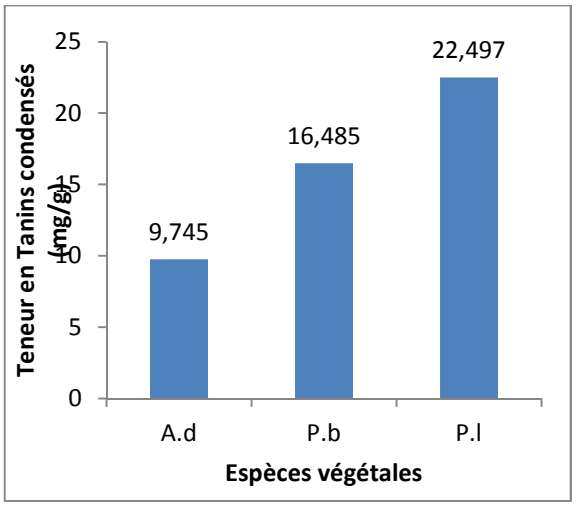

Figure 1 : Teneurs tanins condensés des différentes espèces végétales en mg/g

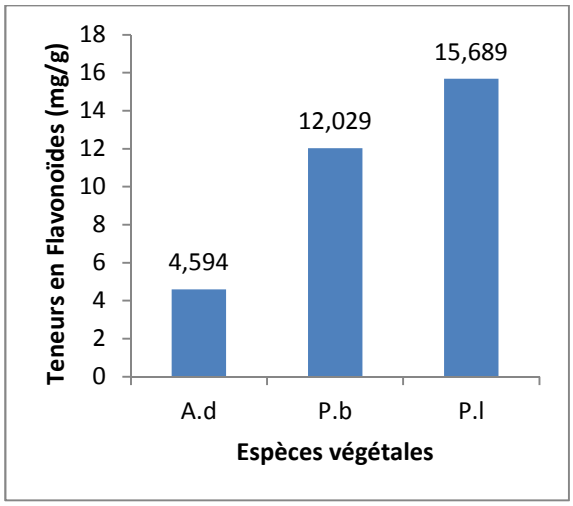

Figure 2: Teneurs en flavonioïdes des différentes espèces végétales en mg/g

A.d : Feuille de *Anchomanes difformis* ***; P.b :*** Feuille de *Parkia biglobosa* ***; P.l :*** Feuille de *Polyalthia longilfolia*

Les teneurs en flavonoïdes totaux de nos échantillons varient de **4,59 mg/g** à **15,69 mg/g**. Les feuilles de ***P. longifolia*** contiennent la plus forte teneur en flavonoïdes alors que celles de ***A. difformis*** présentent la plus faible teneur. Par ailleurs, les teneurs de nos échantillons en tanins condensés varient de **9,74 mg/g** à **22,5 mg/g**.

- **Teneur en anthocyanes, en anthocyanidines et en polyphénols totaux**

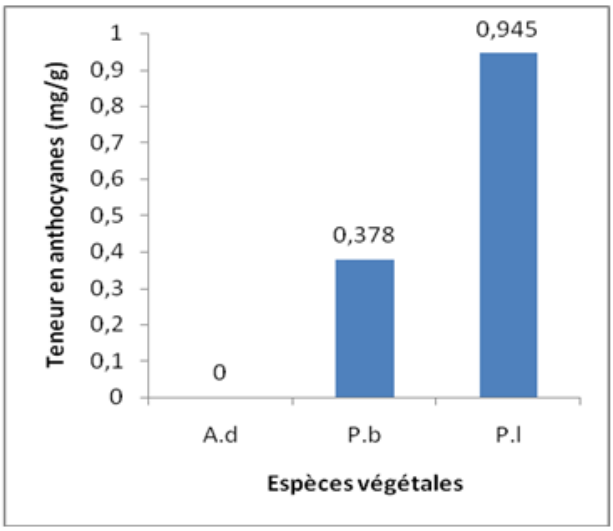

Figure 3 : Teneurs en anthocyanes des différentes espèces végétales en mg/g

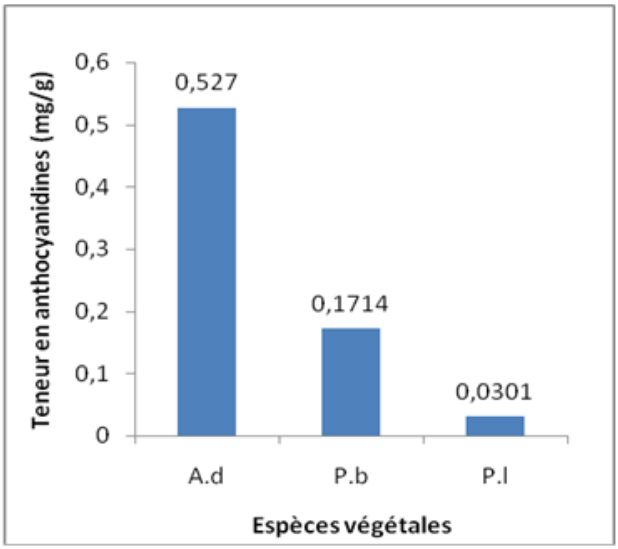

Figure 4: Teneurs en anthocyanidines des différentes espèces végétales en mg/g

A.d : Feuille de *Anchomanes difformis* ***; P.b :*** Feuille de *Parkia biglobosa* ***; P.l :*** Feuille de *Polyalthia longilfolia*

Les teneurs en anthocyanes et en anthocyanidines de nos échantillons varient respectivement de **0 mg/g** à **0,94 mg/g** et de **0,03 mg/g** à **0,53 mg/g**. Les feuilles de ***P. longifolia*** contiennent la plus forte teneur en anthocyanes alors que celles de ***A. difformis*** présentent la plus faible. Par contre les feuilles de ***A. difformis*** contiennent la plus forte teneur en anthocyanidines alors que celles de ***P. longifolia*** présentent la plus faible.

- **Teneur en polyphénols totaux**

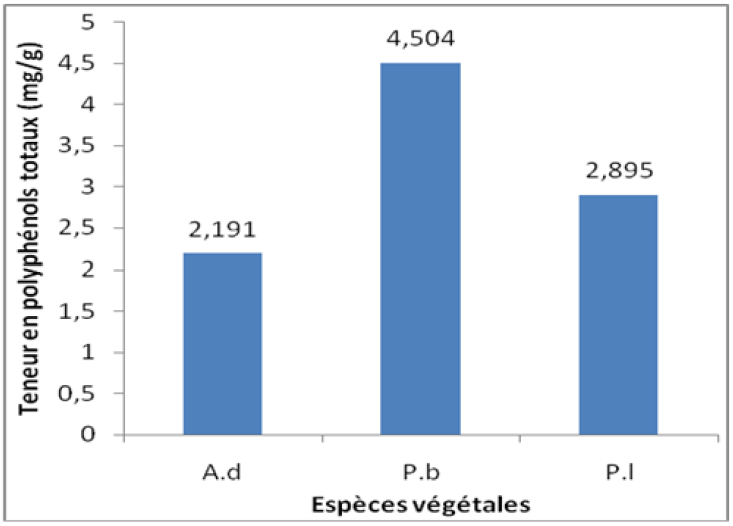

Figure 5 : Teneurs en polyphénols totaux des différentes espèces végétales en mg/g

A.d : Feuille de *Anchomanes difformis* ***; P.b :*** Feuille de *Parkia biglobosa* ***; P.l :*** Feuille de *Polyalthia longilfolia*

Les feuilles de ***P. biglobosa*** présentent la plus forte teneur en polyphénols totaux alors que celles de ***A. difformis*** contiennent la plus faible. Toutefois, cette teneur (**4,5 mg/g)** en polyphénols totaux de l'extrait éthanolique de nos échantillons récolté à Calavi au Bénin est inférieure à celles trouvées par ***Jean-Marie et al.*** **[35]** pour les extraits cyclohexanique (**15,9 mg/g**), dichlorométhanique (**68,9 mg/g**) et hydroalcoolique (**99,7 mg/g**) de la même plante récoltée à Bohicon au Bénin. Par ailleurs, nos résultats sont proches de ceux obtenus par ***Aline et al*** **[36]** au Burkina Faso pour les extraits méthanolique (**3,8 mg/g**) et acétoniques (**6,26 mg/g**) de la même espèce**.**

3.3 EVALUATION DE L'ACTIVITE ANTIRADICALAIRE DES DIFFERENTS EXTRAITS DES PLANTES

Le tracé du graphe exprimant le taux de piégeage du radical DPPH en fonction de la concentration d'extrait a permis de déterminer les concentrations d'extraits éthanoliques permettant de piéger 50 % de radicaux DPPH (IC_{50}). Nous remarquons que ces concentrations varient d'une plante à l'autre (Tableau 2).

Tableau 2: Activité antiradicalaire de l'extrait éthanolique des plantes étudiées

	A.difformis	*P.biglobosa*	*P.longifolia*
IC $_{50}$ (mg/ ml)	50	20	16

La concentration de l'extrait permettant le piégeage de 50 % de radicaux libres est plus faible au niveau de ***P. longifolia***. Cette plante, qui s'était déjà révélé la plus riche en polyphénols, présente donc la plus faible activité antiradicalaire.

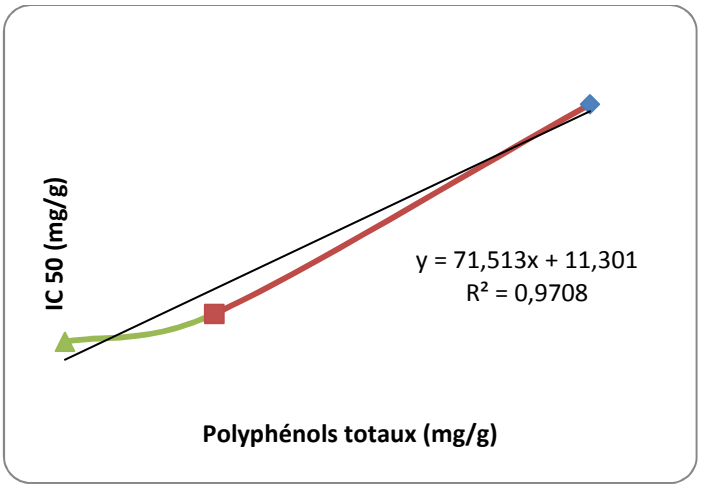

Figure 9: Teneur en polyphénols totaux en fonction de l'activité antiradicalaire

Le tracé du graphe de l'activité antiradicalaire en fonction de la teneur en polyphénols totaux pour l'extrait le plus actif comparé aux moins actifs montre une bonne corrélation entre l'activité antiradicalaire et la teneur en polyphénols avec un coefficient de détermination R^2 = 0,970. L'activité antiradicalaire de ces extraits serait donc fortement liée à leur teneur en composés phénoliques comme en témoignent plusieurs travaux dans la littérature sur les extraits végétaux **[15], [35], [36], [37], [38].**

3.4 IDENTIFICATIONS DES COMPOSES AROMATIQUES PRESENTS DANS LES POUDRES DES PLANTES

***Tableau 3**: Composés volatils présents dans la poudre des feuilles de trois plantes*

RT[a] (mn)	KI[b] cal	KI lit	Composés identifiés	Feuille de ***A. difformis***	Feuille de ***P. biglobosa***	Feuille de ***P. longifolia***
1,73			Acetic acid			1,2
1,84	517	606	Ethyl acetate	14,29	27,3	2,7
2,76	765	767	Toluene	6,37		
5,44	930	932	Decadiyne	1,43		
8,01	1029	1022	o-Cymene	4,40		
21,91	1368	1374	α-Copaene	1,16		3,85
23,69	1411	1417	E-Caryophyllene	10,74	36,23	30,87
24,05	1420	1424	2,5-dimethoxy-p-Cymene	4,17		
24,38	1428	1432	α-E-Bergamotene			2,09
25,04	1444	1452	α-Humulene			8,04
25,35	1452	1458	allo-Aromadendrene	5,42	31,62	26,51
26,01	1469	1478	γ-Muurolene			1,76
26,37	1478	1479	ar-Curcumene			13,81
26,75	1487	1489	β-Selinene			4,45
27,88	1516	1522	δ-Cadinene			1,73
30,13	1576	1582	Caryophyllene oxide			2,37
% des composés identifiés dans chacune des plantes				**47,98**	**95,17**	**99,35**

KI cal : Indice de Kovacs calculé KI lit : Indice de Kovacs dans la littérature RT : Temps de Rétention

Il ressort de l'analyse de ce tableau que 47,98% des composés contenus dans l'extrait éthanolique des feuilles de ***A. difformis*** ont pu être identifiés contre 95,17% pour ***P. biglobosa*** et 99,35% pour ***P. longifolia.***

A. difformis contient sept (7) differents composés aromatiques alors que ***P. biglobosa*** en contient deux (2) contre dix (10) pour ***P. longifolia.*** Enfin, les pourcentages des composés aromatiques présents dans les extraits éthanoliques de chacunes de ces trois plantes sont respectivement 33,69%, 67,85% et 95,48%.

4 CONCLUSION

Le présent travail a été consacré à la détermination des grands groupes chimiques, au dosage des composés polyphénoliques suivi de l'évaluation de l'activité antiradicalaire et l'identification des composés volatils de trois plantes de la pharmacopée béninoise en vue de justifier leur utilisation dans la lutte contre diverses patholigies.

P. longifolia est la plus riche des trois plantes en composés polyphénoliques et a présenté l'activité antiradicalaire la plus intéressante.

Par ailleurs, le présent travail a montré une diversité en métabolites secondaires et en composés aromatiques au niveau des plantes étudiées et a révélé leur richesse en polyphénols, produits naturels antioxydants, à intérêt considérable dans le domaine pharmacologique. Ce travail apporte donc une contribution significative à la connaissance phytochimique des trois plantes investiguées et permet ainsi, de mieux comprendre les propriétés pharmacodynamiques de leurs extraits expliquant leur usage en pharmacopées traditionnelles.

REFERENCES

[1] Who, Edm, Trm, "Stratégie de l'OMS pour la médecine traditionnelle pour 2002-2005". OMS, Genève, 65 p, 2002.

[2] D. J. Newman, G. M.Cragg, K. M.Snader, "The influence of natural products upon drug discovery". *Natural Product Report,* 17: 215 – 234, 2000.

[3] J. B. Calixto, "Twenty-five years of research on medicinal plants in Latin America: A personal view". *Journal of Ethnopharmacology,* 100: 131 - 134, 2005.

[4] S. Abah, Eneojo., L.O. Egwari and T.O. Mosaku. "In vitro Antimicrobial Screening on *Anchomanes difformis (Blume) Engl*. Leaves and Rhizomes Against Selected Pathogens of Public Health Importance". Advances in Biological Research, 5 (4): 221-225, 2011.

[5] A. Akoegninou, B. W. J. Van der, and M. L. J. G. Van der". Flore Analytique du Bénin", Backhuys Publishers, 1034 p, 2006.

[6] J.M. Tokoudagba "Phytochimie et Propriétés anti hypertensives de deux plantes utilisées dans le traitement traditionel de l'hypertension artérielle au Bénin : *Parkia biglobosa (Jacq.) Benth. (Mimosaceae)* et *Spondias mombin L. (Anarcardiaceae)* ". Thèse N° 023-2012 / FDCA/ FAST / UAC, 2012.

[7] I.B. Adebo, I. Doumbia, N. Aka, M. Dosso, and F. Guede Guina, "Evaluation de l'activité antibactérienne de *Phyllanthus amarus (Euphorbiaceae)* sur la croissance in vitro de *Mycobacterium tuberculosis*". Revue de Médecines et Pharmacopées Africaines, Volume 21, pp 35- 42, 2008.

[8] Y .A. Bekro, J. A. M. Bekro, B. B. Boua, B. F. H.Tra, E. E. Ehile, "Etude ethnobotanique et screening phytochimique de *Caesalpinia benthamiana (Baill.) Herend. Et Zarucchi (Caesalpiniaceae)* ". Re. Sci. Nat, Vol. 4, No.2, PP. 217-225, 2007.

[9] J.Bruneton, "Pharmacognosie, phytochimie, Plantes medicinales". Tec et Doc., Lavoisier, Paris, PP.915, 2ème édition, 1993.

[10] J.Bruneton, "Pharmacognosie, Phytochimie, Plantes medicinales". Lavoisier Technique & Documentation. Paris, 1999.

[11] T.Y. Soro, F. Traore, J.Y. Datte, A.S. Nene-Bi, "Activite antipyretique de l'extrait aqueux de *Ximenia americana*". Phytotherapie, PP.297–303, 2009.

[12] N. Dohou, K. Yamni, S. Tahrouch, L. M. I. Hassani, A. Bodoc, N. Gmira, "Screening phytochimique d'une endemique Ibero-marocain, *Thymelaea lytroides Bull*". Soc. Pharm. Bordeaux, PP. 61-78, 2003.

[13] A. M. Rizk, "Constituents of plants growing in Qatar". Fitoterapia, Vol. 52, No. 2, PP.35- 42, 1982.

[14] K. N'Guessan, "Contribution à l'étude ethnobotanique en pays krobou". Thèse de doctorat 3èm cycle, University National de Côte d'Ivoire, 557 p, 1995.

[15] P.J. Houghton and A. Raman, "Laboratory handbook for the fractionation of natural extracts. London". Chapman et hall 1998.

[16] P. Lebreton, M. Jay and B.Voirin, "Analyse qualitative et quantitative des flavonoïdes". Chim. Anal. (Paris), 49 (7), 375-383, 1967.

[17] P. Ribereau-Gayon and S. Stone, "Dosage des anthocyanes dans le vin rouge". E. Bull. Soc. Chim., 9, 2649-2652, 1965.

[18] T. Bahorun, B. Grinier, F. Trotin, G. Brunet, T. Pin, M. Luncky, J. Vasseur, M. Cazin, C. Cazin and M. Pinkas, "Oxygen species scavenging activity of phenolic extracts from hawthorn fresh plant organs and pharmaceutical preparations". Arzneimittel-Forsching, Vol. 46, No. 11, PP. 1086-1089, 1996.

[19] P. Agbangnan, C. Tachon, C. Bonin, A. Chrostowka, E. Fouquet, D. C. K. Sohounhloue, "phytochemical study of a tinctorial plant of benin traditional pharmacopoeia: The red sorghum (*sorghum caudatum*) of Benin". Scientific Study & Research, Vol. 13, No. 2, 121-135, 2012.

[20] P. Schofield, D. M. Mbugua, A. N. Pell, "Analysis of condensed tannins". Animal feed science technology, PP. 21-40, 2001.

[21] B. J. Xu and S. K. C. Chang, "A Comparative Study on Phenolic Profiles and Antioxidant Activities of Legumes as Affected by Extraction Solvents ". Journal of Food Science, Vol. 72, No. 2, PP. 160-161, 2007.

[22] V. I. Singleton and R. M. Lamuela-Raventos, "Analysis of Total Phenols and Other Oxidation Substrates and Antioxidants by Means of Folin-Ciocalteu Reagent ". Method in Enzymology, pp.15 1999.

[23] P. Siddhuraju, P. S. Mohan and K. Becker, "Studies on the Antioxidant Activity of Indian Laburnum (*Cassia fistula L.*), a Preliminary Assessment of Crude Extracts from Stem Bark, Leaves, Flowers and Fruit Pulp". Journal of Food Chemistry, Vol. 79, No. 1, PP. 61-67, 2002.

[24] K. M. Konan, J. A. Mamyrbekova-Bekro, Y. A. Bekro, B. M. G. Djie and B. T. J. Zomi, "In vitro antioxidant activities of total flavonoids extracts from leaves and stems of *Adenia lobata (Jacq.) Engl. (Passifloraceae)* ". Journal of Pharmacognosy and Phytotherapy, Vol. 3(1), pp. 8-12, 2010.

[25] P. D. C. Agbangnan, J.P. Noudogbessi, A. Chrostowska, C. Tachon, E. Fouquet, D C. K.Sohounhloue, "Phenolic compound of Benin's red sorghum and their antioxidant properties". Asian Journal of Pharmaceutical and Clinical Research,6(2), 277-2802013.

[26] X. Duan, W. Zhang, X. Li. and B. Wang, "Evaluation of antioxidant property of extract and fractions obtained from a red alga, *Polysiphoniaurceolata*". Food Chemistry, 95:37-45, 2006.
[27] L. Humbert, Annales de Toxicologie Analytique, 22(2): 61-68, 2010.
[28] F. Chapuis, V. Pichon and M. C. Hennion, "Méthode de préconcentration par extraction en phase solide : principe et application aux industries environnementales et pétrolières". Oil Gas Sci Technol., 60: 899–912, 2005.
[29] P. Yves, B. Bertrand and M. Patrick, "Headspace (HS) et micro-extraction en phase solide (SPME).Théorie et applications". Annales de Toxicologie Analytique, 22(2): 75-79, 2010.
[30] A. D. Bossou, S. Mangelinckx, H. Yedomonhan., P. M. Boko., M. C. Akogbeto, N. De Kimpe, F. Avlessi and D. C K Sohounhloue, "Chemical composition and insecticidal activity of plant essential oils from Benin against Anopheles *gambiae* (Giles) ". Parasites & Vectors 6: 337, 2013.
[31] P. A. Akah and A. I. Nwambie, "Evaluation of Nigerian traditional medicines: Plants used for rheumatic (inflammatory) disorders". Journal of Ethnopharmacology, 42 179- I82, 1994.
[32] A. M. El-Mahamood, and J. M. Ameh, "In vitro antibacterial activity of *Parkia biglobosa (Jacq.)* root bark extract against some microorganisms associated with urinary tract infections". African Journal of Biotechnology (2007) Vol. 6 (11), pp. 1272-1275
[33] N. G. Rajesh, R. U. Shaikh, M. P. Mahesh, "In vitro evaluation of anticancer and antimicrobial activity of selected medicinal plants from Ayurveda". Asian Journal of Traditional Medicines, 6 (3), 2011.
[34] P. Pradhan, J. Mahesh, R. Chulet, Y. Deepak, "Prelimiary studies on effect of biodiversity activity of *Polyalthia longifolia*". Pharmacologyonline, 2: 11-15, 2011.
[35] J-M. Tokoudagba, C. Auger, L. Bréant., S. N'Gom, P. Chabert, N. Idris-Khodja, F. Gbaguidi., J. Gbenou, M. Moudachirou, A. Lobstein and V. B. Schini-Kerth, "Procyanidin-rich fractions from *Parkia biglobosa* (*Mimosaceae*) leaves cause redox-sensitive endothelium-dependent relaxation involving NO and EDHF in porcine coronary artery". Journal of Ethnopharmacology 132, 246–250, 2010.
[36] A. Lamien-Meda, C. E. Lamien, M. M. Y. Compaoré, R. N.T. Meda, M. Kiendrebeogo, B. Zeba, J. F. Millogo and O. G. Nacoulma, "Polyphenol Content and Antioxidant Activity of Fourteen Wild Edible Fruits from Burkina Faso". Molecules, 13, 581-594, 2008.
[37] P. Molyneux, "The use of stable free radical diphenylpicrilhydrazyl (DPPH) for estimating antioxidant activity". *J. Sci. Technol*, 211-219, 2004.
[38] V. N. Enujiugha, "The Antioxidant and Free Radical- Scavenging Capacity of Phenolics from African Locust Bean Seeds (*Parkia biglobosa*) ". Advances in Food Sciences, Vol. 32, No.2 pp. 88-93, 2010.

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A Hybrid Approach for Scheduling in WIMAX for Reduction of Process Waiting Time

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ABSTRACT: Wireless sensor networks consist of hundreds or thousands of applications such as environmental monitoring, traffic analysis, tactical systems and industrial process monitoring. Most of the packet-scheduling mechanisms of WSN use First Come First Served (FCFS), non-preemptive priority and preemptive priority scheduling algorithms. These algorithms incur a high processing overhead and long end-to-end data transmission delay due to the FCFS concept .These algorithms are not dynamic to the changing requirements of WSN applications since their scheduling policies are predetermined. Developing packet scheduling algorithms in wireless sensor networks can efficiently enhance delivery of packets through wireless links. Packet scheduling can guarantee quality of service and improve transmission rate in wireless sensor networks. Considering this combination we are basically focusing on the nodes of wireless sensor network as the process required shortest coverage area to reach. We apply FCFS algorithm & priority algorithm for calculating delay. We can use it for mixing with coverage area for further process. After priority on the basis of time reduction we have to apply SJF (shortest job first) execution time finding. Finally, we have to compare on the basis of delay and execution time. Improve the performance of task scheduling schemes in terms of end to end delay and deadlock prevention.

KEYWORDS: WSN, Scheduling, CPU, Delay, Matlab

1 INTRODUCTION

In wireless communication systems, the process of scheduling users for communication plays an important role for the overall performance. Scheduling is normally part of the general resource management, and typically involves allocating communication resources, such as the transmission resources of a shared radio medium, to users according to some priority order. Scheduling is of outmost importance in many wireless applications and system environments such as the IP Multimedia Subsystem (IMS) that supports user-to-user communication services. For example, real-time user-to-user multimedia telephony services play a key role to satisfy the needs of different services and to improve perceptual quality. When a lot of users enjoy the multimedia services concurrently, the available communication resources need to be allocated efficiently. This requires an efficient strategy and implementation for scheduling user access the communication resources. In order to schedule processes fairly, a round-robin scheduler generally employs time-sharing, giving each job a time slot or *quantum* (its allowance of CPU time), and interrupting the job if it is not completed by then. The job is resumed next time a time slot is assigned to that process. In the absence of time-sharing, or if the quanta were large relative to the sizes of the jobs, a process that produced large jobs would be favored over other processes.

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First-Come-First-Served (FCFS) Scheduling:

First-Come-First-Served algorithm is the simplest scheduling algorithm is the simplest scheduling algorithm. Processes are dispatched according to their arrival time on the ready queue. Being a non preemptive discipline, once a process has a CPU, it runs to completion. The FCFS scheduling is fair in the formal sense or human sense of fairness but it is unfair in the sense that long jobs make short jobs wait and unimportant jobs make important jobs wait. FCFS is more predictable than most of other schemes since it offers time. FCFS scheme is not useful in scheduling interactive users because it cannot guarantee good response time. The code for FCFS scheduling is simple to write and understand. One of the major drawbacks of this scheme is that the average time is often quite long. Other names of this algorithm are:

- First-In-First-Out (FIFO)
- Run-to-Completion
- Run-Until-Done

Round robin scheduling algorithm:

Round robin is the scheduling algorithm used by the CPU during execution of the process. Round robin is designed specifically for time sharing systems. It is similar to **first come first serve scheduling algorithm** but the preemption is the added functionality to switch between the processes. Round-robin (RR) is one of the algorithms employed by process and network schedulers in computing. As the term is generally used, time slices are assigned to each process in equal portions and in circular order, handling all processes without priority (also known as cyclic executive). Round-robin scheduling is simple, easy to implement, and starvation-free. Round-robin scheduling can also be applied to other scheduling problems, such as data packet scheduling in computer networks. It is an Operating System concept The name of the algorithm comes from the round-robin principle known from other fields, where each person takes an equal share of something in turn.

2 RELATED WORK

Scheduling is a rule that specifies which user is allowed to transmit and which user is allowed to receive at each timeslot. Basically Scheduling in Wireless Networks reviews the problem of scheduled channel access in wireless networks with emphasis on ad hoc and sensor networks as opposed to Wi-Fi, cellular, and infrastructure-based networks. It is intended to provide a reference point for the rich set of problems that arise in the allocation of resources in modern and future networks. Some of the factors which effect scheduling are as follows:

- **Deadline:**
  Packet scheduling schemes can be classified based on the deadline of arrival of data packets to the base station (BS), which is: First Come First Served (FCFS). In FCFS, many data packets arrive late and thus, experience long waiting times. Earliest Deadline First: Whenever a number of data packets are available at the ready queue and each packet has a deadline within which it should be sent to BS, the data packet which has the earliest deadline is sent first. This algorithm is considered to be efficient in terms of average packet waiting time and end-to-end delay.

- **Priority:**
  Packet scheduling schemes can be classified based on the priority of data packets that are sensed at different sensor nodes.
  - **Non-preemptive:**
    In non-preemptive priority packet scheduling, when a packet t1 starts execution, task *t*1 carries on even if a higher priority packet *t*2 than the currently running packet *t*1 arrives at the ready queue. Thus *t*2 has to wait in the ready queue until the execution of *t*1 is complete.
  - **Preemptive:**
    In preemptive priority packet scheduling, higher priority packets are processed first and can preempt lower priority packets by saving the context of lower priority packets if they are already running.

- **Packet Type:**
  Packet scheduling schemes can be classified based on the types of data packets, which is following as

- **Real-time packet scheduling:**
  Packets at sensor nodes should be scheduled based on their types and priorities. Real-time data packets are considered as the highest priority packets among all data packets in the ready queue. Hence, they are processed with the highest priority and delivered to the BS with a minimum possible end-to-end delay.
- **Non-real-time packet scheduling:**
  Non-real time packets have lower priority than real-time tasks. They are hence delivered to BS either using first come first serve or shortest job first basis when no real-time packet exists at the ready queue of a sensor node. These packets can be intuitively preempted by real-time packets.

- **Number of Queue:**
  Packet scheduling schemes can also be classified based on the number of levels in the ready queue of a sensor node. These are as follows: Single Queue, Multi-level Queue.

As per literature review previous algorithm as FCFS, Priority, Round robin which resulted in many problems like delay or waiting time. Therefore, overall execution time is more. So there is need of such algorithm which will provide better QOS.

3 PROPOSED WORK

Scheduling is basically a tool to control the execution of processes that is performed by a computer. Therefore at first we have used priority based packet scheduling scheme which aims at scheduling different types of data packets, such as real time and non-real-time data packets at sensor nodes with resource constraints in Wireless Sensor Networks. Most of the packet-scheduling mechanisms of Wireless Sensor Networks use First Come First Served (FCFS) but these algorithms results in many problems such as long end-to-end data transmission delay, high energy consumption, deprivation of high priority real-time data packets also it results in improper allocation of data packets to queues. So here in this thesis we are making a combination of priority scheduling with the coverage area consideration and SJF which is a priority scheduling where priority is the predicted next CPU burst time. Hence by using this combination we can overcome those entire problems which were occurred previously. Considering this combination we are basically focusing on the nodes of wireless sensor network as the process required shortest coverage area to reach .Thus by the use of this combination the execution time will get reduced and give much better results than before.

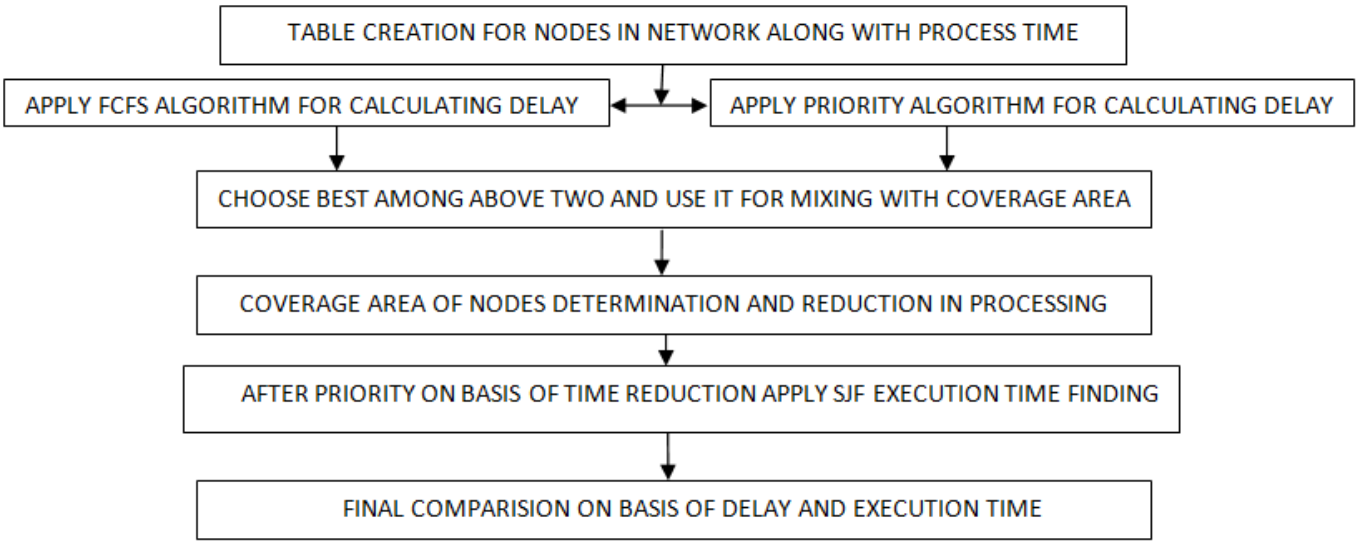
Objective:

1. To implement fast and Modified Scheduling algorithm.
2. To reduce node to node delay time.
3. To reduce overall processing time.
4. Compare with previous algorithm.

4 METHODOLOGY

Here, in this research the process of scheduling includes:

1. Firstly we have to create a table for nodes present in the network along with the process time.
2. Then, apply FCFS algorithm for calculating delay.
3. At the same time apply priority algorithm for calculating delay simultaneously.
4. After this we can choose best algorithm among both and then we can use it for mixing with coverage area for the further process.
5. Now, the determination and reduction in processing of the coverage area of nodes has been done.
6. Most importantly now after priority on the basis of time reduction we have to apply SJF (shortest job first) execution time finding.
7. Now, finally we have to compare on the basis of Delay and Execution time.



5 PERFORMANCE ANALYSIS

For the analysis we have used MATLAB tool. Table 1 shows a number of 12 processes that arrive at same time in the given order. To analyze the performance of these processes, we have applied various scheduling (namely FCFS, Priority & Proposed) algorithms.

Table 1. List of Processes with Burst time and Priority

Process	CPU Burst Time (ms)	Priority
P1	22	6
P2	14	4
P3	26	5
P4	30	11
P5	24	9
P6	45	10
P7	32	7
P8	40	2
P9	19	1
P10	26	3
P11	10	12
P12	15	8

Final results obtained from the proposed scheduling algorithm for the Average Dealy Time and the Average Completion Time along with their comparative analysis with the other scheduling algorithms (FCFS and Priority) are given below in Table 2 and Table 3 respectively.

Table 2. Average Delay Time (ms)

FCFS	PRIORITY	PROPOSED
144.4167	140.0833	90.5833

Table 3. Average Completion Time (ms)

FCFS	PRIORITY	PROPOSED
169.6667	165.3333	113.4167

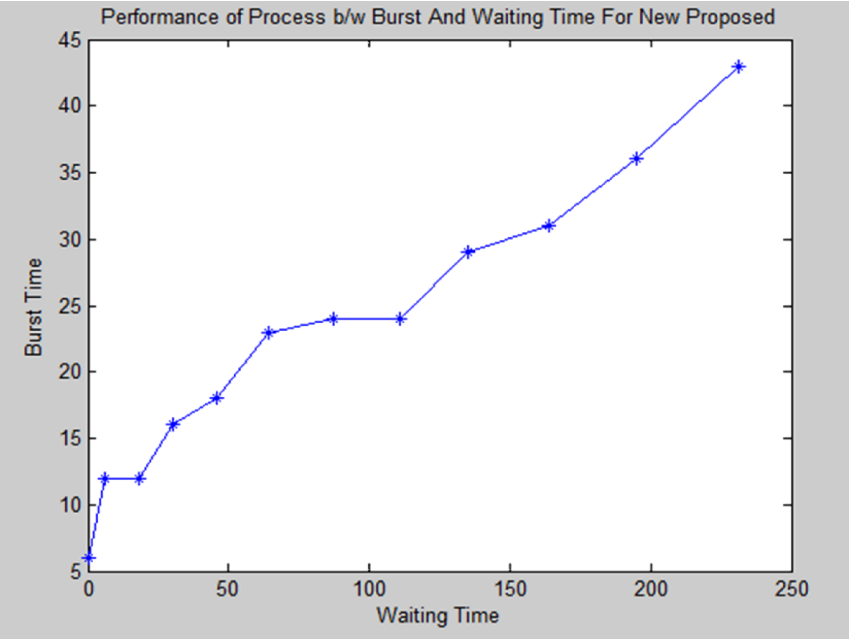


Fig. 1. Performance of process b/w Burst and Waiting time for proposed algorithm

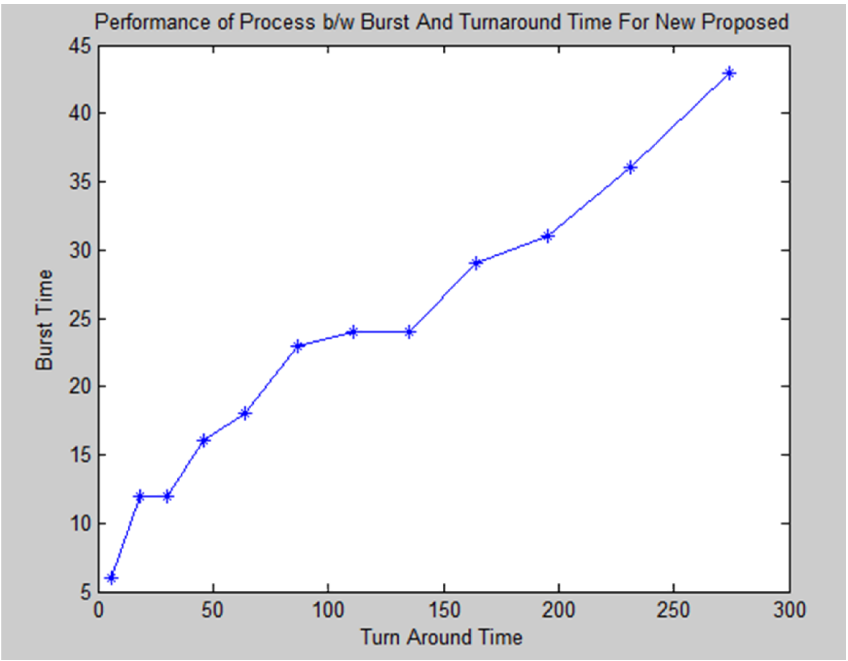


Fig. 2. Performane of Process b/w Burst and Turnaround for proposed algorithm

6 CONCLUSION

It ensures minimum end-to-end data transmission for the highest priority data while exhibiting acceptable fairness towards lowest-priority data. Experimental results show that the proposed DMP packet scheduling scheme has better performance than the existing FCFS and Multilevel Queue Scheduler in terms of the average task waiting time and end-to-end delay. The degradation of the system performance such as end-end delay and packet delivery ratio can done by a condition called deadlock a situation in which the resources held by the real time task for a longer period of time such that the other tasks need to wait for an undefined period time.

REFERENCES

[1] Nidal Nasser, Lutful Karim, and Tarik Taleb, "*Dynamic Multilevel Priority Packet Scheduling Scheme for Wireless Sensor Network*",in IEEE Transactions on Wireless Communications, Vol. 12, no 4, April 2013.

[2] Kumar Shashi Prabh, "*Real-Time Wireless Sensor Networks, a dissertation presented to the faculty of the School of Engineering and Applied Science*", University of Virginia, May 2007.

[3] Bjrn Hovland Brve, "*Packet Scheduling Algorithms for Wireless Networks*", Norwegian University of Science and Technology.

[4] J. Liu, N. Gu, and S. He, "*An energy-aware coverage based node scheduling scheme for wireless sensor networks*," in Proc. 2008 International Conf. Young Comput. Scientists, pp. 462–468.

[5] F. Akyildiz, W. Su, Y. Sankarasubramaniam, and E. Cayirci, "*A survey on sensor networks,"Communications Magazine",IEEE*, vol. 40, pp. 102-114, 2002.

[6] M. Yu, S. J. Xiahou, and X. Y. Li, "*A survey of studying on task scheduling mechanism for TinyOS*," in *Proc. 2008 International Conf. Wireless Commun., Netw. Mobile Comput.*, pp. 1–4.

[7] Jaspher W. Katherine, Arun raj*, "Packet scheduling Algorithms in Different Wireless networks A Survey"* in IJERT, vol. 1, no. 8, 2012.

[8] A.Chandrakasan, R. Amirtharajah, S. Cho, J. Goodman, G. Konduri, J. Kulik, W. Rabiner, and A. Wang, "*Design considerations for distributed microsensor systems*," in Custom Integrated Circuits, 1999. Proceedings of the IEEE 1999, pp. 279{286, IEEE, 1999.

[9] M. Castillo-E_er, D. H. Quintela, W. Moreno, R. Jordan, and W. Westho"*Wireless sensor networks for ash-ood alerting,*" in Devices, Circuits and Systems, 2004. Proceedings of the Fifth IEEE International Caracas Confer- ence on, vol. 1, pp. 142{146, IEEE, 2004.

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FACTORS INFLUENCING PROCUREMENT PERFORMANCE IN THE KENYAN PUBLIC SECTOR: CASE STUDY OF THE STATE LAW OFFICE

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ABSTRACT: Public procurement is crucial to government service delivery. For decades procurement performance has been attracting great attention from practitioners, academicians and researchers due to poor levels of performance. Despite Government efforts for improvement, it is still marred by shoddy works, poor quality goods and services. Stakeholders complain about poor service delivery. Benefits deriving from improved procurement performance at State Law Office (SLO) are dependent on systems and staff. The general objective of the study was to assess factors influencing procurement performance in Kenyan public sector with specific focus on the SLO. It sought to assess the extent to which records management systems, procurement procedures, information communications technology and staff qualifications influence procurement performance. Descriptive design was used in executing the study. Target population was the 600 SLO staff comprising of 7 departments. Sample size of 60 respondents, 10% of target population, was drawn using stratified sampling method. Primary and secondary sources of data were collected using questionnaires, interviews and observation. Both descriptive and inferential data analysis methods including frequencies, percentages, factor analysis and regression were used in STATA. Data was presented using graphs and figures. Based on the analyses of information presented above, the following findings were noted: Demographic indicators show that majority of the study participants are qualified and have attained education levels sufficient to influence favourably their comprehension of antecedents to effective management of the procurement function. Further findings on years of experience indicate that officers participating in the procurement function in the SLO have long work experience. The results indicate that the SLO is performing on the negative in all the five determinants of public procurement performance studied as they all recorded negative mean scores. Overall records management is most significant driver in procurement performance followed by procurement procedures, procurement staff qualifications and ICT in that order. It is recommended that reforms in the Department be accelerated with a view of streaming procurement processes as well as automating activities and back office operations.

KEYWORDS: State Law Office, procurement performance, procurement processes.

1 INTRODUCTION

The weakening global economic conditions are forcing organisations to reinvent their relations with customers and suppliers alike. Thus, costs must be lowered throughout the procurement process by focusing on value addition. Bottlenecks must be removed and performance measurements focus on total system efficiency and equitable reward distribution to key players in the process; to achieve win-win situations. The working principle is to create customer satisfaction at the end point of delivery and continuous improvement of process.

For decades procurement performance has been attracting great attention from practitioners, academicians and researchers due to poor performance. Adoption of e-procurement has rapidly increased since 1990s; yet organisations still

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face challenges associated with its advent and use. Analysis by Wyld (2004) showed that in the United States only 30% of firms surveyed use e-procurement systems for request for quotations (RFQ), online auctions (25%) and e-markets (33%). Despite evidence showing advantages of e-procurement systems, many organisations are still reluctant to embrace it. Organisations need to know critical success factors in implementing e-procurement strategies, processes and systems. Due to limited vision, management of many organisations fails to appreciate the importance of system-wide performance measures.

Procurement professionals find that combinations of quality, service, and price are seldom exactly equal. Burt, Petcavage and Pinkerton (2010) postulated that if quality and price are equal, then supplier should be selected solely on the basis of service. Service is seldom equal and in many cases it is a supplier's capabilities that are being purchased, not commodities. Government as a sovereign power is distinguished from commercial contracting process. In most cases, Government acts in the best interest of the public; to strive to guarantee transparency, accountability and facilitate easy access to information.

The public procurement system in Kenya was governed by amorphous legal framework such as Treasury Circulars from 1969; then Government Supplies Manual of 1978. In 1997, Government initiated the Public Procurement Reform and Enhanced Capacity Project following recommendations of two procurement audits carried out by consultancy firm, Societe Generale de Surveillance (SGS). The audit disclosed serious shortcomings. Thus, Government decided to reform existing practices in order to achieve and enhance economy, accountability and transparency. It harmonized all rules resulting in the Public Procurement Regulations, 2001.

An Independent Procurement Review (IPR), covering selected ministries, state corporations, and educational institutions, carried out in 2005 identified further key weaknesses. Thus, Government enacted the Public Procurement and Disposal Act 2005 and in December, 2006, the Public Procurement and Disposal Regulations 2006 were gazetted to operationalise the Act, effective from 1st January, 2007. The Act and Regulations set out rules and procedures that a procuring entity (PE) shall follow to implement procurement mandate. An effective public procurement system can contribute immensely to Kenya's socio-economic development and particularly be the cornerstone of attaining the Vision 2030 Strategy.

Public Procurement Oversight Authority (PPOA) Legislative and Regulatory Framework Pillar in 2010 assessed the existence, availability, quality and use of the legal framework from the highest level (Act and Regulations) down to the more detailed operational procedures, guidelines, model tender documents, and standard conditions of contract. Key weaknesses noted were excessive use of RFQ, and low use of open tendering method. The survey considered 11,046 procurement transactions by the sampled PEs and found that 89.2% of these were through RFQ; direct procurement 3.3%; low value procurements 3.9%; request for proposals (RFP) 0.1%; restricted tenders 1.3%; while open tenders accounted 1.3%. Excessive use of the RFQ method shows a worrying trend of about 90% of business as clerical operations.

Predominant weaknesses related to procurement operations and strict tendering security requirement constrained private sector access to public procurement. Chapter Twelve of The Constitution of Kenya, 2010, Part VI, has recognised the contribution of procurement to national economy. Section 227 (1) states that PEs should contract in accordance with a system that is fair, equitable, transparent, competitive and cost effective.

Integrated Financial Management Information System (IFMIS) initial launch and development by Ministry of Finance began in 1998 and roll out to Ministries began in 2003. It has only played a partial role in the Public Finance Management (PFM). Out of ten modules targeted, only three have been configured and operating in 48 ministries/departments only, the SLO included. It was limited to the General Ledger (GL), Purchasing Order (PO) and Accounts Payable (AP) modules suffering from technical limitations with functionalities insufficiently interlinked; leading to fragmented approach to its use. Usage resistance was high leading to poor adoption. Design flaw prevents POs from being properly formatted and validated. Poor combination of automated and manual processes undermined quality and accuracy of data. Requisitions, POs, payment vouchers, delivery notes, invoices, and approvals were done manually. Re-engineering process can radically transform the system of SLO transactions.

Some 18 baseline studies of RM were conducted under the Support for Reforming the Public Procurement System (RPPS) commencing 2007. A scoring system based on 13 key record keeping sub-indicators was developed for conducting an assessment. 77.8% obtained low scores ranging from 21% to 49%. Rembe (2011) noted that records management (RM) in most PEs has been unsatisfactory and depressing. This study was carried out at the SLO. Target group is all the 600 members of staff at headquarters. The SLO plays a key role in supporting and facilitating the implementation of Government policy interventions to revitalise the economy and encourage reform and development in various sectors.

1.1 STATEMENT OF THE PROBLEM

Public procurement is key to government service delivery, yet constraints affect its performance. Procurement is perceived as prone to corruption; occasioning waste and affecting quality of service and life improving opportunities. There is need to reverse this worrying trend and win public confidence. Despite Government efforts to improve the procurement system, it is still marred by shoddy works, poor quality goods and services. Improper implementation of recommended performance standards results in unnecessarily high operation costs, uncoordinated business activities, inability to achieve domestic policy goals, and failure to attract and retain professionals. Suppliers complain about the capability of public sector buyers.

The *Systems Audit for SLO, 2008/2009 Report* revealed losses of Kshs.18,291,430.30 through irregular procurements in financial year (FY) 2008/2009. Earlier, in FY 20072008, SLO had lost Kshs. 8,495,968.00 due to inefficiencies. This raises questions on the level of performance of SLO's procurement system. According to Juma (2010), central government procurement was estimated at 10% of gross domestic product (GDP). Even a 10% saving via improved procurement performance means Kshs. 30 billion annual savings for other needy sectors. Consequences of inefficiencies include drains on scarce resources and erosion of public confidence in Government. Nationally, it raises questions for SLO to exist as currently constituted or be privatised. Organisations are founded on goals and objectives and their continued existence can only be justified by the extent to which they meet them. This study is worthy so as to help get to grips with constraints; tackle waste, control public spending and light the fires of enterprise in public sector.

The general objective of this study was to assess factors influencing procurement performance in the Kenyan public sector: case study of the State Law Office. It was guided by the specific objectives of: to evaluate the extent to which records management systems affect procurement performance at the State Law Office, to establish the extent to which procurement procedures affect procurement performance at the State Law Office, to examine how information communications technology affects procurement performance at the State Law Office and to determine the contribution of staff qualifications to procurement performance at the State Law Office.

This study intended to make an in-depth assessment of factors affecting levels of procurement performance so as to improve productivity. There is growing demand from taxpayers for service higher levels. The study identifed ways for enhanced procurement system which, if implemented, can contribute to socio-economic benefits for the SLO, public procurement, and Government.

It is expected that from the findings of this study, SLO could put in place appropriate measures to improve procurement performance levels. Government could benefit from enhanced value for money due to improved revenue collection which could be used to finance other sectors of the economy. This study could form a basis of reference for what needs to be researched further and throw light to the need for future research in procurement. Its recommendations could enable the public at large to benefit through responsive service delivery, if implemented.

The study's scope lies in assessing factors influencing procurement performance in government. The study was conducted at the SLO headquarters which has seven departments, six of them technical/legal and one administrative with a total population of approximately six hundred members of staff. Data was specifically collected from employees of the senior management, middle and lower levels. These were considered as major respondents of the study. Strategic functions are centralised at the headquarters including procurement. All the regional offices are served, coordinated and administered from headquarters.

The study was limited in that, the data for this study was collected from officers who were not readily available due to their busy schedules. The researcher personally administered the questionnaires so as to enhance the rate of returned responses from respondents. The researcher made proper arrangements with respondents to avail themselves for the study off-time hours and motivated them on the value of the study. The study was perceived to narrow to the procurement unit yet the research problem cut across the whole organisation. The impact of limiting this study to the headquarters is to get accurate data from policy makers and key implementers of strategies. However, despite all these limitations mentioned, adequate sample was drawn, credible data collected and analysed.

2 LITERATURE REVIEW

2.1 INTRODUCTION

This chapter comprises the theoretical review/conceptual framework, critique of relevant past studies or empirical review, a summary of the literature reviewed and any research gaps.

2.2 THEORETICAL REVIEW

Several theories have been developed in this area of study. Two of them, Hegelian dialectic theory and Bloom's Taxonomy Theory, are reviewed. After discussing these theories, a theoretical framework was provided.

2.2.1 HEGELIAN DIALECTIC THEORY

This study is based on Hegelian dialectic theory (Hegel, 1995). The theory has it that the organisational entity exists in a pluralistic world of colliding events, forces, or contradictory values that compete with each other for domination and control. Oppositions may be internal or external to an entity with several conflicting goals or interest groups competing for priority. The theory explains that change in organisations occurs when opposing values, forces or events gain sufficient power to confront and engage the status quo. Opposing forces are termed thesis (status-quo) and antithesis (new situation). Records management systemes, procurement procedures, information communications technology and emerging knowledge in procurement and supply chain management in general face several challenges to overcome the obtaining status-quo. Dialogue and consensus-building are primary tools. Agency theory can be applied to employer-employee and buyer-supplier relationships, facilitated by ICT and legal framework. Procurement involves several parties with different competing goals. Internal stakeholders, such as departments exist; with conflicting goals, adding complexity to the procurement performance.

2.2.2 BLOOM'S TAXONOMY OF LEARNING THEORY

Bloom (1956) produced a taxonomy of learning theory which is helpful in identifying different cognitive skills. He identified six levels in this scheme; knowledge, comprehension, application, analysis, synthesis and evaluation. Movement from level 1 to level 6 represents an increase in the level of sophistication of cognitve ability. From strategic thinking perspective, higher demands is be made of the skills associated with analysis, synthesis and evaluation. At operational and tactical level; knowledge, comprehension and application may be more heavily utilised. There are implications with this theory for the ability to learn; from the point of view of attributes in relation to personnel issues with regard to staffing, training and education. Sophisticated levels take on greater importance when analysing situations in terms of relevant factors and the relationships between them, or developing, through synthesis, a picture of the wider system and its functioning as a whole as a result of the inter-dependency of its parts. An example in procurement is the ability to understand each stage of activity in the process, as one side of the coin, but also to appreciate how the stages interrelate and to consider the performance of the system as a whole. Learning is not attempting to transfer a body of knowledge as if it were an inert commodity to be regurgitated in an exam and then promptly forgotten. It should serve more useful purpose to enhance procurement performance through embracing best practice.

2.3 CONCEPTUAL FRAMEWORK

A conceptual framework is a research tool intended to assist a researcher to develop awareness and understanding of the situation under scrutiny and to communicate this. It is used in research to outline possible courses of action or to present a preferred approach to an idea or thought. Successful organisations strive constantly to improve all aspects of their procurement system. In the highly competitive business environment, only the efficient prevail. Therefore, for procurement performance improvement there is need for better functional relationships, sound RM, appropriate procedures, keeping a spotlight on training needs of staff, acquisition and use modern technology, and generally improvement of motivation in the organisation. According to Bogdan and Biklen (2003) a conceptual Framework is a basic structure that consists of certain abstract blocks which represent the observational, the experiential and the analytical/synthetical aspects of a process or system being conceived. The interconnection of these blocks completes the framework for certain expected outcomes.

A variable is a measurable characteristic that assumes different values among subjects. Independent Variables are changes that occur in an experiment that are directly caused by the experimenter. An independent variable is that variable which is presumed to affect or determine a dependent variable. It can be changed as required, and its values do not

represent a problem requiring explanation in an analysis, but are taken simply as given (Dodge, 2003). The independent variables in this study are as follows and are shown in the figure 2.1 below: records management systems, procurement procedures, information communications technology, and staff qualifications.

A dependent variable is a variable dependent on another variable: the independent variable. A dependent variable is what is measured in the experiment and what is affected during the experiment. The dependent variable responds to the independent variable (Everitt, 2002). It is called dependent because it depends on the independent variable. In a scientific experiment, you cannot have a dependent variable without an independent variable. Procurement performance is a function of several variables depicted in figure 2.1 below:

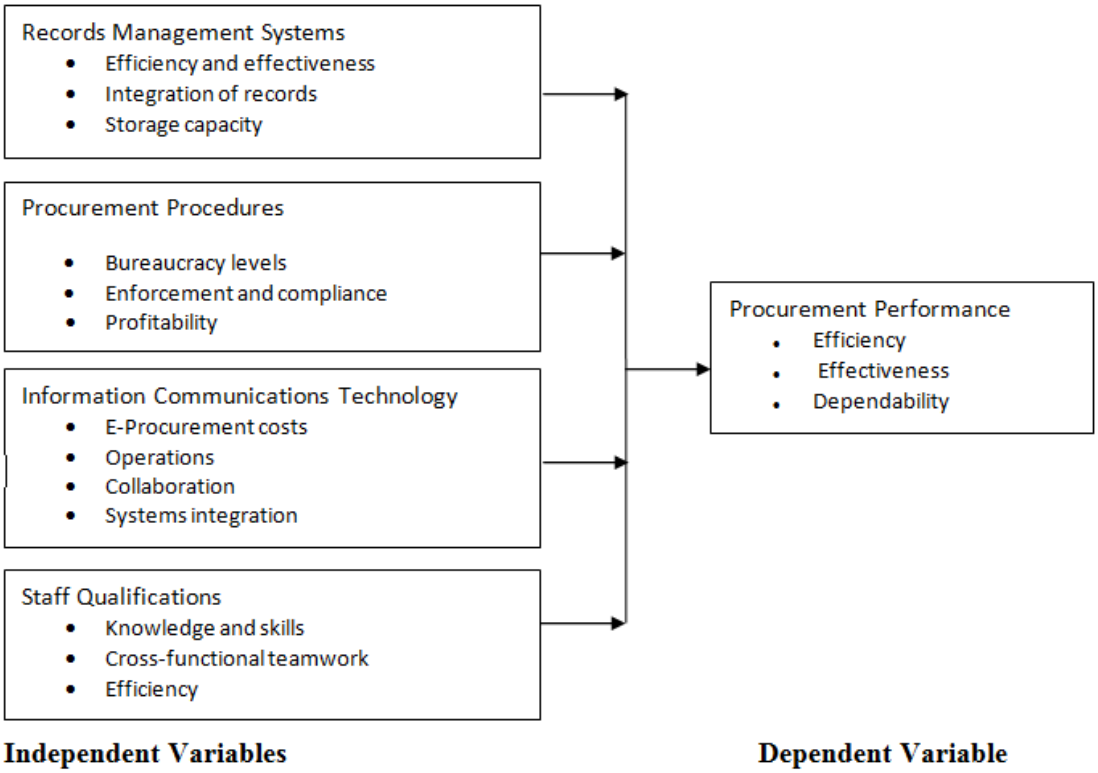

Figure 2.1: Conceptual Framework

2.3.1 PROCUREMENT PERFORMANCE

Smith and Conway (1993) identified seven key success factors which influence procurement, namely; a clear procurement strategy, effective management information and control systems, development of expertise, a role in corporate management, an entrepreneurial and proactive approach, co-ordination and focused efforts. An eighth is fundamental; communicate the key success factors to all levels of the organisation and set out a procurement strategy to achieve continuous improvement in value for money. This should be based on total cost, quality, and enhancement of competitiveness of suppliers using best procurement practice.

Supplier performance has an impact on procurement performance. According to Leenders and Fearon (2002), decisions to buy instead of make to improve quality, lower inventories, integrate supplier and buyer systems, and create co-operative relations underline need for good supplier performance. Recent trends are to fewer suppliers; long-term contracts, e-procurement, and continuing improvement in quality, price, and service require closer co-ordination and communication between key procurement partners. Supplier switching for lower prices may not result in the best long-term value. Sharing information and assisting suppliers to improve performance is a necessity for world-class performance.

There is need to have coherent methods of performance in the procurement function in PEs. Lardenoije, van Raaij and van Weele (2005) asserted that basing on financial performance and neglecting non-financial performance cannot improve the procurement operations because only partial performance is considered. Realisation of procurement goals is influenced by internal and external forces. Interactions between various elements; professionalism, staffing levels and budget resources,

procurement organisational structure, regulations, rules, and guidance, and internal control policies, all need attention and influence procurement performance.

Christopher (2005) distinguished features of a responsive organisation. Major transformations are; from functions to process, profit to performance, products to customers, inventory to information, and transactions to relationships. Critical measures of procurement performance need to be continuously monitored. The idea of 'Key Performance Indicators' (KPI) framework suggests that whereas there are many measures of procurement performance to be deployed in an organisation, only a small number of critical dimensions contribute more than proportionately to success or failure. A balanced scorecard can provide guidance on critical areas where action may be needed to ensure achievement of goals. Three key outcomes of success are: better, faster, and cheaper. The goals combine customer-based measures of performance in terms of total quality with internal measures of resource and asset utilisation. Benchmarking helps identify current best practice and then focuses on how processes could be re-engineered and managed to achieve excellence in critical procurement areas. Emphasis should be on search for strategies that provide superior value in the eyes of customers seeking greater responsiveness and reliability.

Van Weele (2006) maintained that there is a link between procurement process, efficiency, effectiveness and performance. Procurement performance starts from purchasing efficiency and effectiveness in the procurement function in order to change from being reactive to being proactive to attain set performance levels in an entity. Performance provides the basis for an organisation to assess how well it is progressing towards its predetermined objectives, identifies areas of strengths and weaknesses and decides on future initiatives with the goal of how to initiate performance improvements. Procurement performance is not an end in itself but a means to control and monitor the procurement function.

For any organisation to change its focus and become more competitive, performance is a key driver to improving quality of services. Batenburg and Versendaal (2006) noted that use of inappropriate means can be a barrier to change and may lead to deterioration of procurement operations. Organisations which do not have performance means in their processes, procedures, and plans experience lower performance and higher customer dissatisfaction and employee turnover. Measuring procurement performance yields benefits to organisations such as cost reduction, enhanced profitability, assured supplies, quality improvements and competitive advantage. Electronic processes have replaced physical and paper-based processes. E-procurement moves tendering, negotiation and purchasing processes to websites. Improvement to a PE's procurement performance can be realised through reduced costs and wider choice availed.

2.3.2 RECORDS MANAGEMENT SYSTEMS AND PROCUREMENT PERFORMANCE

Records, asserted Thurston (2002), are critical to the operations of any organisation. No entity can operate successfully if it relies on human memory alone to keep trail of her transactions. Procurement records are a vital resource to any organisation that strives to conduct operations effectively. Organisations need accurate and accessible records that are tamper-free, original, reliable and able to reveal institutional memory for informed decision making. PEs should strictly comply with documentation, recording, minuting and filing requirements. The documentation should be kept in orderly, accessible and clean conditions.

Sound RMS is a vital aspect of ensuring transparency, accountability and responsibility in the procurement process. It can reduce vulnerability to legal challenge on financial loss and promote efficiency in terms of human and space resources through greater coordination of the information use, maintenance and control. Procurement RM aims at addressing weaknesses and provides guidance and direction for best practices. David (2005) opined on the future of managing electronic records, which is complex and goes beyond the procurement of a RMS. He contended that firms need an understanding of current ICT trends and business processes and must accept that records systems are products of the moment. The future lies in electronic systems that are more recent in business logic and more useful in business support. Management of electronic records must not be confused with the procurement of document management systems. For any positive contribution to procurement performance, PEs must ensure that records are available to provide documentary evidence of conformity to the requirements of an effective management system. The records control system should facilitate identification, storage, protection retention and disposition of records.

One of the best ways to implement a record management policy is utilizing a business that specializes in it; there are a myriad of companies that offer record management solutions for both paper and electronic documents. Bolton (2006) noted that such solutions make it easy to track, retrieve, and securely store important documents. With so many threats facing entities today, prevention with record management is one vital key to managing a successful.

Rembe (2011) observed that RMS should be accorded a high organisational status and ranking in terms of budgetary allocation, investment in human resource development, records storage space and equipment. It should be viewed as a

critical support function. PEs need to strive to appoint procurement records officers with clearly defined record keeping duties. Transparency and accountability is promoted through the appropriate recording of procurement procedures. There is need for every PE to maintain records retention and disposal schedule for sound management of procurement transactions. This schedule should specify the length of time each type of record to be retained, and the applicable disposal action which may take the form of preservation in closed records room, transfer to the archives or destruction if it is deemed to be valueless upon the completion of the required retention period.

2.3.3 PROCUREMENT PROCEDURES AND PROCUREMENT PERFORMANCE

Procedures are operating instructions detailing functional duties or tasks. According to Saunders (1997), the division between public and private sectors creates two different worlds, requiring different approaches to procurement. Public ownership imposes obligations with regard to public accountability, leading to prescribed procedures and policies. All steps of the procurement cycle must be properly documented with each step being approved by the designated authority. Baily, Farmer, Jessop and Jones (2005) argued that public procurement procedures tend to be characterised by high levels of bureaucracy independent of order value; poor communications and focusing on unit price rather than long-term relations. Procurement perceptions are affected by the existing organisational structure, quality of internal communication system, past experience and resources available. A procurement policy may define the approval process for contracts of varying cost levels and may include role of purchasing, conduct of procurement staff, buyer-seller relationships, and operational issues. Without elaborate and effective procurement procedures Government policy objectives would fail to meet the desired objectives.

Lysons (2006) defined tendering as a purchasing procedure whereby potential suppliers are invited to make a firm and unequivocal offer of the price and terms, which on acceptance shall be the basis of the subsequent contract. Organisations need standard procurement procedures which cover all aspects of the procurement cycle, including supplier selection, contract negotiations, order placement and payment. These are used to control spending activity, ensure appropriate approvals are in place and reduce the risk of overpayment. An appropriate approval process involves a separation of tasks and the involvement of senior managers for transactions that cost more than a specific price for enhanced procurement performance.

Nicholas, Michael and Simone (2008), explored whether opportunities for fraud and corruption might be reduced or increased by rules governing public procurement. They focused on specific European legislation – Procurement Directive 2004/18 on the coordination of procedures for the award of contracts for public works, public supply and public services by public bodies within all EU Member States. They concluded that fraud risks in public procurement may be summarised in terms of insider-driven specifications, low visibility of procurement processes, and ample opportunities for renegotiation of terms. Risks may be increased by innovative procurement practices that have the effect of extending the manoeuvring between tenderers and public bodies, such as competitive dialogue. In Kenya, Part V of the PPDR provides for alternative procurement procedures as restricted tendering; direct procurement; request for proposal; request for quotations; low value procurement; and use of specially permitted procedures. This gives PEs room to meet needs in time during emergency, tragedy, limited sources or economic viability.

Burt *et al.* (2010) stated that every organisation develops procedures to enable its personnel implement policies and plans; designed to meet her objectives. In Kenya, Parliament prescribes a framework within which policies relating to public procurement and asset disposal shall be implemented and may provide for preferences or sanctions against contractors failing to perform according to professionally regulated procedures, contractual agreements or legislation or persons found guilty of corrupt practices. Parliament enacted the Public Procurement and Disposal Act (PPDA), 2005 and the operationalising Public Procurement and Disposal Regulations (PPDR), 2006. This law establishes procurement procedures for different methods of procurement with the aim of increasing public confidence, promoting local industry and stimulating economic development.

Jones and George (2009) postulated that bureaucratic control mechanism is control by a comprehensive system of formal rules and standard operating procedures (SOPs) that shapes and regulates the behaviour of divisions, functions and individuals. SOPs and rules allow employees to perform activities efficiently and effectively. Moncska, Handfield, Guinipero and Patterson (2010) held that the procurement function has a significant impact on corporate performance. Thus, traditional procedures are becoming obsolete in modern organisations. Procedures provide guidance that staffs follow in performing activities, put constraints on behaviour and show how the procurement function should work to achieve strategic objectives.

2.3.4 INFORMATION COMMUNICATIONS TECHNOLOGY AND PROCUREMENT PERFORMANCE

Saunders (1997) reckoned that personnel in procurement are, in a sense, information processors. They receive, analyse, make decisions and distribute information in order to manage the flow of goods and services in the SC. ICT is an enabler for information sharing which organisations in the procurement system can use for eliminating bloated inventory levels caused by cumulative effect of poor information cascading up through a SC. Daugherty, Myers and Autry (1999) averred that information integration is also a key component in many automatic replenishment programs (ARP). Initiatives such as vendor managed inventory (VMI) and collaborative planning, forecasting and replenishment (CPFR) are based on an increased level of automation in both the flow of physical materials, goods and associated information between companies to improve the efficiency in the entire system. It shortens information processing time and tremendously improves procurement performance.

Process integration can enhance procurement performance. ICT provides new ways to store, process, distribute and exchange key information with customers and suppliers in the entire procurement system. Simatupang and Sridharan (2005) emphasised that information is the glue that holds organisations together and can be used to integrate procurement process activities both within a process and across multiple processes. Information on demand, forecasting and replenishment is recognised as a central component in integration of planning and control. Internal integration focuses on cross-functional processes. Externally, focus is on relationships with outside customers and suppliers. A relationship can have various intensity levels ranging from lowest open-market negotiations, cooperation and coordination to the highest collaboration level. Collaboration in procurement is based on a high degree of trust, commitment and information-sharing. It requires linking performance systems with decision making, information sharing and incentive alignment in the SC.

Sriram and Stump (2004) reckoned that enterprise resource planning (ERP) systems are essential for supporting internal information sharing. Externally, inter-organisational information systems (IOIS) constituting automated information systems shared by various firms can be used to support information-sharing with customers and suppliers. ICT contributes to improved communications patterns, increased demand for coordination of joint activities and new organisational structures through its ability to store, transmit and process information and speed up inter-organisational activities. Organisations have huge amounts of raw procurement data but are poor at converting same into market knowledge. They should strive to find trends, patterns and connections in data in order to inform and improve competitive procurement performance.

Thomas and Rainer (2005) opined that procurement systems have long been supported by ICT. With the implementation of ERP systems in the 1990s, EDI connections with suppliers were established through automation of delivery schedules by linking user materials management system with supplier systems. ICT enables organisations to decentralise operational procurement processes and centralise strategic ones due to higher transparency. Prior to e-procurement, strategic procurement often dealt with routine tasks such as individual transactions. Strategic aspects were frequently neglected, with the buyer having little influence over the choice of suppliers and purchased products. Internet technologies facilitate faster and more efficient operational procurement processes enabling managers to concentrate on strategic tasks.

Christopher (2005) contended that there is a dimension to information that enables supply and demand to be matched in multiple markets, often with tailored products, in ever-shorter time frames. This enables suppliers to react in real-time to market changes. ICT serves as the connection between various stages of the system, allowing them to co-ordinate and maximise total supply profitability. It is crucial to the daily operation of each stage in the procurement process. Kim and Rogers (2005) asserted that studies have examined business-to-business (B2B) transactions on different operational performance dimensions such as inventory cost, cycle time, and manufacturer flexibility. Rapid growth of importance of ICT application is a testimony to its impact on improving procurement performance. This is achieved through Internet, Intranet and Extranet. However, organisations must make a trade-off between efficiency and responsiveness.

Bowersox, Closs and Cooper (2007) argued that ICT provides the means for collecting relevant demand data, developing a common database and providing a means for transmitting order information. It allows organisations to change the way they source supplies for smooth operations. Auto makers Ford Motor Company, DaimlerChrysler and General Motors have transacted their businesses on Internet since year 2000 and registered positive results. Based on expected procurement efficiencies, the firms' procurement and product development costs fell by 16%, a reduction that resulted in saving approximately US $ 1,000 per motor vehicle.

Chopra, Meindl, and Dhamram (2007) asserted that ICT provides a collaboration platform by allowing customers and suppliers to work together on product design using specialist ICT design tools. Value chain integration may be made possible if separate activities can be knitted together by faster and more reliable information flows. Integration allows customers to change their specification and delivery schedules themselves which then automatically reconfigures requirements back in the procurement system. ICT can allow managers and external stakeholders to bypass traditional gatekeepers who gained power

from their control of information. ICT-based systems can also create direct communication between the top and bottom of an organisation through use of in-house websites. This helps organisations reduce transaction and production costs and achieve operational efficiency.

Kenth and Vahid (2008) found that ICT drives e-markets to increase the availability of information about suppliers who are made available for each product and increase market interest for parties, reduce procurement costs and support paperless transactions. It enables users to buy at lower prices worldwide. Offers of companies on their websites enable customers to choose between a variety of products and retailers. Products can be customised before shopping and warehousing related costs reduced due to direct delivery. Dell and Amazon work this way. The global setting includes higher cultural distance and geographical complexity, lower behaviour transparency and social difficlties in bonding between procurement channel partners. Thus, ICT could be a more effective procurement performance coordination and control mechanism than personal face-to-face interaction in international exchange relationships.

2.3.5 STAFF QUALIFICATIONS AND PROCUREMENT PERFORMANCE

Saunders (1997) believed that successful functioning of organisational structures and effective operation of planning control systems is dependent on the quality and ability of staff employed. Strategic plans should include information on the acquisition, development, use and reward of human assets. Plans need to take into account the current state of development of the procurement function and the strategic direction in which its state might change. Multi-skilling provides employees with a variety of skills and should be developed extensively. Training is beneficial and generates more than the equivalent cost in payback. To further the goals of value-based management, all employees need broad and continuous education and training. Education, training and professional development should be skill, process oriented and continuous.

Leenders and Fearon (2002), noted that the large number of items, huge monetary volume involved, need for an audit trail, severe consequences of poor performance, and the potential contribution to effective organisational operations associated with the procurement function are five major reasons for developing a sound, professionally managed procurement system. They further argue that qualifications are crucial for value-based management which requires employees to assess and improve processes while contributing to team performance. In addition, qualifications enhance staff ability to perform, enabling them to make better decisions, work as a team, and adapt to change, while increasing efficiency, quality, productivity and job satisfaction. Training is often for improving immediate work while education develops people for the long term. To enable individuals to create value consistently, both education and training are needed.

Cousins (2003), stressed that with the ever increasing popularity of purchasing partnership philosophy, organisations must take a closer look at the educational levels of procurement staff. With procurement's perceived movement from a clerical service to a strategic business function, the calibre of staff in terms of training, education and skills must increase to fulfill its strategic potential. The author asserted that employees need to learn new skills for improving work performance. Procurement comprises a wide range of SC processes such as management of value analysis processes, supplier negotiations and quality certification; and supply market research as well as early supplier involvement in processes such as development of specifications and purchase of inbound transportation. This calls for higher professional skills for enhanced performance.

Baily *et al.* (2005) propounded that knowledge of the mission, the existence of top-down objectives with related performance measures, and process guidelines link individual or group performance to the firm's goals and expectations of upper management require good qualifications. The use of teams, cross-functional managers, broad process and linkage-oriented job responsibilities, and extensive information systems enable individuals to balance conflicting objectives and improve processes. Professional qualifications are the fulcrum around which performance turns. Without well-motivated, able and well trained staff, even the more brilliantly conceived plans and strategies can fail. A motivated team whose members work for and with each other can beat a team of less motivated people even if they are greater in talent. To improve procurement performance, it is essential to understand the roles that are to be performed, the standards to be achieved and how performance is evaluated.

Understanding is what allows an employee to become an innovator, initiative taker, and creative problem solver in addition to being a good performer on the job, (Goetsch & Davis, 2006). They list benefits of training as improved productivity, quality, safety and health, communication and better teamwork. The value-based procurement management paradigm requires a rethinking of the management of human resources. Education must cross necessary boundaries and motivate procurement team performance. However, simply possessing knowledge is less important than applying it. Attention should be moved to skills of doing jobs and demonstrating competences.

Noble (2011) argued that all chartered bodies such as the Chartered Institute of Purchasing and Supply (CIPS) are set up for the benefit of the public, because that is what professionalism is all about. It is both recognition and an expectation that professionals, through their expertise and commitment have a beneficial impact on society and corporate life. It is about promoting best-in-class procurement in organisations, whether responsible management of environment or helping out to stamp out corruption. Meanwhile, according to Maude (2011), many procurement professionals across government lack capability and market knowledge; and process-driven.

2.4 CRITIQUE OF THE EXISTING LITERATURE RELEVANT TO THE STUDY

Existing literature has found colossal constraints in the public procurement system. For instance, Amayi (2011), in his study found that procurement operations require better performance control system. He asserted that a records management system that an organisation adopts has effects on its procurement operations. The researcher concluded that without ethics the performance of procurement operations would be negatively affected and pointed out that existing legal framework was an impediment to the performance of operations in the public procurement. He further concluded that integrated ICT systems organise and disclose enormous amounts of information about the workings of the total system. While appreciating his findings, this study notes that the researcher did not employ the personal observation tool so as to gather data especially on ethics and integrity. Analysis of factors such as core technical skills and application of ICT in procurement management are important to overcome some of the constraints.

Kirungu (2002) in his study found that inefficiency in the supply chain (SC) was caused by bureaucratic procurement and disposal procedures, irrational supply base, adversarial customer-supplier relationships, and traditional storage operations. He recommended that Kenyatta National Hospital (KNH) procurement procedures be exempted from the Public Procurement Regulations, rationalisation of the supply base, and partnership sourcing. This study concurs with his findings pertaining to supply base rationalisation and relationships but wishes to point out that the research instruments used were limited to an interview and observations. No questionnaires were administered which could have given adequate data for analysis. It was further noted that senior managers were not interviewed and he failed to employ records analysis method. This study does not support the recommendation that KNH procurement procedures be de-linked from public procurement legal framework because with appropriate staff and technology, performance in the entire public sector procurement system can be improved.

Maina (2011) in his study found that weak oversight and enforcement, non-transparent practices, lack of effective links between procurement and financial management, poor record management and filing system, and delays and inefficiencies on the implementation of the PPDA as factors influencing the implementation of the procurement law in Kenya, the case of Ministry of Education. The study concluded inefficiencies in procurement led to increased procurement costs, causing longer cycle times, lower quality purchasing decisions within the ministry. While appreciating his findings, this study does not support findings that poor record management system alone impedes performance. Ethical issues should also be put into perspective. Indeed, performance can still be improved if ICT is employed with modern control mechanisms. This study agrees with his recommendation that all stakeholders need to be sensitized on the good of embracing financial and procurement reforms.

2.5 EMPIRICAL REVIEW

Rebecca (2007) sought to pursue the understanding of current business-to-business e-procurement practices by describing the success factors and challenges to its implementation in the corporate setting. The study through factor analysis resulted in three e-procurement success factors: supplier and contract management; end-user behaviour and e-procurement business processes; and information and e-procurement infrastructure. Three challenge-to-implementation factors also emerged: lack of system integration and standardisation issues; immaturity of e-procurement-based market services and end-user resistance; and maverick buying and difficulty in integrating e-commerce with other systems.

Gordon (2009) sought to establish perceived local government (LG) procurement best practice. Secondary research was then drawn upon to establish LG procurement's response to the economic recession. The study was set within the context of English LG. Its contribution is in highlighting that perceived best public procurement practice may well, in the short-term, be inappropriate and perhaps delay economic recovery. Suggestions for more radical short-term procurement strategic interventions were set out and justified as accelerating the economic recovery. The suggestions were considered appropriate, not only for the crisis, but also for future economic downturns or indeed any country facing such a situation. The analysis suggested that British LG procurement strategy generally remain unaltered from that adopted prior to the

economic recession. It is then argued that current best practice may well hinder an economic recovery and a short-term shift in procurement strategy is required.

Financial benefits can accrue from outsourcing procurement in the literature. Raising purchasing process compliance from 60% to 95% can reduce a firm's cost of goods sold by 4% and procurement outsourcing across the board can reduce costs of service and materials by up to 15% (Favre *et al.*, 2004). A slow changeover may be more costly, and it is believed that an expeditious approach may ensure benefits are delivered more rapidly, but the rate at which a firm is able to transition is dependent on organisational culture (John, 2003).

A noted benefit derived from outsourcing purchasing is the imposed behavioural and process discipline which the provider brings (John, 2003). Process discipline could and should be imposed in-house, but in reality this is often very difficult to enforce. Without process discipline it is difficult to track costs. Many smaller firms run into trouble because they simply do not know their true costs (Morgan, 1995) and we believe true cost to be even more difficult to calculate for larger firms who do not have rigorous processes. Outsourcing thus provides a methodology to control and measure costs more accurately. Great care needs to be taken when setting out the value expected to be gained from engaging a service provider and the method in which this value is measured and communicated in terms of quantified and realised benefits.

2.6 SUMMARY OF LITERATURE REVIEW

It is evident that procurement performance requires input from all key stakeholders for holistic win-win situations. Government has provided the legal framework for practice. Equally, sound RMS is a vital aspect of ensuring transparency, accountability and responsibility in the procurement process. Procurement procedures should be designed to ensure transparency, economy and effectiveness. Staff qualifications can enhance staff ability to perform. There is a link between procurement process, efficiency, effectiveness and performance.

2.7 RESEARCH GAPS

In recent years, there has been increasing amount of research on constraints to business relationships and performance. This issue has been raised in literature on marketing, procurenment, information systems and strategy. However, there is still fragmented evidence on how procurement systems operate, especially between public sector PEs and their suppliers. From the PPDR, it is unclear whether procurement procedures favour small suppliers in their relationship with PEs or put them at a disadvantage. More investigations in this field are needed to better understand how procurement performance can impact on the competitive capabilities of PEs and the wider SC. Therefore, this demonstrates that there is still room to study which other factors influence procurement performance.

The inefficiencies of traditional public procurement system include a chain of non-value-adding clerical activities and excessive documentation. Thus there is a gap on the effect of poor record management which gives a lee way for malpractices. This gap can be filled by enhancing the adoption of e-procurement that simplifies the end-to-end SC modules. This study is expected to fill the gap between inefficiencies of traditional procurement systems and aspirations of PEs to integrate applications seamlessly and exchange information with trading partners.

3 METHODOLOGY

3.1 INTRODUCTION

This chapter comprises the research design, target population, sampling frame, sample and sampling technique, instruments, data collection procedure, pilot-test, data processing and analysis design and presentation.

3.2 RESEARCH DESIGN

Research design facilitates study efficiency, yielding maximal information. This study used descriptive design. This design was appropriate because it gave an opportunity for one aspect of a problem to be studied in-depth with minimal expenditure of effort, time and money. It is a scientific method of investigation whereby data is collected and analysed in order to describe the current conditions, terms or relationships concerning a problem (Kothari, 2005). The aim is to assess factors influencing procurement performance in the Kenyan public sector: case study of the SLO. Kombo and Tromp (2006), asserted

that descriptive survey is a method of collecting information by interviewing or administering a questionnaire to a sample of individuals.

3.3 TARGET POPULATION

Target population is that set of elements that the researcher focuses upon and to which results obtained by testing the sample should be generalised (Orodho, 2005). This study targeted the SLO, comprising 7 departments with 600 members of staff at the headquarters due to centralisation of all procurement activities at the head office. Mugenda and Mugenda (2003) explained that the target population should have some observable characteristics, to which the researcher intends to generalise the results of the study. This definition assumes that the population is not homogeneous. Population per department is as shown in the table 3.1 below:

Table 3.1: Target Population per Department

Department	Population
Administration and Finance	150
Registrar-General	130
Administrator-General	108
Civil Litigation	67
Legislative Drafting	50
Advocates Complaints Commission	50
Treaties and Agreements	45
Total	**600**

Source: Survey Data

3.4 SAMPLING FRAME

The sampling frame describes the list of all population units from which the sample was selected (Cooper and Schindler, 2003). This study targets a sample size of 60 respondents that represents 10% of target population. Mugenda and Mugenda (2003), contended that in descriptive studies, a sample of 10% of the population is recommended as a good representation. Ogachi (2011) argued that the use of a reasonable sample is appropriate because it is quick, inexpensive, efficient and accurate means of assessing information about the population. Thus 10% is representative for data for analysis.

Table 3.2: Target Population, Sample and Sample Proportions

Department	Population	Sample	Proportion
Administration and Finance	150	15	10
Registrar-General	130	13	10
Administrator-General	108	11	10
Civil Litigation	67	6	10
Legislative Drafting	50	5	10
Advocates Complaints Commission	50	5	10
Treaties and Agreements	45	5	10
Total	**600**	**60**	**10**

Source: Survey Data

3.5 SAMPLE AND SAMPLING TECHNIQUES

The study employed stratified sampling` method in determining who to administer questionnaire to so as to obtain a representative sample. This is because the population under study was heterogenous; does not constitute a homogeneous group. From the above population of six hundred, a sample of 10% from within each group in proportions that each group bears to the population as a whole was taken using stratified random sampling which gave each item in the population an equal probability chance of being selected. According to Kothari (2005), a representative sample is one which is at least 10% of the population is considered as representative. Stratified random sampling technique is used when population of interest is not homogeneous and can be subdivided into groups or strata to obtain a representative sample.

Sampling Population Proportion into Size (SPPS) was used because the 7 strata did not have equal population. The first procedure was to stratify the population into 7 non-overlapping strata. Sample items were selected from each stratum. To ensure fairness in data collection, departments formed basis for sample determination. Each department formed a stratum while sections under them formed sub-strata. Random sampling was applied in each. The total sample size for the study was 60 respondents.

3.6 INSTRUMENTS

The study used self-administered questionnaires and observation schedules.

A questionnaire is a research instrument that gathers data over a large sample and is one way to elicit self-values (Kombo, 2006). The questionnaires had both closed and open-ended questions. Likert scale of measurement was used. A questionnaire is a research instrument consisting of a series of questions and other prompts for the purpose of gathering information from respondents.

The study considered questionnaires which have advantages over other types of research instruments. They are relatively cheaper, do not require as much effort from the questioner as verbal or telephone surveys, and often have standardised answers that make it simple to compile data. The questionnaire designed in this study comprised of two sections. The first part included the demographic and operational characteristics designed to determine fundamental issues including the demographic characteristics of the respondent. The second part was devoted to the identification of the factors influencing implementation of the 2005 procurement act in the SLO where the variables of the study were put into focus.

The questionnaire was designed to include both structured and unstructured questions. The structured questions were used in an effort to conserve time and money as well as to facilitate an easier analysis as they are in immediate usable form while the unstructured questions were used so as to encourage the respondent to give an in-depth response without feeling held back in revealing of any information.

3.6.1 DATA COLLECTION PROCEDURES

This study utilised both primary and secondary data. Questionnaires, personal interviews, and personal observation techniques were used to collect primary data. Sixty copies of questionnaires were administered to all the seven departments/strata directly affected by the procurement function at the State Law Office as shown in table 3.2. By observation method, data was collected by own observation without interviewing respondents. Data collected related to what was currently happening and not complicated by past behaviour or future intentions or attitudes of respondents. It was suitable in studies small samples are concerned.

The respondents were assured of confidentiality of their names and responses and that the responses would not be handled by any other person but rather was to be used purely for academic purposes. Each questionnaire was coded and only the researcher got to know which person responded. The coding technique was only used for the purpose of matching returned completed questionnaires with those delivered to the respondents.

3.7 PILOT TEST

Before the actual study, it was crucial to conduct a pilot study. Robson (1993) argued that piloting provides opportunity for researchers to test their confidence in identifying shortcomings that may affect the actual collection of useful data. The pilot study evaluates the effectiveness and validity of the instruments. The purpose is not to collect data but to refine the process and instrument. It provides an opportunity to detect and remedy potential problems such as questions that respondents don't understand; questions that combine two or more issues in a single question (double-barreled questions); and questions that make respondents uncomfortable.

3.8 DATA PROCESSING AND ANALYSIS

Before processing the responses, the completed questionnaires were edited for completeness and consistency.

3.8.1 DATA PROCESSING

The study used quantitative and qualitative data analysis techniques. Kombo and Tromp (2006) reckoned that quantitative data analysis consists of measuring numerical values from which descriptions such as mean and standard deviations are made. The first step towards this process was to edit the data. A thorough data cleaning was undertaken. This helped save time in the final analysis of data from the field.

After editing data, the latter was coded for easier classification and writing of the final report. Data with the same information was given a compatible alpha-numeric code. After coding and classifying data, the researcher tabulated the results of the findings for the purposes of comparison and counter-checking the related information for more realistic reporting. Quantitative data was analyzed using the Statistical Packages for Social Sciences (SPSS). The Likert Five Point rating scale of 5, 4, 3, 2, and 1, and were used to analyzed responses. Bar graphs, charts, frequency distribution tables, and percentages were used to present the information. Qualitative data was analyzed using STATA software and findings presented thematically. Key findings and major recommendations are based on the research objectives.

3.8.2 DATA PRESENTATION

Tables were used to present responses and facilitate comparison. Cooper and Schindler (2003) noted that the use of percentages is important for two reasons; first they simplify data by reducing all the numbers to range between 0 and 100. Second, they translate the data into standard form with a base of 100 for relative comparisons. This generated quantitative reports through tabulations, percentages, and measure of central tendency.

Table 3.3: Data Processing and Analysis

No	Research Questions	Independent Variables	Dependent Variable	Method
1	To what extent does records management system affect procurement performance at the State Law Office in Kenya?	Records Management Systems	Procurement Performance	Percentage and Frequency
2	How do procurement procedures affect procurement performance at the State Law Office in Kenya?	Procurement Procedures	Procurement Performance	Percentage and Frequency
3	How does information communications technology impact procurement performance in the State Law Office in Kenya?	Information Communications Technology	Procurement Performance	Percentage and Frequency
4	Which impact does staff qualifications have on procurement performance at the State Law Office in Kenya?	Staff Qualifications	Procurement Performance	Percentage and Frequency

4 FINDINGS AND CONCLUSIONS

4.1 INTRODUCTION

This chapter is presents analysis done in relation to the study objectives and research questions. The first part deals with descriptive analysis of the responses while the second part is devoted to inferential statistics. Sixty questionnaires were issued to the study participants out of whom 49 were received back representing an 82% response rate. Falconer and Hodgett (1999) state that, “even in a survey which is perfectly targeted to its sample, about 42% to 58% response rate is the maximum that is likely to be achieved.” Hagger *et al.,* (2003) proposes that a researcher should strive to achieve a response rate of 50 percent, 60 percent or 75 percent.

4.2 DEMOGRAPHIC INFORMATION

The researcher used four demographic items in the questionnaire; sex, age, job group, work experience, and educational qualification. The respondent’s responses are as below.

4.2.1 RESPONDENTS' SEX

Table 4.1 shows that majority of the respondents were female comprising 63.3percent while females were 36.76 percent implying that more females than males volunteered to participate in the study. Notably males are employed that the SLO than females.

Table 4.1: Sex of Respondent

		Frequency	Percent	Valid Percent	Cumulative Percent
	Male	18	36.7	36.7	36.7
	Female	31	63.3	63.3	100.0
	Total	49	100.0	100.0	

4.2.2 RESPONDENT'S AGE

Table 4.2 shows that most respondents in the age group 45-54 comprised 54.3 percent followed by age bracket of 25-44 years with 34.8 percent and the age bracket above 54 years with 10.9 percent. This gave the implication that the majority were able with adequate experience in matters of procurement in the public sector.

Table 4.2: Age (Years)

		Frequency	Percent	Valid Percent	Cumulative Percent
	25 – 34	8	16.3	17.4	17.4
	35 – 44	8	16.3	17.4	34.8
	45 – 54	25	51.0	54.3	89.1
	55 – 60	5	10.2	10.9	100.0
	Total	46	93.9	100.0	
Missing	System	3	6.1		
Total		49	100.0		

4.2.3 JOB GROUP

Table 4.3 shows that most respondents were in the job group K and above, comprising the professional and management level cadres. This gave the implication that the majority were able with enough professional authority to direct key decisions regarding matters of procurement in the public sector.

Table 4.3: Job Group

	Frequency	Percent
D – J	9	18%
K – N	21	43%
P - R	17	35%
S	2	4%
Total	49	100%

4.2.4 RESPONDENTS' EDUCATIONAL QUALIFICATIONS

Table 4.4 below shows that the level of education was as follows; 4.1 had secondary education, 34.7 percent of the respondents were college diploma holders while majority of the respondents were degree holders 61.3 percent with 42.9 percent being post graduates while 18.4 percent were holding undergraduate qualification. This implied that most persons had attained a level sufficient to influence favorably their comprehension of antecedents to effective management of the procurement function.

Table 4.4 Respondent's Educational Qualifications

	Frequency	Percent
Secondary	2	4.1
College	17	34.7
Undergraduate	9	18.4
Graduate	21	42.9
Total	49	100.0

4.2.5 RESPONDENT'S DESIGNATION

The findings in table 4.5 show that 18.4% of the respondents were heads of Departments, 32.7% were supervisors, while lower level staff cadres comprised 49 percent. It emerges thus that a sizeable percentage of 51% were management staff (heads of departments and supervisors). This gave the implication that the majority were able with adequate designation authority to direct key decisions regarding matters of procurement in the public sector.

Table 4.5: Indicate your Designation

	Frequency	Percent
Head of Department	9	18.4
Supervisor	16	32.7
Lower level	24	49.0
Total	49	100.0

4.3 PROCUREMENT PERFORMANCE AND ITS DIMENSIONS AT THE STATE LAW OFFICE

In order to measure procurement performance at the SLO, factor analysis was conducted on the questions regarding procurement key performance indicators (KPIs) and a procurement performnace index generated. In addition different indices (records management system, procurement procedures, ICT, staffing) were derived for each of the independent variables using factor analysis of the corresponding questions in the questionnaire. These results are presented below:

Table 4.6: Indices

Variable	n	Median	Std. Dev.	Min	Max
Procurement Performance Index	46	1.48e-09	1.26	-1.79	3.54
Records Management Index	48	-1.47e-08	1.09	-2.07	2.60
Procurement Procedures Index	46	-2.27e-09	1.18	-1.75	2.75
ICT Index	48	-3.26e-09	1.14	-1.43	3.97
Procurement Staffing Index	48	-1.71e-09	1.21	-2.00	2.61

The results as hown in table 4.6 indicate that the SLO is performing on the ngative in all the five determinants of public procurement performance as they all recorded negative indices. On the overall, the procurement performance is positive but very low (a median index of 1.48e-09). The implication of these findings is that the SLO must not remain complacence in reforming the public procurement function. Kernel density functions of the indices are presented in fig. 4.1, all showing non-normal distributions.

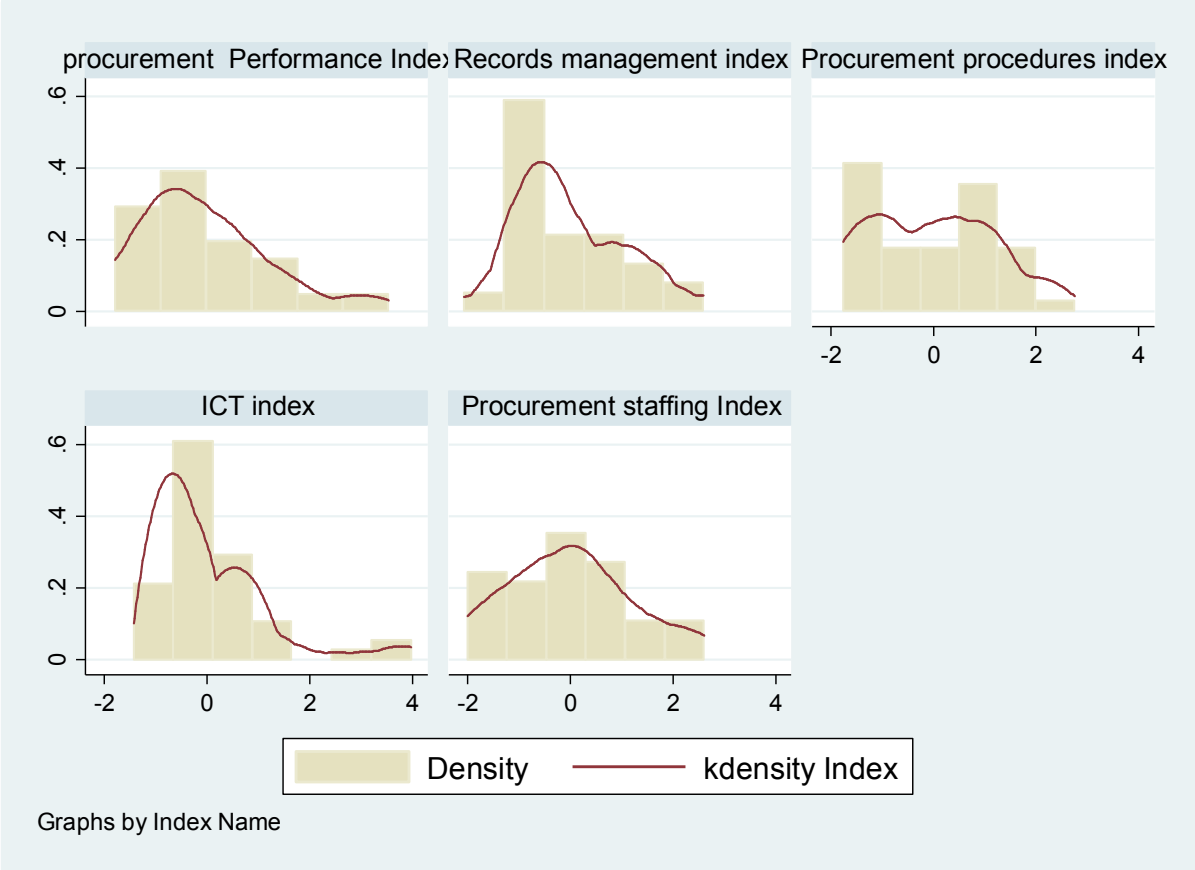

Figure 4.1: Histogram and kernel density distributions of indices

The next subsections are aimed at exploring the specific indicators explaining the trends in each of the independent variables studied.

4.3.1 PROCUREMENT PERFORMANCE

Results presented in table 4.7 indicates that factor 1 accounted for 31 percent in the variance in procurement performance. The first factor was used to determine the factor loadings (contributions) for each of the dimensions that were used to measure procurement performance. The results (factor loading of 0.67-0.79) indicate that that procurement life cycle/ time taken from beginning of a sourcing process to time contract is signed as well as the quality of employees at SLO were the main dimensions enhancing positive procurement performance. On the other hand, poor staff safety, low levels in soliciting ideas from suppliers resulted in negative procurement performance. The role of the other dimensions were minimal.

Table 4.7: Factor Rotation and Scoring Coefficients for Procurement Performance

Factor analysis/correlation — Number of obs = 46
Method: principal factors — Retained factors = 6
Rotation: orthogonal varimax (Kaiser off) — Number of params = 51

Factor	Variance	Difference	Proportion	Cumulative
Factor1	1.29565	0.15050	0.3128	0.3128
Factor2	1.14515	0.25330	0.2764	0.5892
Factor3	0.89185	0.19436	0.2153	0.8045
Factor4	0.69749	0.00602	0.1684	0.9729
Factor5	0.69147	0.43599	0.1669	1.1398
Factor6	0.25548	.	0.0617	1.2015

LR test: independent vs. saturated: chi2(55) = 107.88 Prob>chi2 = 0.0000

Variable	Factor 1	Factor 2	Factor 3	Factor4	Factor5	Factor6
Q 6	-0.15455	-0.01113	0.29693	0.16875	-0.34401	-0.91005
Q8A	0.06880	-0.02467	0.87830	0.08480	0.01607	0.79978
Q8B	0.67001	0.34261	-0.01780	-0.21789	-0.18056	0.51639
Q8C	0.01059	0.06107	0.21533	1.08770	-0.11631	0.14569
Q8D	-0.11479	-0.01931	0.23065	0.25986	0.07348	1.34083
Q8E	0.06203	0.24282	0.25912	0.13335	0.59813	-0.05043
Q8F	0.06077	-0.15398	-0.18438	-0.22604	0.88142	0.49587
Q8G	0.79201	0.17970	-0.04112	0.37502	0.42517	-0.34747
Q8H	0.23449	0.73652	0.04036	-0.19824	-0.25206	-0.30475
Q8I	0.19367	0.75817	0.12080	0.32977	0.32097	0.11527
Q8J	-0.10966	0.16626	0.63477	0.15094	0.09676	-0.69602

4.3.2 RECORDS MANAGEMENT SYSTEMS

Results presented in table 4.8show that the first factor accounted for 87 percent in the variation of records management systems index. The first factor was used to determine the factor loadings (contributions) for each of the dimensions that were used to assess the state of records management systems. The results (factor loading of 0.32-0.71) indicate that while the SLO has recognized that maintaining good, efficient, effective and user-friendly procurement records systems promotes good working interfaces with key stakeholders in the supply chain, records management should be accorded high organisational status (negative factor loading). This is more discernible as records storage space remains a challenge at the SLO.

Table 4.8: Factor Rotation and Scoring Coefficients for Records Management Systems

Factor analysis/correlation — Number of obs = 48
Method: principal factors — Retained factors = 4
Rotation: (unrotated) — Number of params = 26

Factor	Eigenvalue	Difference	Proportion	Cumulative
Factor 1	4.55209	3.79430	0.8674	0.8674
Factor 2	0.75779	0.42837	0.1444	1.0118
Factor 3	0.32942	0.32573	0.0628	1.0746
Factor 4	0.00369	0.02267	0.0007	1.0753
Factor 5	-0.01898	0.06413	-0.0036	1.0717
Factor6	-0.08311	0.01655	-0.0158	1.0558
Factor 7	-0.09966	0.09369	-0.0190	1.0368
Factor 8	-0.19334	.	-0.0368	1.0000

LR test: independent vs. saturated: chi2(28) = 260.90 Prob>chi2 = 0.0000

Variable	Factor1	Factor 2	Factor 3	Factor4
Q10a	0.32780	-0.05999	-0.30954	7.42023
Q10b	0.71077	-0.15720	-0.32682	-1.0e+01
Q10c	-0.01868	-0.47972	1.10036	-1.10799
Q10d	-0.01329	-0.07019	0.42333	9.55306
Q10e	0.31746	0.14860	-0.57185	-3.15137
Q10f	0.01410	0.70611	-0.63278	4.35640
Q10g	-0.22666	0.11075	0.63477	-4.04375
Q10h	-0.26922	0.79862	0.06514	-2.26480

4.3.3 PROCUREMENT PROCEDURES

The findings of the factor analysis presented in table 4.9 show that the first factor accounted for 72 percent in the variation of procurement procedures index. The first factor was thus used to determine the factor loadings (contributions) for each of the dimensions that were used in the quationniare to assess the state of procurement procedures at the SLO. The findings indicate that the variables with the highest positing loading are; low PPOA compliance enforcing capacity and the use of open tendering as the most preferred method of procurement at SLO. The implication of these results is that though they seem positive in fast-tracking and facilitating life cycle time in procurement process, the attendant weakness are subject to abuse by different stakeholders. The overall net effect in this case may not result in positive procurement performance. Results also indicate that the existing procurement procedures need review.

Table 4.9: Factor Rotation and Scoring Coefficients for Procurement Procedures

Factor analysis/correlation — Number of obs = 46
Method: principal factors — Retained factors = 4
Rotation: orthogonal varimax (Kaiser off) — Number of params = 26

Factor	Variance	Difference	Proportion	Cumulative
Factor 1	2.06594	1.19869	0.7150	0.7150
Factor 2	0.86725	0.29901	0.3002	1.0152
Factor 3	0.56824	0.55693	0.1967	1.2119
Factor 4	0.01131	.	0.0039	1.2158

LR test: independent vs. saturated: chi2(28) = 97.21 Prob>chi2 = 0.0000

Variable	Factor1	Factor 2	Factor 3	Factor 4
Q12b	-0.09928	0.73934	-0.00557	0.59877
Q12c	-0.04386	0.58561	-0.16183	-1.14259
Q12d	0.13024	0.19635	-0.23449	4.79205
Q12e	0.82066	-0.26942	-0.61866	-4.46271
Q12f	0.49879	-0.22522	-0.43158	3.38348
Q12g	-0.16985	-0.01977	0.62670	5.58768
Q12h	-0.10420	-0.23856	1.08618	-1.29675
Q12i	-0.13673	0.55716	0.92327	-4.25825

4.3.4 INFORMATION COMMUNICATIONS TECHNOLOGY

The results form the factor analysis as shown in table 4.10 show that the first loading factor accounted for about 52% in in the variation of ICT for the procurement function. The first factor was thus used to determine the factor loadings (contributions) for each of the dimensions that were asked in the study questionnaire in order to evaluate the state of ICT for procurement at the SLO. Staff were of the stong view that use of ICT enables systems integration, promotes transparency, accountability and reliability in addition to enhancing relationship management. It is also evidenced from the factor loadings that staff are yet to benefit from attendant ICT use and adoption: achieving the paradigm shift into ICT enabled new frontiers of knowledge as well total automation and streamlining of procurement functions is yet to be realized.

Table 4.10: Factor Rotation and Scoring Coefficients for ICT

Factor analysis/correlation — Number of obs = 48
Method: principal factors — Retained factors = 3
Rotation: orthogonal varimax (Kaiser off) — Number of params = 15

Factor	Variance	Difference	Proportion	Cumulative
Factor 1	1.91987	0.01824	0.5157	0.5157
Factor 2	1.90164	1.65869	0.5108	1.0265

LR test: independent vs. saturated: chi2 (15) = 168.95 Prob>chi2 = 0.0000

Variable	Factor 1	Factor 2	Factor 3
Q15A	-0.13239	-0.02968	1.07863
Q15B	-0.27791	0.80849	-0.73811
Q15C	0.06001	0.73963	-1.71538
Q15D	-0.17629	0.11738	1.59185
Q15E	0.58551	-0.15088	-0.98378
Q15F	0.76916	-0.55758	1.12184

4.3.5 PROCUREMENT STAFF QUALIFICATIONS

Table 4.9 presents the analysis findings on procurement qualifications at he SLO. The first explained 52 percent in the variation of Procurement Qualifications. The factor loadings (contributions) for this variable was based on the first factor. The findings indicate that SLO practices staff promotion system that is accords first priority to internally qualified staff. This has enabled many procurement professionals to progressively go up career ladder.

Table 4.11: Factor Rotation and Scoring Coefficients for Procurement Staff Qualifications

Factor analysis/correlation — Number of obs = 48
Method: principal factors — Retained factors = 5
Rotation: orthogonal varimax (Kaiser off) — Number of params = 35

Factor	Variance	Difference	Proportion	Cumulative
Factor 1	1.99196	0.17871	0.5186	0.5186
Factor 2	1.81325	1.45525	0.4721	0.9907
Factor 3	0.35801	0.05855	0.0932	1.0839
Factor 4	0.29946	0.18228	0.0780	1.1618
Factor 5	0.11718	.	0.0305	1.1924

LR test: independent vs. saturated: chi2(36) = 135.77 Prob>chi2 = 0.0000

Variable	Factor 1	Factor 2	Factor 3	Factor4	Factor5
Q 19A	-0.07655	0.45447	-0.49686	1.04783	-0.31461
Q 19B	-0.28665	0.54566	0.40758	-0.04774	-0.39555
Q 19C	0.11015	0.02924	-0.09445	-0.88623	-0.75452
Q 19D	0.16714	0.04616	-0.64921	0.22294	1.77755
Q 19E	0.18224	-0.02252	-0.01846	1.23311	-0.19868
Q 19F	0.62711	-0.07709	-1.25312	0.27375	-1.43302
Q 19G	0.67120	-0.21604	0.13322	-0.65489	2.09352
Q 19H	-0.04790	0.43241	0.36649	-0.44630	1.13848
Q 19I	-0.13372	0.04092	1.54556	-0.14954	0.07814

4.4 RELATIONSHIP BETWEEN PUBLIC PROCUREMENT PERFORMANCE AND INDEPENDENT VARIABLES

The next section provides the empirical analysis on the relationship between procurement performance and its drivers. This has been achieved through OLS regression with robust parameters. The nature and magnitude of the relationship is represented by corresponding correlation and regression coefficients for each of the independent variables shown in tables 4.9 and 4.10. The co-efficient of co-relation values between the variable of procurement performance and independent variables ranges from 0.12 to 0.47 and are all positive. Notable, it is only the relationship between record management systems and procurement performance that is significant 5 percent level of confidence. The coefficients indicate that there is a positive relationship between procurement performance and its determinants.

Table 4.12: correlation coeffients between procurement perfomance and its determinants

	Correlation coefficient
Record mgt Systems	**0.47****
Procurement Procedures	**0.37**
ICT	**0.17**
Procurement Staff Qualifications	**0.12**

**** significant at 5% level**

Under this sub-section, the researcher is interested in finding out the impact of record management systems, procurement procedures, ICT and procurement staff qualifications on procurement performance. Thus the following equations are formulated to find out the significant effect of independent variables on dependent variable. Hence the regression equation is:

$Y = a + b1x1 + b2x2 + b3x3 + b4x4$

Y = Procurement Performance (Dependent Variable)

X = [x1, x2, x3, x4] represents a vector of Independent Variables where x1 = Record Management Systems, x2 = Procurement Procedures, x3 = ICT and x4 = Procurement Staff Qualifications.

Table 4.13 shows that the four factors studies contributes significantly (at 10% confidence level) to procurement performance at the SLO at 31%. The remaining 69% can be contributed by other factors that have not been studied in the current research.

Table 4.13: OLS Regression Results

Linear regression — Number of obs = 42
F(4, 37) = 2.90
Prob > F = 0.0349
R-squared = 0.3062
Root MSE = 1.1134

Procurement Perf._Index	Coeff.	Std. Err.	t	P>t	[95% Conf.	Interval]
Records Mgt Sys._Index	.4702398	.1826581	2.57	0.014	.1001393	.8403403
Procurement Proc._Index	.2755352	.1584545	1.74	0.090	-.0455242	.5965946
ICT_Index	.1181281	.1012884	1.17	0.251	-.0871017	.3233579
Procurement Qualification Index	.1951088	.1931556	1.01	0.319	-.1962616	.5864791
Constant	.0007176	.1832465	0.00	0.997	-.3705751	.3720102

Hence the variable considered for this study that highly and significantly influenced public procurement performance level at the SLO office is records management systems. Therefore, the under mentioned regression equation is formulated:

$$Y = 0.0007 + 0.47x1 + 0.28x2 + 0.11x3 + 0.20x4$$

In this equation, if efficiency in record management systems (RMS) increases by 1 unit, the overall procurement performance increases by 0.47; all other factors kept constant. Overall records management is the most significant driver in procurement performance followed by procurement procedures, procurement staff qualifications and ICT in that order. The sequence is a pointer to the varying levels in terms of the current state of each factor studied. The most significant factor (RMS) is where the SLO has recorded significant streamlining milestones while the least factor (ICT) represents the area with the lowest performance. The results confirm the outcome of the factor analysis that found out that the the SLO has recognized that maintaining good, efficient, effective and user-friendly procurement records systems promotes good working interfaces with key stakeholders in the supply chain. Notable, the procurement systems have not been streamlined and automated at the SLO.

4.5 SUMMARY OF FINDINGS

The preceding chapters have so far presented the aim, objectives and the problem statement of the study, a review of literature on internal audit performance, the research methodology employed and analysis of the data. This chapter presents a summary of the findings, conclusions and recommendations made to help improve the performance of public procurement in the SLO & and other state departments in Kenya based on the objectives of the study. The chapter concludes with recommended areas for further research work.

The summary of the findings of the study was based on the objectives of the study. Based on the analyses of information presented above, the following findings were noted:

4.5.1 RECORDS MANAGEMENT SYSTEMS

The SLO recorded significant streamlining milestones in records management. It recognised that effective procurement records systems promote working interfaces with key stakeholders in the supply chain. Records storage space inadequacy was a challenge at the SLO.

4.5.2 PROCUREMENT PROCEDURES

Management of procurement life cycle at SLO was the main dimension enhancing positive procurement performance. There was low PPOA compliance enforcing capacity and the use of open tendering as the most preferred method of procurement at SLO. The implication of these results is that though they seem positive in fast-tracking and facilitating life cycle time in procurement process, the attendant weakness are subject to abuse by different stakeholders. The overall net effect was negative procurement performance.

4.5.3 INFORMATION COMMUNICATIONS TECHNOLOGY

Procurement systems were still largely manual, neither streamlined nor automated. This resulted in efficiency and losses. ICT enables systems integration, promotes transparency, accountability, reliability and enhancement of relationship management. Staff members are yet to benefit from attendant ICT use and adoption.

4.5.4 STAFF QUALIFICATIONS

SLO practices staff promotion system that is accords first priority to internally qualified staff. This has enabled many procurement professionals to progressively go up career ladder. Majority of the respondents were qualified for effective management of the procurement function. Further findings on years of experience indicated that officers participating in the procurement function in the SLO had long working experience.

In summary, majority of the respondents were in consonance on the importance of all the factors studied on the public procurement performance. The results of the current study were in tandem with past studies in the subject area.

4.6 CONCLUSIONS

This study concluded that the SLO was performing on the negative in all the five determinants of public procurement performance studied as they all recorded negative mean scores. Overall records management was the most significant driver in procurement performance followed by procurement procedures, procurement staff qualifications and ICT; in that order.

Based on the summary of findings, the following conclusions were made: having motivated and well qualified staff and effective records management systems are crucial for enhanced public procurement performance. On the other hand, failure to automate procurement systems and non-adoption of ICT systems impacted negatively on procurement performance.

4.7 RECOMMENDATIONS

In view of the research findings and taking cognizance of the need to accelerate ongoing reforms in procurement, the following recommendations are preferred.

To ensure enhance procurement performance records management should be accorded high organisational status. Digitization of all procurement records and networking with key players in the supply chain shall be of great value.

The SLO should also deepen reforms in the procurement with a view of streamlining processes as well as automating activities and back office operations. The existing procurement procedures need review with stakeholder involvement. The organization structure in which procurement function was embedded need be reformed to be more flatter in order to scale down bureaucracy and red-tape in the procurement process. Realignment of procurement processes with key performance indicators such as performance contracts and service charter will enhance service delivery at SLO is further recommended.

Achieving the paradigm shift into ICT shall enable new frontiers of knowledge as well total automation and streamlining of procurement functions is yet to be realized. Procurement is a skilled profession that requires well trained people. The appropriate authorities need to ensure that procurement function is managed by qualified staff to ensure performance. Further research on other factors such as leadership, ethics, integrity and governance is recommended.

4.8 SUGGESTED AREAS FOR FURTHER RESEARCH

The scope of this research was broad and attempted to assess the performance of the public procurement in the SLO. The study was limited to the SLO, and the findings cannot be equally generalised to apply to the private sector entities and other government organisations too. In connection to this limitation, it is possible to carry out further research how the issues look like in other sectors. The current study found that the variables considered; records management systems, procurement procedures, ICT, and staff qualifications accounted for 31% variability in public procurement performance; implying that the 69% could be due to other factors beyond the scope of the current study. Further research is recommended on factors such as leadership, ethics, integrity and governance.

REFERENCES

[1] Amayi, F. K. (2011). Factors Affecting Procurement in the Public Service: a Case Study of the State Law Office. Eldoret: Moi University.

[2] Baily, P., Farmer, D., Jessop, D. & Jones, D. (2005). Purchasing Principles and Management, (9th Ed.). London: Prentice Hall.

[3] Batenburg, R., & Versendaal, J. (2006, January). Alignment Matters -Improving business functions using the procurement alignment framework, Utrecht.

[4] Bloom, B. S. (1956). Taxonomy of Educational Objectives: Cognitive Domain.

[5] Bolton, P. (2006). Government procurement as a policy tool in South Africa , Journal of Public Procurement, Vol. 6 No.3, pp.193-217.

[6] Bowersox, D. J., Closs, D. J., & Cooper, M. B. (2007). Supply Chain Logistics Management (2nd Ed.). New York: McGraw-Hill.

[7] Burt, N. D., Petcavage, D. S., & Pinkerton L. R. (2010). Supply Management: Text and Cases, (8th Ed.). New York: McGraw-Hill.

[8] Chartered Institute of Purchasing and Supply Australia (2005). How do we measure up? An Introduction to Performance Measurement of the Procurement Profession: Retrieved August 10, 2012, from CIPS Website: http://www.cips.org/documents/Performance_Measurement.pdf

[9] Chopra, S., Meindl P., & Dhamram V. K. (2007). Supply Chain Management: Strategy, Planning and Operation, (3rd Ed.). Noida: Pearson Pentice Hall.
[10] Christopher, M. (2005). Logistics and Supply Chain Management: Strategies for Reducing Cost and Improving Service, (3rd Ed.). London: Prentice Hall.
[11] Cooper, D.R. & Schindler, P.S. (2003). Business Research Methods. New York: Mc Cousins, P. D., & Spekman, R. (2003). "Strategic supply and the management of inter-and intra-organizational relationships". Journal of Purchasing & Supply Management, ol. 9 No. 1, pp. 19-29.
[12] Daugherty, P. J., Myers, M. B., & Autry, C. W. (1999). "Automatic replenishment programs: An empirical examination". Journal of Business Logistics, Vol. 20, No. 2, pp. 63-82.
[13] David, R. (2005). "The future of managing electronic records". Records Management Journal, Vol. 15 Iss: 3 pp. 128 – 130.
[14] Davila, A., Gupta, M., & Palmer, R. (2003). "Moving procurement systems to the Internet: the adoption and use of e-procurement technology models". European Management Journal, Vol. 21 No. 1, pp. 11-24.
[15] Favre, D., Findlay, C., & Zaniker, J. C. (2004). The Case for Procurement Outsourcing, available at: www.ascet.com (accessed October, 2012)
[16] Goetsch, D. L. & Davis, S. B. (2006). Quality Management: Introduction to TQM for Production, Processing, and Services. New Jersey: Prentice-Hall.
[17] Gordon J., & Murray N., (2009). Public Procurement Strategy for Accelerating the Economic Recovery, Supply Chain Management: An International Journal, Vol. 14 Iss: 6, pp.429 – 434.
[18] Hornby, A. S. (2010). Oxford Advanced Learners' Dictionary of Current English, (8th Ed.). Oxford: Oxford University Press.
[19] Jones, G. R, & George, J. M, (2009). "Contemporary Management", (6th Ed.). New York: McGraw-Hill.
[20] John, G. (2003). The Core Conundrum, Supply Management, Vol. 8 No. 9, pp. 20.
[21] Juma, M. J. O. (2010). "Public Procurement Reforms" Kenya Procurement Journal, Issue No. 08, October 2010.
[22] Kenth L., & Vahid M. (2008). "Determining the Value of Information for Different Partners in the Supply Chain", Iss: 9 pp. 659 – 673. International Journal of Physical Distribution & Logistics Management, Vol. 38.
[23] Kenya Gazette Supplement No. 77 (2005). Public Procurement and Disposal Act, (Acts No. 3). Nairobi: Government Printer.
[24] Kimunya A. (2006). Public Procurement and Disposal Regulations, Kenya Gazette Supplement No. 92, Legal Notice No. 174. Nairobi: Government Printer.
[25] Kim, J. & Rogers, K. (2005). "An Object-oriented Approach for Building a Flexible Supply Chain Model", International Journal of Physical Distributions & Logistics Management, Vol. 35 No. 7, pp. 481-502.
[26] Kirungu K.H. (Dec 2002). An Investigation of Possible Constraints to Efficient Management Of the Supply Chain in Government Hospitals. A Case Study for Kenyatta National Hospital. Mombasa: Government Training Institute.
[27] Kombo, D. K., & Tromp, D. L. A., (2006). "Proposal and Thesis Writing", (2nd Re-print). Nairobi: Paulines Publications Africa.
[28] Kothari, C. R. (2005). Research Methodology: New Age International, (3rd Ed.). London: Longman Publishers.
[29] Lardenoije, E. J., Van Raaij, E. M., & Van Weele, A. J. (2005). Performance Management Models and Purchasing: Relevance Still Lost. Researches in Purchasing and Supply Management, the 14th IPSERA Conference, (pp. 687-97). Archamps.
[30] Leenders, R. M., & Fearon, E. H. (2002). Purchasing and Supply Management, (12th Ed.). Chicago: McGraw-Hill Companies.
[31] Lysons, K. F. (2006). Purchasing and Supply Chain Management, (7th Ed.). London: Pearson Education Ltd.
[32] Ogachi, J. F. (2011). "The Status of The Procurement Profession in Kenya, Baseline Indicators 2011. Nairobi: Centre for Advanced Studies.
[33] Maina, E. T. (2011). Factors Influencing the Implementation of the Public Procurement and Disposal Act, 2005 in Kenya: a Case on the Ministry of Education. Nairobi: JKUAT.
[34] Maude, F. (2011). "David Cameron: What the Prime Minister wants from you". Journal of Purchasing & Supply Management, 2011 March Vol. 16 No. 5, pp. 33-34.
[35] Moncska, R. M., Handfield, R. B., Guinipero, L. C., & Patterson, J. L. (2010): Purchasing and Supply Chain management. Learning: Cengage.
[36] Morgan, J. (1995). You can outsource work – but not the worries, Purchasing, Vol. 118 No.8, pp.17.
[37] Mugenda, O. M. & Mugenda, A. G. (2003). Research Methods: Quantitative and Qualitative Approaches. Nairobi: Acts Press.
[38] Noble, N. (2011). Ethics: A Public Duty; Professional Bodies have a Moral – and Usually Legal – obligation to serve the public interest. CIPS does. Journal of Purchasing & Supply Management, 2011 March Vol. 16 No. 5, p. 25.

[39] Nicholas, D., Michael L., & Simone W. (2008). "Do European Procurement Rules Generate or Prevent Crime?", Journal of Financial Crime, Vol. 15 Iss: 3 pp. 243 – 260.
[40] Rebecca A., & Ravi N., (2007). Business-to-business e-procurement: success factors and challenges to implementation, Supply Chain Management: An International Journal, Vol. 12 Iss: 2, pp.104 – 115.
[41] Rembe, M. J. (2011). Kenya Procurement Journal, Quarterly PPOA Bulletin, Issue No. 08, March 2011.
[42] Robson, C. (1993). Real World Research, A Resource for Social Science Research Methods, Oxford: Blakwell.
[43] Saunders, M. (1997). Strategic Purchasing & Supply Chain Management, (7th Ed.). Essex: Pearson Education Ltd.
[44] Simatupang, M. T. & Sridharan, M. R. (2005). "The Collaboration Index: A Measure for Supply Chain Collaboration," International Journal of Physical Distribution & Logistics Management, Vol. 35, No. 1, pp. 44.
[45] Smith, R. & Conway, G. (1993). Organisation of Procurement in Government Departments and their Agencies. London: HM Treasury Consultancy and Inspection Services Division.
[46] Sriram, V. & Stump, R. (2004). "Information technology investments in purchasing: An Empirical Investigation of Communications, Relationships and Performance Outcomes," Omega, The International Journal of Management Science, Vol. 32, No., pp. 41-55.
[47] Thomas, P., & Rainer A. (2005). "Successful use of e-procurement in Supply Chains". Supply Chain Management: An International Journal, Vol. 10 Iss: 2 pp. 122-133.
[48] Thurston, A. (2002). "International Records Management Module". London: International Records Management Trust.
[49] Van Weele, A. J. (2006). Purchasing & Supply Chain Management: Analysis, Strategy, Planning and Practice, (4th Ed.). Australia: Thomson.
[50] Wyld, D.C. (2004). "The weather report for the supply chain: a longitudinal analysis of the ISM". Department of Management, Southeastern Louisiana University, Los Angeles: Hammond.

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Synthesis, characterization and rheological study of a polyelectrolyte polymer and its application in wastewater treatment

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ABSTRACT: The aim of this work is to synthesize a polyelectrolyte polymer (Polyvinyl alcohol (PVA)) through radical means and vinyl acetate as a vinylic monomer followed by hydrolysis. This includes its viscosity-mass which is well controlled. Its aim is also to optimize waste waters treatment of the purification station of the Galvacier Company (Kénitra), where the treatment is based on the process of coagulation/flocculation.
The synthesized polymer was characterized on the one hand by the use of infrared fourier transformation spectroscopy (IRFT), and on the other hand by the use of the viscometer to study its rheological behavior.
The result obtained concerning the micro- structural characterization confirms the structure of polyvinyl alcohol.
Processing the wastewater Samples through synthesized PVA enabled us to achieve attractive valuations on the physicochemical parameters of pollution waste water of the station. These results are translated into minimum values of the following parameters: 89 µS/cm.103 for electrical conductivity at 32 °C for temperature; 6,32 for the pH; 55,5 for the turbidity (NTU); 280 mg/l for suspended matter; 220 mg/l for the biochemical oxygen demand (BOD); 645 mg/l for chemical oxygen demand (COD) and 2.93 for COD/BOD report. Indeed, we found these results in an optimal dose equal to 0.2 g / l of this flocculating agent.

KEYWORDS: Polymer; flocculant; coagulant; Turbidity and PVA.

1 INTRODUCTION

Water is an essential element for most of the large companies of transformation, textile, slaughterhouses, galvanization... the use of the latter becomes a major source of pollution in case of non-treatment of the receiving milieu.

Several studies have focused on treating this type of wastewater using different methods among which we find the membrane separation, microfiltration, nanofiltration, adsorption and coagulation/flocculation [1], [2], [3]. In our case, we used the method of coagulation/flocculation [3] for the treatment of waste water (Galvacier).

During this work, we synthesized a polyelectrolyte polymer (PVA) [4], [5] by radical ways [6], using vinyl acetate as the vinylic monomer, followed by hydrolysis, whose viscosimetric study was determined.

2 MATERIALS AND METHODS

2.1 MATERIALS USED

In this work, we used first, the infrared spectroscopy with Fourier transformation for the identification of the structure of PVA, and secondly, we used the turbidimeter type HCAH2100, multi parameter Consort C535, apparatus of measuring COD type CR 2200 and the apparatus of measuring the biochemical demand of oxygen to evaluate the different physicochemical parameters of wastewater.

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Viscosity measurements were performed using a viscometer Ubbelohd. The measurement conditions used are as follows:

- Viscometer size 1b for a series of dilution, capillary tube, constant K = 0.051493.
- Measurement Temperature in ° C: 30; 35, 40, 45, 50, 55 and 60
- Number of measurement: 2 each time
- Solvent: pure methanol

2.2 PREPARATION OF SAMPLES

To determine the viscosimetric behavior of standard PVA, we dissolved the polyelectrolyte polymer in pure methanol at different concentrations (5 %, 10 %, 15 % and 20 %). Next, we studied their viscosity by the capillary viscometer type Ubbelohd at variable temperatures going from 30 °C to 60 °C.

Fig.1. Apparatus viscometer

2.3 COAGULATION/FLOCCULATION PROTOCOL

The application of the method of coagulation/flocculation of the wastewater sample requires a prior optimization study of the pH of the medium, which led us to a pH value equal to 8, and the coagulant to the value 1g.

Quantities of synthesized PVA (0.1 g, 0.2 g, 0.3 g, 0.4 g and 0.5 g) were added to the reactional medium. Then, we added 1 g of oxygenated water in each container at the same temperature that we left under magnetic stirring (200 rev/min) for 5 min.

Finally, we reduced the stirring speed to 20 rev/min for 3 min before measuring the pollution parameters.

3 RESULTS AND DISCUSSIONS

3.1 CHARACTERIZATION OF POLYACETATE VINYL: AFTER HYDROLYSIS

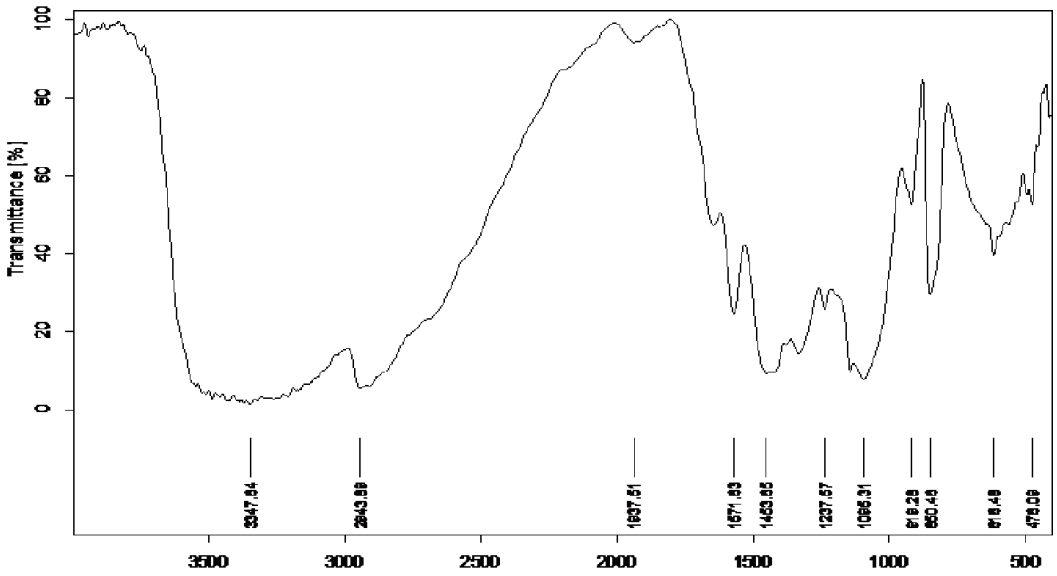

Fig.2. Spectrum of polyacetate vinyl obtained by Fourier Infrared Spectroscopy after hydrolysis.

IRFT spectra shown in Figure 2 showed us several bands among which are the band that lies at 2943.89 cm^{-1} corresponding to the CH bond of carbon SP^3, the band that lies at 1453.65 cm^{-1} corresponding to CH_2 group, the band that lies at 1085.31 cm^{-1} corresponding to the C-OH bond , the band that lies at 1571.83 cm^{-1} corresponding to the C-C bond and the band that lies at 3347.64 cm^{-1} corresponding to the OH function, which confirms the structure of the polyvinyl alcohol .

3.2 VISCOSIMETRIC BEHAVIOR OF POLYVINYL ALCOHOL (PVA)

The viscosimetric behavior study is done using a capillary viscometer of Ubbelohd type at varying temperatures going from 30, 35, 40, 45, 50, 55 and 60 °C.

The course of the viscosity variation according to the concentrations is shown below:

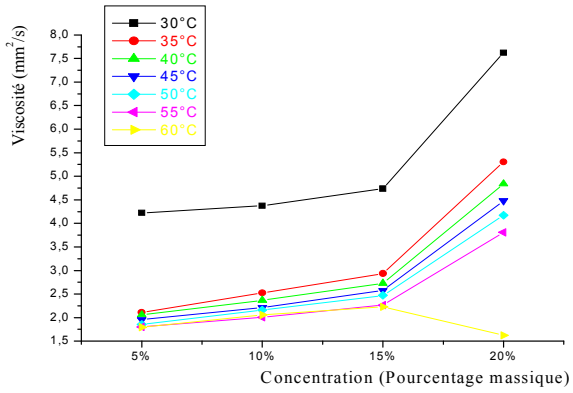

Fig.3. Variation of viscosity according to different concentration.

The results shown in Figure 3 are quite logical and expected. Indeed, the viscosity of the solution increases gradually as the concentration of PVA increases.

From 60 °C, the studied PVA goes from a viscous state to a liquid state, which explains the downfall of the observed viscosity.

3.3 APPLICATION OF PVA IN THE TREATMENT OF WASTEWATER

In this work, we tested the PVA as a flocculant to treat wastewater collected from the company Galvacier, Kénitra.

3.3.1 THE ELECTRICAL CONDUCTIVITY

The electrical conductivity is probably one of the most important parameters to control the quality of wastewater. It reflects the overall degree of mineralization that informs us about the salinity rate [7]. In Figure 4, we have shown the electrical conductivity according to PVA doses.

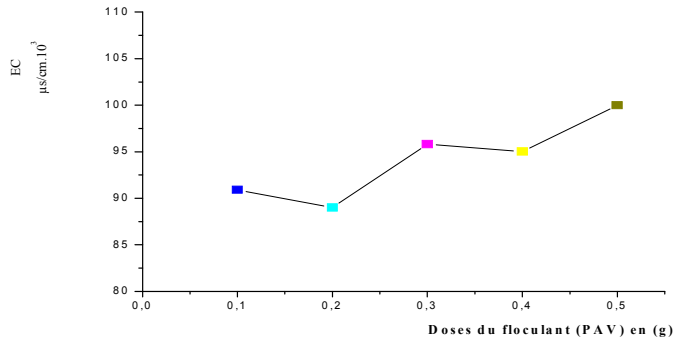

Fig.4.The evolution of the electrical conductivity according to PVA doses

From the curve of Figure 4, we found that the EC has decreased to a minimum value of about 89 µS/cm10^3. This value was determined at an optimum dose of flocculant 0.2 g PVA, which represents a large mass compared to the commercial PVA and / or ferrocryle [8].

3.3.2 TEMPERATURE

In Figure 5, we have represented the evaluation of the temperature according to PVA doses.

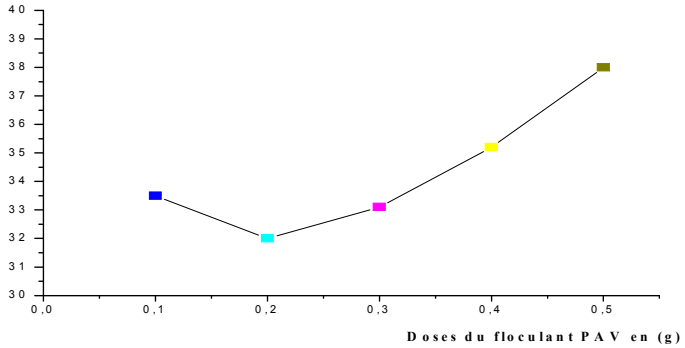

Fig.5. Evolution of the temperature according to the flocculant PVA doses

The Lowest temperature of the treated waters with the PVA flocculant was determined in the minimum value which has the order of 32 °C at a dose of 0.2 g of this flocculant. The average temperatures of wastewaters discharged by the galvanizing industry are between 30 °C [9] and 35 °C. The latter is considered as the limit value of the direct discharge into the receiving milieu [10].

3.3.3 THE PH CHANGE OF THE TREATED WATER

The curve in Figure 6 shows the variation in pH according to the PVA doses.

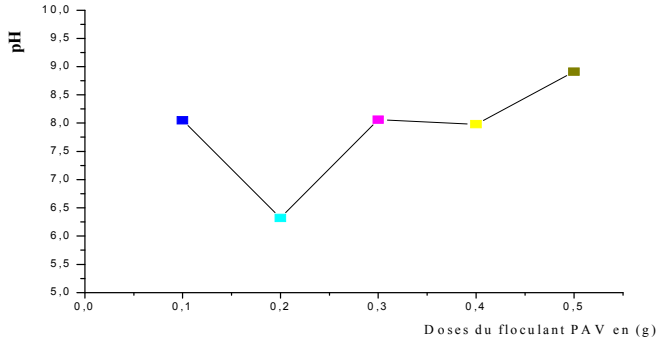

Fig.6. Evolution of the pH according to the flocculant PVA doses

From Figure 6, we found that the minimum pH is recorded in the value of 6.32 to an optimal dose of PAV equal to 0.2 g. For our study, the pH of the wastewater treated by the used flocculant is closed to neutrality.

3.3.4 TURBIDITY

The curve of Figure 7 represents the change in turbidity according to the PVA doses.

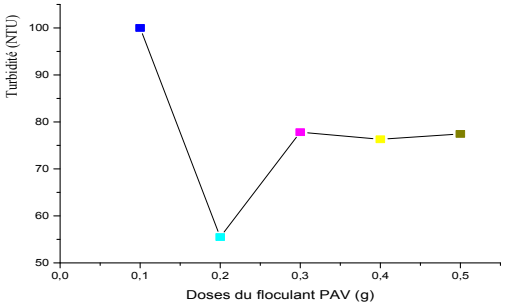

Fig.7. Evolution of the turbidity according to PVA doses.

The minimum turbidity of the water treated by the PVA has been recorded in the 55.5 NTU value to an optimal value of about 0.2 g as a dose of used flocculant. Thus the aspect of water has become very limpid.

3.3.5 SUSPENDED MATTER

Suspended solids represent the inorganic, organic and organometallic particles contained in the wastewater altogether [11]. The curve of Figure 8 shows the variation of the suspended solids according to the PVA doses.

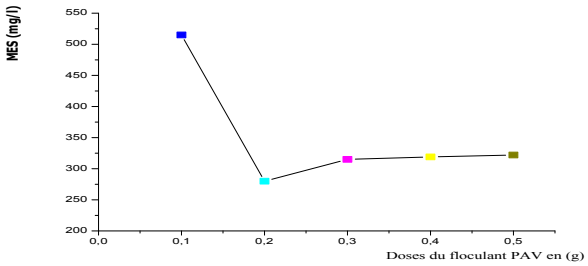

Fig.8. Variation Evolution of MES based doses of PVA.

From the figure above, we observe that the minimum value is recorded in 280 mg/l at an optimal dose of the order 0.2 g for the used flocculant (PVA).

3.3.6 THE BIOCHEMICAL DEMAND IN OXYGEN (BDO_5)

The figure below shows the variation of BDO_5 according to the PVA doses.

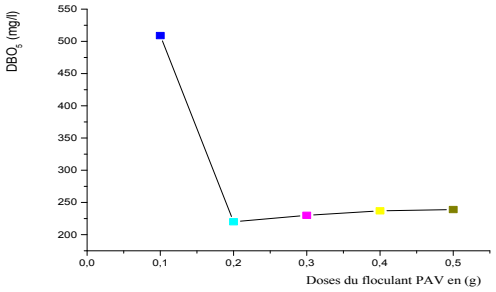

Fig.9. Evolution of BOD_5 according to the PVA doses.

The minimum value of the recorded BDO_5 is around 220 mg/l for an optimal dose equal to 0.2 g of PVA. This value is lower than the one specified in the norm of the limit values of the industry discharges (500 mg/l) [12], [13].

3.3.7 THE CHEMICAL DEMAND IN OXYGEN (COD)

The COD enables us to assess the concentration of inorganic or organic materials whether dissolved or in suspension in water, through the required amount of oxygen for the total chemical oxidation [10]. We have shown in Figure 10 the variation of the COD according to the PVA doses.

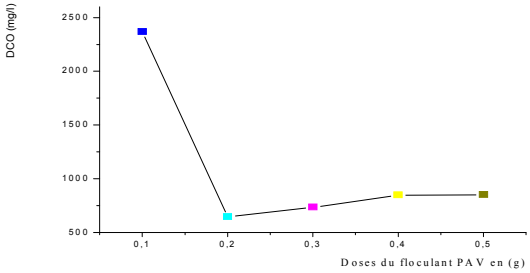

Fig.10. Evolution of the COD according to the PVA doses.

From the curve shown in Figure 10, we see the lowest value of the COD is recorded at 645 mg/l, for an optimal dose equal to 0.2 g of PVA. The Limit value of the direct discharge is 1000 mg/l [10].

3.3.8 THE COD ACCORDING TO BDO_5

The relation COD/BDO_5 is relevant to the definition of the purification chain of an effluent. Indeed, the low value of the relation COD/BDO_5 implies the presence of a large proportion of biodegradable matters and allows to consider a biological treatment. Conversely, a large value of this ratio indicates that much of the organic matter is not biodegradable and, in this case, it is preferable to consider a physico - chemical treatment [10]. The relation COD/BDO_5 enables us to deduce if the directly discharged wastewaters into the receiving environment have the characteristics of domestic wastewater (the relation COD/BDO_5 less than 3) [9]. The results of this relation provide an indication of the importance of the polluting materials whether little biodegradable or not.

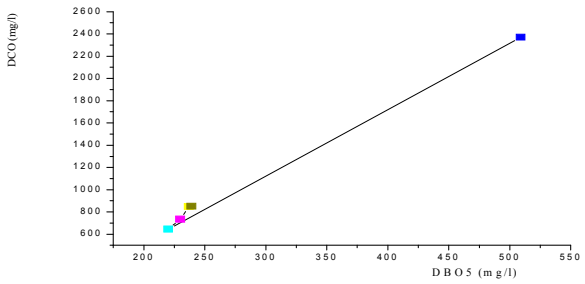

Fig.11. Evolution of the COD according to the BOD_5.

From Figure 11, we found the average value of the relation COD/BDO_5 is 2,93. It is consistent with that of wastewaters whose COD/BDO_5 is less than 3. So we can conclude that even if the wastewaters of this urban rejection provide a low organic load, they are relatively easily biodegradable.

4 CONCLUSION

Wastewaters of the galvanization company provide values of major physico -chemical parameters of pollution that relatively exceed the general value limits of direct and indirect discharges in the receiving environment (estuary of Sebou), which could create a risk of an environmental pollution for the latter. Hence the need for treatment of the wastewater is prior to its discharge into the receiving natural environment.

After assessing the degree of organic pollution, we can say that all the studied parameters (especially with BDO_5, COD and MES) localize the analyzed wastewater in a space whose physicochemical parameters have an average quality.

REFERENCES

[1] Li W., Hua, T., Zhou, Q., Zhang, S., Li, F., ‘‘Treatment of stabilized landfill leachate by the combined process of coagulation/flocculation and powder activated carbon adsorption’’, Desalination, vol. 264, no. 1-2, pp. 56–62, 2010.

[2] Chan G.Y.S., Chang, J., Kurniawan, T.A., Fu, C.X., Jiang, H., Je, Y., ‘‘Removal of non-biodegradable compounds from stabilized leachate using VSEPRO membrane filtration’’, Desalination, vol. 202, no. 1-3, pp. 310-317, 2007.

[3] Franceschi M., Girou, A., Carro-Diaz, A.M., Maurette, M.T., Costes, E.P., “Optimization of the coagulation/flocculation process of raw water by optimal design method”, Water Res., vol. 36,no. 14, pp. 3561–3572, 2002.

[4] Meihua Z., Jinwen Q., Qiang Z., Quanfu A., Jing L., “Preparation method and pervaparation performance of polyelectrolyte complex/PVA blend membranes for dehydration of isopropanol’’, J. of Membrane Science, vol. 361, no. 1, pp. 182-190, 2010.

[5] Ulas T., John A., Pierson, Spyros G., “Effect of polyelectrolytes and quaternary ammonium compounds on the anaerobic biological treatment of poultry processing wastewater’’, Water Resear, vol. 41, no. 6, pp. 1334-1342, 2007.

[6] Brembilla A., Cuny J., Roizard D., Lochon P., “Synthèse et polymérisation du diamino-3,4 styrène: Application a une méthode générale de préparation de polyvinyl-5(6) benzimidazoles’’, European polymer journal, vol. 18, no. 10, pp. 893-900, 1982.

[7] James F. Rusling Biomolecular Films: Design, Function, and Applications (Surfactant Science), 2000.

[8] M. Berradi, Z. Chahab, H. Arroub, H. Nounah, A. El harfi., "Optimization of the coagulation/flocculation process for the treatment of industrial wastewater from the hot dip galvanizing of steel'' J. Mater. Enviro. Sci., vol. 5, no. 2, pp. 360-365, 2014.
[9] Ministère de L'Environnement du Maroc. « Normes Marocaines, Bulletin officiel du Maroc », N° 5062 du 30 ramadan 1423. Rabat, 2002.
[10] Journal Officiel de la République Algérienne. Normes de rejets dans le milieu récepteur 46, pp. 7-12, 1996.
[11] Wong S.S., Teng T.T., Ahmad A.L., Zuhairi A., Najafpour G., "Treatment of Pulp and Paper Mill Wastewater by Polyacrylamide (PAM) in Polymer Induced Flocculation'', J. Hazard. Mat., vol. B135, pp. 378–388, 2006.
[12] J. Rodier. L'analyse de l'eau naturelle, eaux résiduaires, eau de mer, 8^{éme} éd. Denod, Paris, 1996.
[13] ONEP. Approche de la typologie des eaux usées urbaines au Maroc. ONEP et GTZ. Rabat (1998).

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اثر برنامج تربوي علاجي مقترح في التربية الفنية وقياس مدى فعاليته في علاج ضعف الدفعة الحيوية للمعاقين عقليا

[The Effect of an Art Educational Program on developing vitality of Mentally Retarded Children]

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قسم التربية الخاصة – كلية التربية – جامعة الملك فيصل
الهفوف– الاحساء -المملكة العربية السعودية

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ABSTRACT: This project aims at investigate the effects of an educational program- based on Art Education, on developing the vitality (libido) of the Mild Mentally Retarded Children, who are assumed to be studying in Mental Education Center, in Al Ahsaa.

To achieve the aim of the project, the researcher has applied an experimental approach by comparing the performance and behavioral manifestations of the experimental and control samples in addition to compare the statistical differences between the performance of the experimental group in pre- posttests and measurements. The researcher used a set of tools and standards to test the validity of all the hypotheses and has reached the following results:

1. In posttests, there was statistically significant differences in development of sensory-motor activities apparent between experimental and control groups, reflected positively among the experimental group.
2. Measurements proved statistical significance for improvement in intelligence among experimental group, which confirms the effectiveness of the program.
3. The Statistical significant in post measurements did not show any improvement in the level of attention among the experimental group, confirming failure of the third hypothesis of this study.

KEYWORDS: Art Educational Program, developing vitality, Mentally Retarded Children.

ملخص: هدف مشروع البحث إلى دراسة أثر التطبيقات الفنية في تطور الدفعة الحيوية للمعاقين عقليا وذلك من خلال تطبيق برنامج تربوي مقترح. وقد تم استخدام المنهج التجريبي في هذه الدراسة من خلال مقارنة الأداء والمظاهر السلوكية للعينتين التجريبية والضابطة بالإضافة إلى مقارنة الفروق الإحصائية بين أداء المجموعة التجريبية في القياسات القبلية والبعدية. وتمثل مجتمع الدراسة التلميذات المعاقات عقليا من فئة ذوي الإعاقة البسيطة المنتسبات إلى مراكز التربية الفكرية بمحافظة الإحساء وقد بلغت العينة الكلية 16طفلة معاقة عقليا. تم تقسيم هذه العينة إلى مجموعتين تجريبية وضابطة (قوام كل منهما 8 طالبات) متجانستين في الخصائص والقدرات. وقد استخدمت الباحثة مجموعة من الأدوات والمقاييس شملت:
- جهاز التآزر الحسحركي لقياس مستوى التآزر عند أفراد العينة.
- مقياس الانتباه من إعداد الباحثة وقد تم تطبيقه لجمع بيانات عن العينة مباشرة في الصورة (أ) وبواسطة المعلمات (الصورة ب المدرسية) وبواسطة الأمهات (الصورة ج المنزلية).
- البرنامج المقترح والذي تناول مجموعة من الأنشطة الفنية المتنوعة استهدفت تنمية التآزر الحسحركي وتقوية الانتباه والتركيز وذلك من خلال التدريبات الحركية والعضلية وتدريبات ذهنية وحسية تساعد في تنمية القدرة الذهنية والتفكير.
أشارت نتائج الدراسة إلى:
1. وجود فروق ذات دلالة إحصائية واضحة بين المجموعتين التجريبية والضابطة في تطور التآزر الحركي - بعد تطبيق البرنامج المقترح - تعزى لصالح المجموعة التجريبية.
2. وجود دلالة إحصائية على تطور مستوى الذكاء للمجموعة التجريبية في القياسات البعدية لتطبيق البرنامج المقترح.
3. عدم وجود دلالة إحصائية على تطور الانتباه للمجموعة التجريبية في القياسات البعدية لتطبيق البرنامج المقترح، وهذا يشير إلى عدم صدق الفرضية الثالثة للدراسة.

كلمات دلالية: الدفعة الحيوية، المعاقين عقليا ، برنامج تربوي ، تآزر حركي ، ضعف الانتباه ، الذكاء.

1.مقدمة

1-1. تمهيد

لعل أخطر وأسوأ ما يعاني منه الطفل المعاق عقلياً في حياته هو أن تتسم معظم أساليبه السلوكية بالضعف الحيوي وعدم مقدرته على الانتباه والتحكم العضلي أو التآزر الحركي إضافة إلى نقص الذكاء لان ذلك سوف يكون له تأثيرا سلبيا في التعلم والتطور النمائي مما يعجزه عن المشاركة والتأثير في مجتمعه ويصبح أكثر استهدافاً لصنوف الإحباط. وتشير الدراسات الى ان ضعف الانتباه والتآزر عند المعاق عقليا يظهر لديه عجزا في المهارات اللازمة للتفاعل مع الآخرين. (بخش، 1997).

ونظراً لتعقد مشكلة الإعاقة العقلية سواء من حيث عواملها ومسبباتها أو من حيث مظاهرها السيكومترية والإكلينيكية وما يترتب على ذلك من إخفاق الطفل المعاق في تحقيق معدل النضج اللازم في نمو مهاراته العقلية والاجتماعية والحركية وخاصة في مراحل الطفولة المبكرة فإن أساليب الرعاية التربوية والإرشادية لقيت اهتماما متزايداً من الباحثين والمتخصصين في الآونة الأخيرة, وبشكل يتناسب مع احتياجات المجتمع والسياسات التربوية والعلاجية التي تتبناها الدول العربية في المجالات العلاجية والتأهيلية لحالات الإعاقة العقلية بمختلف درجاتها كأسلوب وقائي، نمائي, وعلاجي لجوانب القصور في شخصية المعاق عقلياً خلال مراحل وفترات نموه المختلفة. وتندرج فئة الأطفال المعاقين عقلياً ضمن فئات التربية الخاصة، والتي يُصمم لها برامج تناسب الطلبة ذوي الاحتياجات الخاصة على حسب احتياجاتهم وقدراتهم، فتكون مختلفة بالنسبة لنوع الإعاقة وشدتها. (الشمري،1429 هـ،)

ولقد اتضح أن الأنشطة الفنية تمكن المعوقين من أن يقوموا بأعمال فنية تُجاري إخوانهم الأسوياء، ويستمتعون بقدرتهم على الإنتاج والعمل الفني، الأمر الذي يقلل من شعورهم بالقصور والدونية ويُنمّي مشاعر الثقة بالنفس لديهم. (السديري، 1412هـ). بالإضافة الى ذلك يعتقد في ان المعاق عقليا يستفيد نمائيا عند ممارسة الانشطة المحببة لديه، ولكن لم يظهر بوضوح شكل ومدى هذا التطور النمائي وعليه جاءت فكرة هذه الدراسة للتعرف على أثر الانشطة الفنية في تطور الدفعة الحيوية لدى المعاق.

1 -2. مشكلة الدراسة

تبحث الدراسة الحالية عن مدى فعالية استراتيجية التربية الفنية كأسلوب تربوي علاجي يستهدف تنمية الدفعة الحيوية للمعاق عقليا ,وذلك بمؤسسات التربية الفكرية بمحافظة الإحساء.

بعد مراجعة الدراسات السابقة تبين للباحثة أن معظم نتائج هذه الدراسات توصلت إلى فعالية البرامج التربوية في تنمية بعض جوانب النمو للأطفال المعاقين عقليا. لذلك تتناول مشكلة الدراسة دراسة أثر برنامج مقترح تم بناؤه من قبل الباحثة من عدة انشطة فنية متنوعة تستهدف تحفيز عدة مهارات عند المعاق ممثلة في جوانب نفسية وحركية ترمي الباحثة من وراء ذلك التعرف على مدى نجاح هذا البرنامج في تطور هذه المهارات لدى الطفل المعاق. وتم وضع السؤال الرئيس للدراسة والذي تضمن تساؤلا عن فعالية برنامج الانشطة الفنية المقترح فيما يخص موضوع الدراسة، على النحو الاتي:

- هل توجد فروق ذات دلالة إحصائية بين أفراد المجموعة التجريبية الذين خضعوا للبرنامج المقترح وأفراد المجموعة الضابطة الذين لم يخضعوا للبرنامج في الأداء على أدوات الدراسة؟ وهل توجد دلالة احصائية واضحة لأثر البرنامج المقترح في تطور مستوى الدفعة الحيوية لأفراد المجموعة التجريبية في متغيرات الدراسة. ؟

1-3. وبناء على هذا التساؤل تم وضع الفرضيات التالية:

1. توجد فروق ذات دلالة إحصائية واضحة بين المجموعتين التجريبية والضابطة في تطور التآزر الحركي -بعد تطبيق البرنامج المقترح -تعزى لصالح المجموعة التجريبية.
2. توجد دلالة إحصائية على تطور مستوى الذكاء للمجموعة التجريبية في القياسات البعدية لتطبيق البرنامج المقترح.
3. توجد دلالة إحصائية على تطور الانتباه للمجموعة التجريبية في القياسات البعدية لتطبيق البرنامج المقترح.

1-4. أهداف الدراسة هدفت الدراسة إلى:

1. تصميم برنامج تربوي علاجي يساهم في تنمية مهارات الطفل المعاق عقليا في عدد من الجوانب الإنمائية وقياس مدى فعالية هذا البرنامج في تنمية الدفعة الحيوية لديه.
2. المساهمة في تطوير مهارات الطفل المعاق عقليا في عدد من الجوانب الإنمائية بما يحقق تنمية الدفعة الحيوية لديه.
3. المساهمة في إثراء المنهج المدرسي ببرنامج تربوي يمكن أن يكون رافد أو نواة لتصميم مادة علمية في التربية الفنية تقدم ضمن المنهج المدرسي الأساسي.
4. إثراء مجال البحث العلمي بدراسة يمكن أن تفيد الجانب الثقافي، التربوي، والاجتماعي في عدد من قطاعات المجتمع ذات الاختصاص والتي تُعنى بهذه الفئة.

1-5. أهمية الدراسة

تعتقد الباحثة في أهمية الدراسة للاتي

1. تتميز هذه الدراسة بالأصالة، حيث انه لم يسبق أن تم البحث في هذا الموضوع على صعيد الوطن العربي أو غيره من الدول الغربية حتى الآن. بالإضافة إلى ندرة البحوث التي تناولت موضوعات متعلقة بتطوير مناهج تربوية لهذه الفئة.
2. أن ما تقدمه هذه الدراسة يحقق أهداف التقييم، حيث أن من أغراضه -حسب دراسات جيمس وستيوارت,1993م -الوظائف الإدارية للتقييم، فالتقييم المهني يزود المعلمين بمادة تشخيصية مفيدة مع تحديد الاحتياجات الخاصة للفئة، أو التزويد بمادة تساعد في حفظ السجلات. والتقييم الإداري يصمم لإنتاج بيانات تسمح بمقارنة أداء المعلمين والمدارس والسلطات التعليمية المحلية.
3. وتعتقد الباحثة بان هذه الدراسة بالإضافة لما تحققه من تنمية في مهارات الفئة المستهدفة وتنمية الدفعة الحيوية لديهم يمكن أن تحقق أيضا تأثيرا واضحا في تقييم وتقويم منهج التربية الفنية أو أن يصبح البرنامج المقترح نواة لمنهج علمي في التربية الفنية يقدم لذوي الإعاقة العقلية،
4. إضافة إلى ما توفره الدراسة من أدوات ومقاييس تساعد في تقييم سلوك ومهارات المعاقين عقليا.

1-6. **منهج الدراسة**: تم استخدام المنهج التجريبي المعتمد على القياس القبلي والبعدي لمجموعة تجريبية واخرى ضابطة.

1-7. حدود الدراسة: الحدود المكانية للدراسة تمثلت في معهد التربية الفكرية بالأحساء، كما شملت الحدود البشرية للدراسة عينة مكونة من 16 طالبة من ذوي الاعاقة العقلية البسيطة ضمن مجتمع المعاقات عقليا وممثلات لخصائص هذا المجتمع من حيث السن وتراوحت اعمارهن العقلية بين 113-201شهرا. وبأعمار زمنية بين 9 و15سنة... من الاناث القابلين للتعلم. اما الحدود الزمانية لتطبيق البرنامج فقد شمل ذلك عام دراسي كامل.

1-8. مصطلحات الدراسة

الدفعة الحيوية: **ويقصد** بها القدرة على الكلام والحركة (في الجلوس والوقوف والمشي)، والتآزر الحركي والعضلي، وحركة الشفاه، والانتباه، والميل نحو العمل والذي قد يتأثر بمدى الرغبة في بذل الجهد أو الخوف من الفشل.Earl, 1963. وتعرف اجرائيا في هذه الدراسة بانها القدرة العقلية العامة (الذكاء)، والانتباه، والتآزر الحركي.

الإعاقة العقلية Mental Retardation؛ حسب تعريف الجمعية الامريكية للتخلف العقلي تمثل الاعاقة العقلية مستوى من الاداء الوظيفي العقلي الذي يقل عن المتوسط بدرجة ملحوظة (70 $\pm$ 5) , والتي تؤدي الى التدني في عدد من مظاهر السلوك التكيفي وتظهر في مراحل العمر النمائية.

المعاقين عقليا Mentally Retarded؛ يتم تعريفهم إجرائيا في هذه الدراسة بكونهم فئة من الأطفال يعانون من انخفاض في مستوى القدرة العقلية العامة مع تدني واضح في مستوى التوافق الاجتماعي يضاف إليه تأخر في نمو المهارات الحسية والحركية.

قابلين للتعلم Educable؛ عرفهم كمال مرسي، (1999م) بأنهم فئة ضمن المعاقين عقليا تتراوح ح نسبة الذكاء بينهم بين50 – 70درجة، ويتوقف مستوى النمو العقلي لديهم عند مستوى طفل عادي في سن7 – 11 سنة تقريبا ويعانون من ضعف التحصيل الدراسي وضعف المهارات ولكن يتميزون بقابليتهم الجيدة للتعلم والتطور النمائي.

البرنامج التربوي Educational Program؛ يعرف إجرائيا في هذه الدراسة بأنه برنامج تربوي علاجي يهدف إلى تنمية بعض مهارات الطفل المعاق عقليا في جوانب محددة باستخدام الأنشطة الفنية.

التآزر الحسحركي Sensory-motor Coordination؛ يقصد به إجرائيا في هذه الدراسة استخدام المهارات الحركية الدقيقة وضبط حركة العينين واليدين. بالإضافة إلى توجيه اليد للامساك بالأشياء ولمسها ودفعها بالتنسيق الحركي مع العينين والاستجابات الحسية المختلفة.

ضعف الانتباهAttention Deficiency ؛ يعرف إجرائيا بقصور الانتباه في المدة والمدى بالإضافة إلى وحدة الموضوع. ويشار إليه في هذه الدراسة بتوفر سمات تشتت الانتباه بسرعة وضعف التركيز والانتباه الانتقائي بسبب ضعف المثيرات الداخلية، وهي خاصية تجعل المعاق لا يتعلم من الخبرات التي تمر به إلا إذا وجد من ينبهه لها حتى يدركها ويتعلم منها.

2. الإطار النظري

2-1. مفهوم الإعاقة العقلية

يتم تحديد الإعاقة العقلية أو ما يعرف بالتخلف العقلي Mental Retardation من خلال اختبارات الذكاء العامة وغالبا ما يكون مستوى ذكائهم اقل من 75% , إضافة إلى ما يتصفون به من سلوكيات وتصرفات غير عادية. وحسب تعريف الجمعية الأمريكية للتخلف العقلي عام 1992 American Association on Mental Retardation, 1992 يشير مصطلح التخلف العقلي إلى محددات قوية في الأداء الحالي, ويتسم بأداء عقلي وظيفي دون المتوسط متلازما مع محددات أخرى مرتبطة به في واحد أو أكثر من مجالات المهارات التكيفية التالية: التواصل Communication, رعاية الذات self-care , المعيشة المنزلية Home living , المهارات الاجتماعيةSocial skills , استخدام المجتمعCommunity use ,توجيه الذات Self- direction, الصحة والسلامة Health & Safety , الأداء الأكاديمي Functional Academic, وقت الفراغ Leisure , والعمل Work.

كما أكدت الكثير من الدراسات وجود مشكلة التأخر في النمو الانفعالي للمعاق Heward-1991,Hallahan,0 وفي دراسة ايرل C. Earl على المعاقين عقليا اتضح أنهم يعانون من تأخر في النمو الانفعالي يظهر في الآتي:

1. توقف نموهم في النمط الوجداني الطفلي.
2. ضعف الدفعة الحيوية.
3. ضعف المشاعر الوجدانية.
4. أيضا قد يصاحب بميل نحو الإتيان ببعض الحماقات التي تعبر عن نزعة إجرامية تعرف بالبلاهة الأخلاقية.

2-2. تعريف الإعاقة العقلية

"تمثل الإعاقة العقلية مستوى من الأداء الوظيفي العقلي الذي يقل عن متوسط الذكاء بانحرافين معياريين ويصاحبها قصور في السلوك التكيفي ، وتظهر في مراحل العمر النمائية منذ الميلاد وحتى 18سنة. "

التعريف الطبي للإعاقة العقلية: يعتبر الأطباء من أوائل المهتمين بتعريف و تشخيص ظاهرة الإعاقة العقلية, ويقدم التعريف وصفا لحالات الإعاقة العقلية و أسبابها و لكنه لا يقدم تشخيصا للقدرة العقلية, ويشير إلى انه تحدث الإعاقة العقلية بسبب عدم اكتمال عمر الدماغ نتيجة لإصابة المراكز العصبية والتي تحدث قبل أو بعد الولادة .أما **التعريف السيكومتري للإعاقة العقلية فقد** ظهر نتيجة للانتقادات التي وجهت إلى التعريف الطبي بحيث انه لا يستطيع وصف نسبه الذكاء بسبب صعوبة استخدام الطبيب لمقاييس القدرة العقلية كمقياس ستانفورد بينيه للذكاء أو مقياس وكسلر لذكاء الأطفال حيث يعتمد التعريف السيكومتري على نسبه الذكاء باستخدام مقياس ستانفورد بنيه و مقياس وكسلر. اعتمد التعريف السيكومتري على نسبة الذكاء (I , Q)كمحك في تعريف الإعاقة العقلية ، وقد اعتبر الأفراد الذين تقل نسبة ذكائهم عن 75معاقين عقلياً، على منحنى التوزيع الطبيعي.

وقد اشار التعريف القانوني الى انه: يتميز ضعاف العقول بالنمو العقلي المتوقف والذي يحدث في سن مبكرة ويدوم بعدها وتتميز هذه الفئة بأنها غير قادرة على الاعتماد على نفسها أو تصريف شئونها أو أن تكسب عيشها بنفسها وواضح أن هذا التعريف يعني بتحديد مسئولية المجتمع نحوه وهي المسئوليات المدنية والجنائية) مرسي،1999م).

التعريف الاجتماعي Social Definition : ظهر التعريف الاجتماعي للإعاقة العقلية نتيجة للانتقادات المتعددة لمقياس القدرة العقلية و خاصة مقياس ستانفورد بنيه و مقياس وكسلر في قدرتها على قياس القدرة العقلية للفرد فقد وجهت انتقادات إلى محتوي تلك المقاييس و صدقها وتأثرها بعوامل عرقيه و ثقافيه وتحصليه واجتماعيه الأمر الذي أدي إلى ظهور المقاييس الاجتماعية والتي تقيس مدى تفاعل الفرد مع المجتمع و استجابته للمتطلبات الاجتماعية وقد نادت بهذا الاتجاه ميرسر و جينيس و يركز التعريف الاجتماعي على مدى نجاح أو فشل الفرد في الاستجابة للمتطلبات الاجتماعية المتوقعة منه مقارنة مع نظائره من نفس المجموعة العمرية

التعريف التربوي Educational Definition: ظهر التعريف التربوي للإعاقة العقلية استكمالا للتعريف الاجتماعي للإعاقة العقلية حيث يركز هذا التعريف على التدني الواضح في الأداء التحصيلي للطلبة المعاقين عقليا مقارنة مع الأطفال العاديين المناظرين لهم في العمر الزمني وخاصة في المهارات اللغوية والقراءة والكتابة والحساب.

وتتضمن المقاييس التربوية عددا من المهارات التربوية التي تظهر مدى التباين في الأداء بين الطلبة العاديين والمعاقين عقليا على كل المهارات وهي:

- المهارات اللغوية وتضم مهارات اللغة الاستقلالية واللغة التعبيرية
- المهارات العددية
- مهارة القراءة
- مهارة الكتابة

تعريفات أخرى للإعاقة العقلية

تعريف هيبر: مستوي الأداء الوظيفي العقلي الذي يقل عن الذكاء المتوسط بانحراف معياري واحد ويصاحبه خلل في السلوك التكيفي ويظهر في مراحل العمر النمائية منذ الميلاد وحتى سن 16

تعريف جروسمان: مستوي الأداء الوظيفي العقلي الذي يقل عن متوسط الذكاء بانحراف معيارين ويصاحبه خلل في السلوك التكيفي ويظهر في مراحل العمر النمائية منذ ميلاد وحتى سن 18

ويعتبر تعريف جروسمان من أكثر التعاريف قبولا في أوساط التربية الخاصة

ويعرف **دول** المعاق عقلياً بأنه الشخص الذي تتوفر فيه الشروط التالية) عبيد،2007)

- عدم الكفاءة الاجتماعية بشكل يجعل الفرد غير قادر على التكيف الاجتماعي،
- عدم الكفاءة المهنية
- عدم القدرة على تدبير أموره الشخصية.
- يكون متخلفاً عقلياً عند بلوغه مرحلة النضج.
- أن تخلفه قد بدأ منذ الولادة أو في سنوات عمره المبكرة.
- أن تعود إعاقته إلى عوامل تكوينية أو وراثية أو نتيجة مرض ما.
- الشرط الأخير أن تكون حالته غير قابلة للشفاء.

وتتفق الباحثة مع اراء كل من دول وجروسمان وهيبر وغيرها في ان المعاق عقليا يشترط ان تتوفر فيه السمات السابقة، لكن يجب ان تجتمع معا هذه السمات حتى يحكم عليه بالإعاقة العقلية، فلا يكفي نقص الذكاء مع توفر التوافق الاجتماعي مثلا.

3-2. تصنيف الإعاقة العقلية

أولا: التصنيف حسب نسبة الذكاء والتوافق الاجتماعي :الإعاقة العقلية البسيطة وتتراوح نسبة ذكاء هذه الفئة من 55 -70

الإعاقة العقلية المتوسطة وتتراوح نسبة ذكاء هذه الفئة من 40-55

الإعاقة العقلية الشديدة وتقل نسبة ذكاء هذه الفئة عن 40

ثانياً: التصنيف حسب الشكل الخارجي :والذي اشار الى متلازمة داون, حالات اضطرابات التمثيل الغذائي, حالات القماءة, حالات صغر حجم الدماغ, حالات كبر حجم الدماغ, وحالات استسقاء الدماغ

ثالثاً: التصنيف حسب القدرة على التعلم :ويشمل القابلين للتعلم، القابلين للتدريب، والاعتماديين وشديدي الإعاقة

2-4. أسباب الإعاقة العقلية

قد تحدث الإعاقة العقلية بسبب عدم اكتمال عمر الدماغ نتيجة لإصابة المراكز العصبية والتي تحدث قبل أو بعد الولادة. (الروسان، فاروق 2010م)

أولاً : عوامل ما قبل الولادة

من اهم الاسباب لحدوث الاعاقة العقلية نجد **الأسباب الوراثية**: فهي مسئولة عن حوالي 75% من حالات الضعف العقلي بالإضافة الى **الأشعة؛** حيث يؤدي تعرض الأم الحامل للأشعة لمضاعفات, وأكثرها حدوثا هو سرطان الدم (اللوكيميا) وغيره من أنواع السرطان, وصغر حجم الدماغ. **والحصبة الألمانية؛** وتشير الدراسات التي أجريت على عينة من الأطفال الذين أصيبت أمهاتهم بالحصبة الألمانية أثناء الحمل إن ما نسبته (37%) منهم كان مصاباً بإعاقة عقلية (القريوتي والسرطاوي والصمادي, 1998). ومن الاسباب ايضا **الزهري الولادي**- أحد الأمراض التناسلية, وفي حالة ولادة الأطفال الذين كانت أمهاتهم مصابات بالزهري فان هؤلاء الأطفال يكونون في الغالب متخلفين عقليا (الشناوي, 1997). كما يذكر الشناوي (1997), قائمة بالأمراض التي تصيب الأم الحامل وتؤثر على نمو الجنين ومنها **مرض تسمم الدم؛** والمعروف باسم (Toxoplasmosis) حيث يتسبب فيروس هذا المرض في تلف الجهاز العصبي المركزي للجنين. والذي يترتب عليه إحدى مظاهر الإعاقة كالإعاقة العقلية أو البصرية أو السمعية أو الحركية أو حالات كبر أو حجم الدماغ, وتناول القريطي,2001 **اثر تعاطي العقاقير والأدوية أثناء الحمل؛** وذكر أن بعض العقاقير التي تتناولها الأم الحامل تصب الأجنة بأضرار قد تؤدي إلى الموت, أو يخرج البعض ولديه تشوه, وبينت الأبحاث, إن بعض المخدرات التي تتعاطاها الأم الحامل مثل الهيروين , والمورفين يمكن أن تؤدي إلى هبوط لدى المولود الجديد بما في ذلك التنفس. وفي أثناء الحمل فان بعض الأدوية يكون لها تأثير خطير, قد يؤدي إلى حدوث نزيف أو إلى موت الجنين. وتؤدي الكحوليات إلى ضمور في خلايا جدار المعدة , وهذا يسبب عسر الهضم . وإيقاف إفراز العصارات الهاضمة, مما يتسبب عنه سوء الامتصاص مع نقص شديد في الاحتياجات الغذائية للتمثيل الغذائي, وهذا يؤدي إلى ضمور خلايا الجهاز العصبي, إلى تلف خلايا الكبد, وتصلب الشرايين مع إتلاف مباشر لخلايا المخ والجهاز العصبي, وتلاحظ حالة صغر الرأس عن الولادة كما أن التآزر الحركي الدقيق يكون ضعيفا, ويختلف الضعف العقلي من المتوسط إلى الشديد (الخوجا , 2001).كذلك تناول (نصر الله , 2002) تأثير **سوء التغذية** بالنسبة للام الحامل في جميع مراحل حياتها؛ حيث ذكرانه يجب أن يشتمل غذاء الأم على العناصر اللازمة لها ولصحتها, كذلك لتطور نمو الجنين. فإصابة الأم الحامل بالأنيميا يمكن أن يحرم الجنين من التغذية اللازمة لنموه نمواً سليماً, حيث أن عدم توازن المواد الغذائية الكيماوية المختلفة والفيتامينات قد يتسبب في تلف دائم للجنين ينتج عنه تخلف عقلي. وتربط الكثير من الدراسات بين حدوث حالات الإعاقة العقلية البسيطة وسوء التغذية وخاصة في المناطق الفقيرة أو المعدمة , ومما يدلل على ذلك ارتفاع نسب حالات الإعاقة العقلية البسيطة بين أبناء الطبقات المتوسطة والفقيرة مقارنة مع أبناء الطبقات الغنية في دول العالم المختلفة, وخاصة في الدول الفقيرة أو تلك التي تعاني من الحروب والكوارث. **تلوث الماء والهواء؛** تعتبر المياه الملوثة والهواء الفاسد من العوامل التي تؤثر بطريقة غير مباشرة على نمو الجنين, وخاصة إذا ما تعرضت الأم الحامل إلى تلوث واضح في الماء والهواء, وخاصة في البيئات التي تزداد فيها نسب تلوث الماء والهواء بالغازات والمواد السامة ونتاج المصانع الكيماوية.

ثانيا : عوامل تحدث أثناء عملية الولادة:

من اهمها **الأطفال المبتسرون** (عدم اكتمال الحمل) : تفيد الدراسات إن هناك علاقة بين التخلف العقلي وبين الولادة المبسترة , فالولادة المبكرة لها مجموعة من الأسباب , والنتائج , وكلها تكون ضد الوليد, فالمواليد غير المكتملين أكثر عرضه للتلف العصبي, وهم أكثر عرضه للوفاة من المواليد. **والإصابات الجسمية** : قد تحدث أثناء الولادة بعض التعقيدات والتي تؤدي إلى حدوث جروح في دماغ الطفل. أو إلى نزيف داخلي, حيث يمكن أن يحدث هذا أثناء المخاض. نتيجة لوضع الجنين أو الأدوات المستخدمة في الولادة. وقد يؤدي التلف إلى التخلف الشديد والشلل والتشنجات, أو الشلل المخي ومشكلات في الإدراك ونشاط حركي زائد. ايضا **التشنجات**: تحدث هذه التشنجات نتيجة لاختلال الأكسجين وحوادث الولادة, وذلك بسبب كبر رأس الجنين عن الخوص, أو عند إخراج الطفل. و**نقص الأكسجين أثناء عملية الولادة**: يعتبر نقص الأكسجين للأم الحامل, والجنين, أثناء عملية الولادة من أهم العوامل التي تؤدي إلى أشكال متعددة من الحالات غير المرغوب فيها, سواء كان ذلك للأم نفسها, أو للجنين, حيث يؤدي ذلك إلى إحداث تلف في الخلايا الدماغية (القريطي . 2001).

ثالثاً: مجموعة أسباب ما بعد الولادة :

ومن أهم أسباب مرحلة ما بعد الولادة في حدوث حالات الإعاقة العقلية كما تناولها هارون, صالح(1992) نجد **سوء التغذية للطفل؛** ويعتبر سوء التغذية وخاصة في المناطق الفقيرة سبباً رئيسياً من أسباب حالات الإعاقة العقلية البسيطة في مرحلة ما بعد الولادة,... **والحوادث والصدمات؛** خاصة تلك الحوادث والصدمات التي تؤثر بشكل مباشر على منطقة الرأس , إذ تصاحب مثل هذه الحوادث أو الصدمات عادة نقصاً في الأكسجين , أو نزيفاً في الدماغ, أو كسوراً ي الجمجمة أو المخ. مما يؤدي إلى تلف الجهاز العصبي المركزي وبالتالي الإعاقة العقلية. ايضا **الأمراض والالتهابات؛** تعتبر الأمراض والالتهابات التي يتعرض لها الأطفال في سنوات حياتهم الأولى سبباً مباشراً من أسباب حدوث حالات الإعاقة العقلية. ومن الأمراض التي تصيب الأطفال في مرحلة عمرية مبكرة, وخاصة إذا لم يتم تطعيم الأطفال ضدها, مرض النكاف والحصبة والجدري والتهاب السحايا والتهاب الدماغ واضطرابات الغدد, ...الخ.

2-5. خصائص الطفل المعاق عقليا

على الرغم من تباين خصائص الأفراد ذوي الإعاقة العقلية إلا أن هذه الإعاقة غالباً ما تؤثر في مجالات النمو العقلي ، والجسمي / الحركي ، والانفعالي / الاجتماعي ، واللغوي ، والشخصي .

فمن **الناحية العقلية** يعاني هؤلاء الأفراد كمجموعة يعانون من ضعف الانتباه والقابلية للتشتت ، وعدم الإفادة من التعلم العارض ، ونجده مثل انتباه الطفل الصغير محدود في المدة والمدى, فلا ينتبه إلا لشيء واحد ولمدة قصيرة ويتشتت انتباهه بسرعة لان مثيرات الانتباه الداخلية عنده ضعيفة ويحتاج إلى ما يثير انتباهه من الخارج, والى من ينبهه الى ما يدور حوله ويشده الى الموضوع الأساسي, فلا ينشغل بمثيرات اخرى ليس لها علاقة بهذا الموضوع, وهذه خاصية تجعل المتخلف لا يتعلم من الخبرات التي تمر به الا اذا وجد من ينبهه إليها وحتى يدرك ويتعلم منها. بالإضافة الى ضعف الذاكرة قصيرة المدى، وضعف القدرة على التمييز من جهة والتعميم ونقل أثر التعلم من جهة أخرى، وضعف القدرة على التفكير المجرد. **ومن الناحية الجسمية / الحركية** فالأشخاص المتخلفين عقلياً، وإن كان نموهم يسير وفقاً للتسلسل الطبيعي، إلا أن لديهم ضعفاً عاماً أو تأخراً من حيث سرعة النمو أو معدله. وقد يصاحب الإعاقة العقلية وبخاصة الشديدة والشديدة جداً تشوهات مختلفة في الرأس أو الوجه أو في أطراف الجسم . ومن أهم المعوقات الجسمية التي تنتشر بين المعاقين عقليا: الصرع وصعوبات البصر والسمع والحركة والشلل الدماغي (مرسي, كمال 1999). كذلك فهم يكونون أكثر عرضة للإصابة بالأمراض ومظاهر الضعف المختلفة في الأجهزة العصبية والعضلية – العظمية وغيرها. و كلما قلت

درجة الذكاء واقتربت من 50 كلما بدأت الفروق في مستوى النمو الجسمي والحركي تظهر فهم اقل وزنا وطولا , وأقل قدرة على المشي بطريقة صحيحة (نصر , 1999) .

أما بالنسبة **للنمو اللغوي** فالإعاقة العقلية غالباً ما تؤثر سلباً على القدرة التواصلية للأفراد وتقود إلى ضعف أو تأخر لغوي وكلامي. فلغتهم تتطور ببطء وتتسم بعدم النضج وكلامهم غالباً ما يكون مضطرباً من حيث الانسياب / الطلاقة أو النطق أو الصوت. وفي حالات الإعاقة العقلية الشديدة والشديدة جداً فقد لا تتطور القدرات الكلامية وقد أشار هالمان وكوفمان (1982) الى الخصائص التالية :

- إن مدى انتشار المشكلات الكلامية واللغوية وشدة هذه المشكلات يرتبط بشدة الإعاقة العقلية التى يعاني منها الفرد , فكلما ازدادت شدة الإعاقة ازدادت المشكلات الكلامية واللغوية وأصبحت أكثر انتشارا .

- إن المشكلات الكلامية واللغوية لاتختلف باختلاف الفئات التصنيفية للإعاقة العقلية- إن البنية اللغوية لدى المعاقين عقليا تشبه البناء اللغوي لدى غير المعاقين عقليا فهي ليست شاذة , انها لغة سوية ولكن بدائية. ومن **الخصائص الانفعالية والاجتماعية** نجد ان العجز في السلوك التكيفي يعتبر من احد الخصائص المهمة للمعاق عقليا, ولا يعود ذلك للضعف العقلي فحسب بل ايضا الى اتجاهات الآخرين نحو المعاقين عقليا وطرق معاملتهم وهذا يؤدي الى تدني مفهوم الذات لديهم. و يشير الخطيب، جمال (2008) بقوله أنه كثيرا ما تفرض الإعاقات قيودا خاصة على الأطفال قد يكون لها أثر كبير على تطور مهاراتهم الاجتماعية والانفعالية. كما ان المتخلفين عقليا يظهرون انماط سلوكية اجتماعية غير مناسبة ويواجهون صعوبات بالغة في بناء العلاقات الاجتماعية مع الآخرين . ان المعاق عقليا يميل الى الانسحاب والتردد اضافة الى أن المعاقين عقليا لا يتطور لديهم شعور الثقة بالذات, فهم يعتمدون على الآخرين في حل مشكلاتهم. ان الطفل المعاق عقليا قد يكون هادئا ليتأثر بسرعة, حسن التصرف والسلوك راضيا بحياته كما هي , قانعا بإمكاناته المحدودة, ويستجيب اذا عاملناه كالطفل الصغير ويغضب اذا اهمل ولكن لا يستمر في الغضب فترة طويلة, فسرعان ما يضحك ويمرح ومن السهل التأثير عليه لأنه سريع الاستهواء (عبيد, ماجدة السيد, 2007) .

2-6. أهمية التربية الفنية لذوي الإعاقة العقلية

إن التربية الفنية بجانب كونها منهجا دراسيا يساهم في تعليم الأطفال غير العاديين , نجده أيضا يلعب دورا هاما في تنمية مهارات الطفل المعاق عقليا لحقيقة أن خصائص المعاق ومحدودية قدراته تجعله لا يستفيد بشكل جيد من دراسة المواد الأساسية بالمدرسة.

وقد أصبح الهدف من دراسة التربية الفنية المساهمة في تعديل السلوك وتربية الطفل المعاق في الجوانب العقلية، النفسية, الحركية والاجتماعية.. وهذا ما يشير إليه مصطلح التربية الفنية حيث تعني أن هنالك مساهمة في تربية التلاميذ عن طريق ممارستهم للأعمال الفنية والاستمتاع بها. (فراج, عفاف, 2001م).

إن ممارسة الأعمال الفنية لذوي الإعاقة العقلية بجانب مساهمتها في تربية الطفل فإنها تعني كذلك في ضوء مفاهيم التربية والتعليم والفن ضمان حدوث نمو فني من خلال ممارسات موجهة, وهذا النمو والتطور في مهارات الطفل المعاق تتحدد اتجاهاته في الآتي حسب ما صاغته ابوزيد, سميرة 2001م):

1. الرؤية الفنية: حيث يكون قادرا على الإحساس بالجمال ويدرك العلاقات التشكيلية.
2. الإبداع التشكيلي: وهو نشاط يقوم به الفرد ويشكل عالمه المحيط تشكيلا ماديا ينقل من خلاله أحاسيسه وانفعالاته وأفكاره إلى الرائي, وذلك في صيغ فريدة تعكس شخصيته.
3. الاتجاه الجمالي: ويمثل انعكاس النمو الفني على سلوك الطفل عندما يصدر قراراته ويبدي اختياراته.

وحسب الدراسات الحديثة وتحليل رسوم الأطفال المعاقين عقليا ثبت أن التربية الفنية في مدارس ذوي الاحتياجات الخاصة تأخذ في اعتبارها ألا يكون الابتكار وإبراز الجمال هو الهدف الرئيس، وإنما المساعدة على أن يكون التعبير الفني انعكاسا للصراعات الداخلية وانعكاسا لاهتمامات الفرد وأفكاره البسيوني, محمد, 1987م).

وتتضح **أهمية ممارسة الفن** لذوي الإعاقة العقلية في الآتي: (عبد الرحيم ,فتحي السيد, 1987م).

أولا: الاتصال بالبيئة؛ إن ممارسة الفن تدعم تجارب المعاق المتواصلة للاتصال بالبيئة, وهي وسيلة لتنشيط اهتماماته بالبيئة وتوثيق علاقاته بها, ومن ثم يمكن أن نلاحظ أهمية هذه الممارسات لأولئك الذين فقدوا بعض وسائل التفاهم الرئيسة تماما,

ثانياً: الاتزان الانفعالي؛ إن السماح للطفل المعاق عقليا بممارسة الفن هو سماح له بان يكون عضوا مؤثرا في بيئته المحيطة به من خلال ما تتضمنه أعماله الفنية من وجهة نظر خاصة لا تتشابه مع الآخرين، وهذا يختلف عن بقية المواقف الحياتية الأخرى, التي يكون الطفل متأثرا فيها بالآخرين طوال الوقت ومعتمدا عليهم. وان ممارسة التأثير على الآخرين والتأثر بهم يحدثان نوعا من الاتزان الانفعالي لدى هذا الطفل.

ثالثاً: التعبير عن المشكلات دون ضبط؛ إن التعبير الفني وسيلة جيدة وفاعلة في التعبير والتنفيس عن الصراع والمشكلات أيضا عن شعور المعاق ولا شعوره ودوافعه، دون اللجوء إلى عمليات الضبط أو الحذف لكل ما يراه غير ملائم للتعبير, وذلك كما يحدث في عمليات التعبير الأخرى. ويصاحب هذه العمليات نوع من الإشباع البديل للدوافع.

رابعاً: تنمية الحواس؛ إن ممارسة الفن لها تأثيرها الايجابي على تنمية الحواس، فهي تتيح للحواس وبعض أعضاء الجسم, كالبصر واللمس, فرصة كبيرة لتناول الخامات , وأحداث معالجات متنوعة.. وهذا بدوره يساعد في تنمية الحواس والقدرة على التمييز بين الأشكال والهيئات والصور والألوان وغيرها، وعلى توظيف العضلات الصغرى والكبرى, وبالتالي اكتساب المهارات اليدوية.. Rubin & Judith, 1954.

خامساً: توظيف العمليات العقلية؛ فممارسة الأنشطة الفنية لها تأثيرها الايجابي على الأفراد أو ذوي الإعاقة العقلية من حيث توظيف العمليات كالملاحظة والانتباه والإدراك والتعميم والاختيار والقدرة على فهم المعلومات البصرية. وهذا التوظيف يمكن أن يفيد في مواقف الحياة المختلفة. وعليه تعتبر الممارسات الفنية وسيلة وجسرا لتعليم هذه الفئة وتكيفها مع مفردات البيئة.. (أبو القطط، عائدة,2001م).

ويضاف إلى كل ذلك ما يمكن أن تشكله التربية الفنية من أهمية للمعاق تتمثل في تحقيق الشعور بالثقة – التنفيس الانفعالي – تحقيق الذات –تحقيق التوافق- والاهتمام بالقيمة الفردية للطفل المعاق.. (عبلة حنفي,عبلة, وزهران, حامد, 1980م).

وتتضح أهمية الخبرة الفنية لدى الأطفال المعاقين بشكل عام في إكسابهم عدد من المهارات والقيم والاتجاهات، منها ما ذكره عبد الحميد، (1420هـ: 81):

1. وسيلة ممتازة للتعبير عن المشاعر والأفكار
2. يكتشف أنه يعمل بالخامات وليس ضدها، ويتفهم خصائصها بعقله كما تفهمها بحواسه.
3. وسيلة للبهجة والسعادة في البيئة المحيطة بالطفل

ويدخل ضمن أهداف التربية الفنية أيضا إعداد الطفل غير العادي لحياة عادية, إعادة تكيف الطفل المعاق, تعويض الطفل المعاق عن جوانب النقص, والكشف عن خصائص فنون المعاق بجانب علاجه تربويا عن طريق العلاج بالفن, حيث أفسحت دراسات العالم النفسي فرويد1856- 1939 عن بعض الخطوط الدالة على ماهية الفن وقدرة الفنون على احتضان مشاعر نفسية ذات صلة مباشرة بالفنان تكشف عن شخصيته النفسية.

2-7. دور الأنشطة الفنية الفردية في تنمية المعاقين عقلياً:

هناك عدد من الأهداف التي يمكن أن يتم تحقيقها من خلال الأنشطة الفنية الفردية مثل التلوين أو تشكيل الصلصال، وهي: (الغامدي، 1429هـ: 30)

1. تدريب الحواس على الاستخدام غير المحدود.
2. التنفيس عن الانفعالات.
3. تأكيد الذات والشعور بالثقة فيها.
4. التدريب على استخدام بعض المواد والأدوات.
5. معرفة مصادر العدد والأدوات والخامات .
6. شغل وقت الفراغ بشكل مثمر نافع.

دور الأنشطة الفنية الجماعية في تنمية المعاقين عقلياً.

كما أن هناك عدداً من الأهداف التي يمكن أن يتم تحقيقها من خلال الأنشطة الفنية الفردية، فهناك أيضاً عدد من الأهداف للأنشطة الفنية الجماعية مثل المشروعات والمعارض ، وهي: (الغامدي، 1429هـ:30)

1. تنمية الناحية العاطفية أو الوجدانية.
2. التدريس على أسلوب الاندماج في العمل والتعامل.
3. الترابط الاجتماعي وتوحيد مشاعر الناس.
4. تنمية شخصية المتعلم وقدراته وإعداده كمواطن في حياته داخل المدرسة وخارجها.
5. تنمية روح الجماعة عن طريق إسهامه في المشروعات أو الوحدات الدراسية.
6. نشر الثقافة البصرية في المجتمع المدرسي بما يساعد على تكوين المفاهيم الجمالية على أسس موضوعية.
7. تزويد الطلبة بالمفاهيم والمصطلحات الفنية، ودور الأدوات والخامات والأجهزة في الإنتاج.
8. المشاركة الجماعية الإيجابية في أعمال فنية جماعية، ومعارض فنية.
9. الربط بين الفن، والمهن المختلفة في البيئة المحلية.

وقد تناول حسين الطيبي دور التربية الفنية في رعاية المعاقين ذهنيا على النحو الآتي

1. تنمي فيهم الثقة بالنفس ويجد فيها المعاق نفسه ويشعر من خلالها بالنجاح والإشباع
2. تحقيق التوازن الانفعالي.
3. أن الأعمال الفنية التي ينتجونها تعد مفاتيح تشخيصية للصعوبات الانفعالية والمشكلات التي تصاحب الإعاقة.
4. تنميه القدرة على الانتباه والتميز مما يؤدى إلى تأثير إيجابي في جميع جوانب شخصية المعاق ذهنيا.

هذا وقد ظهرت قديما بعض من البرامج التي استدخلت تطبيقات التربية الفنية كأسلوب تعليمي ضمن أساليبها التربوية, من أهمها ما طبقته الرائدة دسيدرس, حيث اعتبرت الرسم شكل من أشكال الكلام لذلك تقول " أن الرسم في بعض الأحيان هو الطريقة الرئيسة التي يستطيع بها الطفل أن يعبر عن أفكاره".. مجدي عزيز,(2003م).

إن توفير أسس الرعاية والعناية بالمعوق وتطوير طرق تربوية وعلاجية , تمكننا من تصحيح الكثير من المفاهيم الخاطئة في مجتمعنا لمفهوم الإعاقة والمعاقين . بدأ البحث في حل هذا الإشكال في العالم منذ زمن طويل لإطلاق قدرات المعاقين بطرق بسيطة سهلة , تساعد على تحفيز الفعل الكامن في داخلهم , فالكثير من المصابين بالإعاقة العقلية يمتلكون كفاءات معرفية لا يستطيعون توظيفها دون مساعدة , فلا بد من توفير مساعدة آلية بسيطة , وطرق تربوية وعلاجية حديثة لتطوير قدراتهم, وهذا لا يتم إلا بتضامن جهود علماء التربية وعلم النفس والاجتماع والطب , وبناء منظومة من البرامج التربوية العلاجية لكل حالة من حالات الإعاقة. **وتعتمد أنواع العلاجات التالية :** كما وضحها (لطيف الحبيب , 2010م)

- العلاج النفسي والاجتماعي لدراسة الحالة النفسية والسلوك الاجتماعي للمعاق لوضع البرامج العلاجية المناسبة لتلك الإعاقة .
- العلاج التربوي الذي تنفذه مدارس ومعاهد إعادة تأهيل المعوقين.
- العلاج الطبيعي يتكون من علاجات متنوعة كالسباحة والموسيقى واللعب مع الحيوانات ,ينفذه كادر مختص في العلاج الطبيعي والمساج .
- العلاج اللغوي يساعد المعاق في تحسين أدائه اللغوي اللفظي المتوفر وتطوير اللغة غير اللفظية كالإيماء والمحاكاة والإشارة من قبل كادر مختص.
- العلاج بتوفير العمل للمعاق , فمشاركة المعاقين بشكل واسع في النشاطات الاجتماعية والثقافية والإنتاجية , يؤثر بشكل فعال على تحسين قدراتهم التعليمية وبالتالي تمكنه من الاشتراك في مجالات وحقول العمل المختلفة .

2-8.أهم ضوابط عملية العلاج لذوي الاعاقة العقلية:

هناك مجموعة من الضوابط التي لابد من أخذها بعين الاعتبار عند تقديم الاستراتيجيات العلاجية ذوي الاحتياجات الخاصة وقد تم ذكر اهمها في الاتي: أن يسبق البرنامج العلاجي التشخيص والتقييم الشامل والدقيق من قبل فريق متعدد التخصصات لحالة الطفل من ذوي الإعاقة من جميع النواحي النفسية والتعليمية والطبية والاجتماعية, واختيار البرنامج العلاجي المناسب لإشباع احتياجات الطفل من ذوي الاحتياجات الخاصة وتحقيق أقصي درجة من النمو التعليمي والنفسي والاجتماعي في إطار الأهداف المراد تحقيقها. (عامر، طارق ومحمد ربيع, 2008م). كما اضاف (الكيلاني ,سيد 2012م) الفردية في البرامج العلاجية حيث لا يمكن أن يكون هناك قالب علاجي واحد يصلح مع كل الأفراد وإن كان الاضطراب أو الخلل واحد إذ يتأثر ذلك بمتغيرات عده, بجانب وصف المستويات الحالية للأداء لكل فرد من ذوي الإعاقة بما في ذالك التكيف الشخصي ، والتكيف الاجتماعي ، ومهارات العناية بلذات ، والمهارات الحركية، ومستوى الأداء الأكاديمي. ايضا تناول تحديد الأهداف طويلة المدى في أي برنامج علاجي, وتحديد الأهداف قصيرة المدى بجانب وصف الخدمات العلاجية والخدمات المساندة والوسائل والأدوات التدريبية و تحديد موعد البدء بتقديم الخدمات العلاجية. واكد (أبو حلتم،سعيد, 2005) اهمية تحديد أعضاء فريق التشخيص المسئولين عن تنفيذ البرنامج العلاجي لكل انواع الاعاقات و أن يكون البرنامج العلاجي واضحا من حيث مكوناته الأساسية وتدرجها من حيث المستوى، وأن تكون هذه المكونات مشوقة بالنسبة للمتعلم, مع تنويع

أنشطة التعليم العلاجية بحيث تشتمل على بعض الأنشطة التفصيلية (الحسية الحركية) ومحاولة تحويلها إلى نشاط جماعي مع مراعاة الفروق الفردية لكل فرد من ذوي الاحتياجات الخاصة . وهذا ما كان قد اشار اليه ايضا (جلجل، نصره محمد, 2005) اضافة الى ضرورة تدريب الوالدين والأسرة كجزء من البرنامج العلاجي. وتقويم فاعلية البرنامج العلاجي بشكل مستمر (الخطيب، جمال, 2001م).

وقد اكدت ايضا (شقير، زينب, 2013م) بانه لابد من وجود فريق عمل متكامل يتكون من مجموعة من الأعضاء لكل منهم عمله التخصصي وهم: الطبيب ، التمريض، الأخصائي النفسي، الأخصائي الاجتماعي، معلم التربية الخاصة، الوالدان) ، وقد ينضم إلى هذا الفريق بعض المتخصصين تبعا لنوع الإعاقة مثل أخصائي العلاج الطبيعي في حالة الإعاقة الجسمية الحركية، أخصائي التخاطب و أخصائي التأهيل السمعي في حالة ذوي الإعاقة السمعية ... وهكذا. حيث يتم وضع الخطة العلاجية والتربوية الملائمة لحاجات وخصائص الطفل من ذوي الاحتياجات الخاصة بعد تحديد نقاط القوة ونقاط الضعف التي يعاني منها الطفل من ذوي الإعاقة وتناول ايضا(سليمان، عبد الرحمن, 1998م) اهمية التشخيص موكدا على ضرورة توفر الدقة في تشخيص حالات ذوي الاحتياجات الخاصة حيث انها هي الضمان الوحيد لنجاح البرنامج العلاجي المقدم للطفل.

4. الدراسات السابقة

4-1. الدراسات العربية

اهتمت العديد من الدراسات العربية بالبحث في أساليب تطوير قدرات ومهارات المعاق عقليا , ورغم ان هذه الدراسات تباينت من حيث الاهداف والمحتوى الا انها كانت قدتشابهت في تناول اثر مجالا من مجالات الفنون في تطور مهارة سلوكية عند المعاق.

نجد **دراسة سوزان رضوان,2009م** بعنوان: **أثر استخدام العرائس في اكساب التلاميذ ذوي الاحتياجات الخاصة القابلين للتعلم بعض القيم** كانت قد استهدفت التعرف على اثر استخدام مسرح العرائس في اكساب التلاميذ ذوي الإعاقة الذهنية القابلين للتعلم بعض القيم وذلك بالتطبيق على عينة من تلاميذ المدارس الفكرية بمحافظة الدقهلية – مصر بعد تقسيمهم إلى مجموعتين الاولى ضابطة مكونة من 10 تلاميذ وتلميذات والثانية تجريبية مكونة من 10 تلاميذ وتلميذات. وقد توصلت الدراسة إلى تأكيد اثر استخدام المسرح في اكساب التلاميذ ذوي الاحتياجات الخاصة القابلين للتعلم بعض القيم. اما **دراسة شيماء الدياسطي, 2006م, كانت قد** تناولت **فعالية استخدام برنامج مسرح العرائس في تنمية قدرات التفكير الابتكاري لدى اطفال ما قبل المدرسة** من سن 5 -6 سنوات وقد بلغ عدد أفراد العينة 16طفلا وطفلة. استخدمت الباحثة اختبار قوودانف هاريس للذكاء واستمارة المستوى الاقتصادي والاجتماعي بجانب اختبار التفكير الابتكاري بالحركة والافعال لمحمد ثابت على الدين, وتوصلت الدراسة إلى وجود فروق دالة احصائيا بين المجموعتين في قدرات التفكير الابتكاري.

أما **دراسة إبراهيم،2006 م:** بعنوان " **إجراءات تعليمية يستخدمها معلمي التربية الفكرية في تعليم وتدريب التلاميذ المتخلفين عقلياً (نموذج خطة مقترحة** ". مقدم لجائزة حمدان بن راشد آل مكتوم – للأداء التعليمي المتميز),فقد هدفت إلى وضع نموذج لخطة تدريس مقترحة لمساعدة معلمي ومعلمات التربية الفكرية على القيام بوضع تصوراتهم الخاصة بكيفية التخطيط لتوصيل المهارات الأكاديمية الوظيفية، ومهارات الحياة اليومية، والمهارات الاجتماعية، والبدنية، والمهنية لتلاميذهم المعاقين عقلياً, وفي منهج الدراسة استخدم الباحث المنهج الوصفي لمعالجة مشكلة دراسته المتمثلة في الوصول إلى طريقة مقترحة لتدريس وتدريب التلاميذ المتخلفين عقلياً، وإبراز الملامح الأساسية لنموذج التدريس المقترح، حيث قدّم وصفاً وافياً للإجراءات التعليمية التي يجب أن يتخذها معلم التربية الفكرية لمساعدة تلاميذه المتخلفين عقلياً في مواجهة الصعوبات والمشكلات التي تقابلهم أثناء تعرضهم للمثيرات المختلفة خلال مراحل التعلم الثلاث (الاكتساب، الاحتفاظ، النقل). نتائج الدراسة: توصلت الدراسة إلى الاستنتاج التالي:- يمكن لمعلم التربية الفكرية أن يخطط وينظم عملية تعليم التلاميذ المتخلفين عقلياً على نهج الإجراءات التعليمية المتمثلة في نموذج الخطة المقترحة والمنسّقة مع قواعد ومبادئ الاتجاه السلوكي في تعليم التلاميذ المتخلفين عقلياً، فمثل هذه الخطط تمكنه من إنجاز عملية التعلم بكل يسر وسهولة بحيث يقوم ببرمجته في خطوات تدريسية صغيرة متدرجة من السهل إلى الصعب.

قدم **عزام، 2004م** دراسة بعنوان " **دور الفنون في تأهيل المعاقين ذهنياً** ", وهي دراسة مقدمة إلى المؤتمر العربي الثاني "الإعاقة الذهنية بين التجنب والرعاية" 14- 15 ديسمبر 2004م،جامعة أسيوط. هدفت الدراسة إلى بيان دور الفنون التعبيرية في تأهيل المعاقين ذهنياً، وبناء مقياس لدور الفنون المختلفة في تأهيل المعاقين ذهنياً، كذلك استخدام عمليات الإبداع والتعبير في إعادة تأهيل وعلاج اضطرابات التوافق والاضطرابات العقلية والانفعالية. اعتمد الباحث المنهج التجريبي من خلال الدراسة الميدانية باستخدام مقياس دور الفنون التعبيرية في تأهيل المعاقين ذهنياً على عينة تتكون من عدد (20) طفل من الأطفال متوسطي الإعاقة، وعدد (10) أطفال من الأطفال بسيطي الإعاقة، وعدد (5) من الأطفال العاديين في المدارس العادية. وتوصلت الدراسة إلى أن الفنون التعبيرية تهيئ الطفل المعاق ذهنياً للوعي بذاته، إذا ما استخدمت طرق التدريس والأدوات المناسبة، واستخدام الفنون كمعايير منظمة للعمليات والأنشطة التي يقوم بها الطفل، بحيث يمكنه التعلّم والتوافق خطوة بخطوة باستخدام بعض الأنشطة الفنية كالرسم أو التلوين وغيرها. كما توصلت إلى النتائج التالية

(95%) -1من الأطفال متوسطي الإعاقة يحبون مادة التربية الفنية ويستمتعون بخامة الصلصال بينما هناك (5%) من الأطفال يخافون منها.
(42%) -2من الأطفال متوسطي الإعاقة يمكنهم أن يختاروا بأنفسهم الخامة الفنية.
(71%) -3من الأطفال العاديين يمكنهم رسم رجل يجلس على كرسي بطريقة صحيحة بينما عجزت باقي العينة عن ذلك.
(57%) -4من الأطفال بسيطي الإعاقة يتقبلون العمل الجماعي وحوالي (75%) من الأطفال العاديين يتقبلون العمل الجماعي.

كذلك اجرت **رحاب صالح, 1999م دراسة** بعنوان مدى فعالية برنامج انشطة مقترح لتنمية بعض المفاهيم المكانية للأطفال المتخلفين عقليا القابلين للتعلم.هدفت الدراسة إلى اعداد برنامج يشمل مجموعة من الأنشطة (حركية- قصصية –فنية-عقلية) لتنمية بعض المفاهيم المكانية, كذلك هدفت إلى اكساب الأطفال المتخلفين عقليا المفاهيم المكانية المتناولة بالدراسة وهي الاتجاهات المكانية –الخط المستقيم – المسافة – والترتيب. وقد استخدمت الدراسة المنهج التجريبي لعينة من مدرسة احمد شوقي للتربية الفكرية بالإسكندرية وعددها 10 اطفال كمجموعة ضابطة ويتراوح عمرهم الزمني من 9-12 سنة بنسبة ذكاء بين 50 – 75% . وادوات الدراسة كانت استمارة استطلاع رأي المعلمين حول مدى استيعاب الأطفال للمفاهيم المكانية (من اعداد الباحثة), مقياس لقياس خمسة انواع من المفاهيم المكانية لدى المتخلفين عقليا (اعداد الباحثة), والبرنامج المقترح. تمثلت اهم النتائج في وجود فروق ذات دلالة احصائية بين المجموعتين بعد تطبيق البرنامج المقترح لصالح المجموعة التجريبية على مقياس المفاهيم المكانية.

وفي ذات السياق نجد **دراسة نيفين بهاء الدين ابراهيم,1999م** بعنوان فاعلية قصص الأطفال في تنمية بعض جوانب النمو للمعاقين عقليا القابلين للتعلم.استهدفت الدراسة معرفة الخصائص العامة لقصص الأطفال التي يمكن ان تقدم للمعاقين عقليا من حيث البناء الفني –الشكل – فن الرواية. استخدمت الدراسة المنهج الوصفي وشبه التجريبي لعينة تكونت من 60 معلم من العاملين مع المعاقين عقليا ثم مجموعة من الأطفال المعاقين عقليا وعددهم10 اطفال ذكور واناث بعمر زمني5 – 7 سنوات من مدارس التربية الفكرية. تم استخدام استبيان لاستطلاع رأي المعلمين حول فعالية القصص من اعداد الباحثة, استمارة جمع البيانات من الأطفال المعاقين عقليا من اعداد الباحثة, البرنامج القصصي من اعداد الباحثة, وبطاقة تحليل القصة لكمال الدين حسين. توصلت نتائج الدراسة فعالية قصص الأطفال في تنمية بعض جوانب النمو للأطفال المعاقين عقليا القابلين للتعلم في مرحلة ما قبل المدرسة حيث ثبتت فعالية البرنامج المقترح.

أما **دراسة محمد ابراهيم عبدالحميد ,1996م** - بعنوان "العلاقة بين ممارسة بعض الأنشطة وتنمية التوافق النفسي والاجتماعي لدى الأطفال المتخلفين عقليا فقد استهدفت وضع برنامج لبعض الأنشطة الحركية والموسيقية والتعبيرية الفنية وتنمية التوافق النفسي والاجتماعي لدى بعض المتخلفين عقليا. تكونت عينة الدراسة من أفراد متخلفين اعمارهم بين 5 -7 سنوات وعددهم30طفلا وطفلة مقسمين بالتساوي إلى مجموعتين تجريبية وضابطة. وتم استخدام مقياس السلوك التكيفي-فاروق صادق, مقياس قوودانف للذكاء, برنامج لبعض الأنشطة المقترحة. توصلت نتائج الدراسة إلى وجود فروق دالة احصائيا بين المقياس القبلي والبعدي على الدرجات الكلية للمقياس.

ومن الدراسات التي تناولت الاسلوب التحليلي للمفاهيم النظرية نجد **دراسة منى صادق ميخائيل , 1996م,** بعنوان: "مسرح العرائس كاسلوب لاكساب أطفال الرياض بعض المفاهيم الاساسية لجان بياجية".هدفت الدراسة إلى استخدام مسرح العرائس في اكساب اطفال الرياض بعض المفاهيم الاساسية لجان بياجية, وتكونت العينة من 240 طفلا وطفلة برياض منطقة شرق الاسكندرية التعليمية ممثلة للاعمار بين 4 -6 سنوات.وقد تم استخدام المنهج التجريبي ذو المجموعتين الضابطة والتجريبية وتكونت كل مجموعة من 120طفلا وطفلة.وقد استخدمت الباحثة بعض الأدوات واهمها مسرح العرائس, مقياس المفاهيم المحددة في الدراسة (من اعدادها), بطاقات التقويم القبلي والبعدي(من اعداد الباحثة), اختبار الذكاء لقوود انف هاريس,استمارة تقدير المستوى الاقتصادي والاجتماعي للاسرة المصرية من اعداد عبدالعزيز الشخص. واظهرت النتائج ان المسرح اثبت فعالية عالية في اكساب المفاهيم الاساسية لجان بياجية لعينة الدراسة.

وفي نفس الاتجاه في تناول اثر المجال القصصي للفنون على فئة المعاقين عقليا نجد **دراسة ايمان عبد العزيز نور الدين,1993م**, بعنوان: تأثير استخدام القصة الحركية بمصاحبة الاغنية الشعبية على اللياقة الحركية والتفكير الابتكاري لطفل مرحلة ما قبل المدرسة. هدفت الدراسة إلى تنمية الابتكار باستخدام القصة الحركية بمصاحبة الاغنية الشعبية. وقد تم استخدام المنهج التجريبي المعتمد على القياس القبلي والبعدي لمجموعة تجريبية ومجموعة ضابطة, تكونت العينة من60 طفلا وطفلة أعمارهم بين 5 -6 سنوات. وقد تم استخدام اختبار ذكاء رسم الرجل لجوود انف, اختبار اللياقة الحركية لراجوون, واختبار التفكير الابتكاري لتورانس. وقد توصلت الدراسة لوجود فروق فروق ذات دلالة احصائية للقياس البعدي لصالح المجموعة التجريبية في ابعاد التفكير الابتكاري مما يشير إلى فعالية البرنامج المقترح بالدراسة. **ودراسة نادية عبد القادر, ١٩٨٨بعنوان " تأثير برنامج جمباز موانع خاص على تنمية الذكاء وبعض القدرات الحركية لدى المتخلفين عقلياً. "** هدفت الدراسة إلى التعرف على أثر ممارسة برنامج جمباز موانع خاص على تنمية كل من القدرات الحركية والذكاء لدى المتخلفين عقلياً القابلين لل تعلم والمنهج المستخدم هو المنهج التجريبي على عينة قوامها) ١٥٠ (تلميذاً وتلميذة وكان العمر الزمني

١٢ سنة من فئة المورون ، وأسفرت النتائج عن أن ممارسة برنامج جمباز : من ٨ الموانع)الحس حركي (له تأثير إيجابي على القدرات الحركية لدى المتخلفين عقلياً ، وله تأثير إيجابي على الذكاء لدى المتخلفين عقلياً) .١٨

وايضا نجد دراسة السيد محمد البسيوني,1992م وعنوانها: برنامج مقترح لتنمية بعض المهارات الاجتماعية لمفهوم الدور من خلال النشاط الدرامي الاجتماعي الخلاق (مسرح خيال الظل) لطفل ما قبل المدرسة. تكونت العينة من 60 طفلا من سن4 -6 سنوات.واهم الأدوات المستخدمة كانت اختبار رسم الرجل لجوودانف هاريس, البرنامج المقترح, استمارة العامل الاجتماعي الاقتصادي لزكريا الشربيني, اختبار بطاقات مصورة من اعداد الباحث. من اهم نتائج الدراسة: توجد فروق ذات دلالة احصائية بين متوسطي درجات أطفال المجموعة التجريبية في تطبيق الاختبار المصور لقاس مهارات الدور الجتماعي قبل وبعد تطبيق البرنامج لصالح المجموعة بعد التطبيق.

كما نجد **دراسة هانم أبو الخير الشربيني, 1987م** بعنوان: استخدام مسرح العرائس في تعديل بعض انماط السلوك المشكل لدى أطفال الروضة. هدفت الدراسة إلى تقديم برنامج متكامل يشمل مجموعة مسرحيات متكاملة يمكن استخدامها مع اطفال ما قبل المدرسة في تعديل سلوكهم العدواني والاعتمادي. تكونت عينة الدراسة من 240 طفلا وطفلة تراوحت اعمارهم بين 4-6سنوات. وقد استخدت الباحثة مقياس السلوك العدواني(من اعدادها) ومقياس السلوك الاعتمادي للأطفال (من اعدادها), والمسرحيات الخاصة بتعديل السلوك.واظهرت النتائج وجود فروق دالة احصائيا بين درجات الأطفال الذكور والاناث على مقياس السلوك العدواني قبل وبعد تطبيق البرنامج, وان استخدام مسرح العرائس مع اطفال ما قبل المدرسة يساعد في تعديل بعض السلوكيات السلبية مع اكسابهم بعض السلوكيات الايجابية.

4-5. الدراسات الأجنبية

لم يتم تناول الاثر النمائي للفنون بشكل كبير في الدراسات الاجنبية, ومع ذلك نجد بعض الاهتمام بفن القصة ومسرح العرائس كاسلوب مستهدف للبحث في اثره النمائي والتطوري لفئة المعاقين عقليا.

ومن هذه الدراسات نجد **دراسة Gibson ,1992م 1بعنوان:** "The Art of puppetry" فن العرائس". استهدفت الدراسة البحث في إلى أي مدى يشجع مسرح العرائس الأطفال على العمل والابتكار من خلال النصوص المقدمة لهم. قام الباحث بتحليل مضمون المسرحيات المقدمة للأطفال واعتمد نموذج (ايزينير) الذي يرتكز على التوضيح, التفسير, والتقييم. ثم قام بملاحظة الأطفال اثناء مشاهدة العروض. ووجد ان مسرح العرائس قد نقل طرقا مختلفة للابتكار.

اما الدراسات التي كانت قد اثبتت امكانية تطور الذكاء لدى المعاقين عقليا من اهمها دراسة كوردر* Corder ,١٩٧٣بعنوان " تأثير برنامج تربية رياضية خاص على مستوى الذكاء واللياقة البدنية عند المتخلفين عقلياً. " هدفت الدراسة إلى التعرف على تأثير برنامج تربية رياضية خاص على مستوى

الذكاء واللياقة البدنية عند المتخلفين عقلياً ، استخدم الباحث المنهج التجريبي على عينة

قوامها) ١٦ (طفلاً متخلفاً عقلياً ، وأسفرت النتائج عن تقدم ملحوظ في مستوى الذ كاء) واللياقة البدنية) **٢٣**

أما دراسة **Maes Michael,1994 بعنوان" استخدام رواية** القصة في تعليم القراءة للمعاقين ذهنيا", فلادلفيا كانت قد استهدفت استخدام طريقتين من طرق رواية القصة بالاستعانة براوي القصة واستخدام الأدوات التقليدية في تعليم القراءة. تمثلت عينة الدراسة في مجموعة من التلاميذ بمدارس فلادلفيا تتراوح اعمارهم بيت 5 – 7 سنوات والاخرى من 8 -11 سنة من المعاقين ذهنيا واستغرقت الدراسة 5 اشهر بمعدل مرتين اسبوعيا. توصلت نتائج الدراسة إلى تحسن المعاقون ذهنيا في القراءة بتفوق اعلى بين الاناث وقد اظهر البرنامج فائدة كبرى للمدربين والمتدربين على حد السواء.

وهنالك دراسة Nainis & Paice (2006) كانت قد اجريت بهدف معرفة اثر الانشطة الفنية الهادفة في علاج بعض الاعراض النفسية للمرضى. وتم استخدام الفن التشكيلي مع فئة مرض السرطان. وقد اشارت نتائج الدراسة الى وجود اثر ايجابي على ثمانية اعراض نفسية تعاني منها هذه الفئة التي كانت قد اظهرت تحسنا ملحوظا ومباشرا انعكس بالفائدة في حياتهم وتحسن اوضاعهم العلاجية.

تناولت جميع الدراسات التي تم ذكرها دراسة الاثار الايجابية لممارسة الفنون على الأطفال المعاقين عقليا بخلاف الدراسة الاخيرة التي اكدت لنا على دور الانشطة الفنية في التأثير على الدفعة الحيوية بشكل عام على كل اشكال الاضطرابات والمشكلات النفسية والجسمية. وقد اثبتت هذه الدراسات عموما وجود دلالة واضحة للأنشطة الفنية على التطور النفسي والاجتماعي للطفل. لكن يؤخذ على هذه الدراسات عدم شموليتها لجوانب اخرى مهمة وتعد قصورا اساسيا يعاني منه المعاق عقليا, الا وهو جانب الانتباه والذكاء العملي بالإضافة إلى مشكلة التآزر الحسي حركي. وهذا ما دعا الباحثة إلى تناوله كقضية اساسية في هذه الدراسة. ايضا ولصعوبة التحقق من مستوى التطور النمائي كمتغير تابع لأثر المتغير المستقل (البرنامج العلاجي) لخصوصية العينة, تقوم الدراسة الحالية باعتماد المقارنة بين المجموعتين الضابطة والتجريبية اضافة إلى القياسات القبلية والبعدية لذات المجموعة التجريبية بخلاف جميع الدراسات السابقة.

5. منهج الدراسة وإجراءاتها

منهج الدراسة: تم استخدام المنهج التجريبي المعتمد على القياس القبلي والبعدي في مستويات الاداء السلوكي لمجموعة تجريبية ومجموعة ضابطة.

5-1. إجراءات الدراسة:

وقد اشتملت إجراءات الدراسة على: (مجتمع الدراسة وعينتها، أدوات الدراسة، طريقة التطبيق، الأساليب الإحصائية).

5-2. مجتمع الدراسة:

تكون مجتمع الدراسة الحالية من التلميذات ذوات الإعاقة العقلية ب(معهد التربية الفكرية) في مدينة الهفوف بالأحساء- بالمملكة العربية السعودية.

5-3. عينة الدراسة وخصائصها:

تكونت عينة الدراسة من 16 طفلة معاقة عقليا تم اختيارهن وفق الشروط التالية:

- اعمارهن العقلية بين 113- 201شهرا. وبأعمار زمنية بين 9 و15سنة.
- من ذوي الإعاقة العقلية البسيطة تم التحقق من هذا الشرط باستخدام مقياس رسم الرجل لقوودانف المقنن على البيئة السعودية. درجات الذكاء تراوحت بين 58 - 72 درجة.
- تتوفر فيهن مشكلة قصور الدفعة الحيوية المتمثلة في:
  - مشكلة قصور التآزر الحسحركي -وتم التأكد من ذلك الشرط باستخدام مقياس التآزر الحسحركي.
  - تشتت الانتباه – وتم التحقق من توفر هذا الشرط باستخدام مقياس الانتباه للمعاق عقليا من اعداد الباحثة.
  - أن لا تعاني الطفلة من أية إعاقات قد تؤثر على استجابتها أو فهمها كالإعاقة السمعية: وقد تم التأكد من تحقيق هذا الشرط من خلال التقارير الطبية, ملف الطالبة, المعلمات, وملاحظة الباحثة.

5-4. أدوات الدراسة

تكونت أدوات الدراسة من الاختبارات التالية:

1. **اختبار الذكاء.**

وصف الاختبار

تم تطبيق اختبار رسم الرجل لقوودانف(النسخة السعودية, فؤاد ابوحطب وآخرون) من المقاييس المصنفة ضمن مقاييس القدرة العقلية ويهدف إلى توظيف رسوم الاطفال للتعرف على قدراتهم العقلية بتحديد درجة الذكاء وسماتهم الشخصية ايضا, تم اعداد الاختبار بواسطة قوود انف 1926 وطوره هاريس1936 ثم على عدة بيئات غربية وعربية. وقد تم تقنينه على البيئة السعودية بواسطة فؤاد بو حطب 1979 وتم تطويره بشكل متكرر وشمل 77 عنصرا يعكس البيئة السعودية.

2. **جهاز قياس التآزر الحسحركي.**
3. **"مقياس الانتباه لذوي الإعاقة العقلية" من إعداد الباحثة ويتكون من**

الصورة المنزلية؛ تم إعداد المقياس من خلال إيمان الباحثة بالدور الأساسي والفاعل الذي يلعبه الأهل في عملية تقييم الأطفال المعاقين عقليا. فهم مصدر مهم للمعلومات التشخيصية حيث يتوفر لهم الوقت الكافي والفرص العديدة لمراقبة سلوك أطفالهم وبخاصة انتباه الطفل واستجابته للمثيرات الحسية المختلفة.

الصورة المدرسية: تضم عدد من البنود عن سلوك المعاق في البيئة المدرسية، وتطبق بواسطة المعلمين.

الصورة الذاتية: يتم اختبار الطفل بشكل مباشر من خلال قياس مستوى الاستجابة على عدد من المثيرات الحسية.

وقد تم إعداد صور المقياس ومن ثم توزيعها على عدد من أساتذة الجامعات داخل المملكة وخارجها لتحكيم المقياس والتأكد من موافقة فقراته للهدف الذي وضعت له، وبعد تحكيم الفقرات تم الأخذ بالتعديلات اللازمة للأخطاء اللغوية والعلمية.

دلالات صدق المقياس:

للتعرف على دلالات صدق المقياس تم استخراج دلالات صدق المحتوى وصدق البناء وصدق المحكمين.

صدق البناء : تم التحقق من صدق البناء للمقياس من خلال حساب معاملات الارتباط (بيرسون) بين كل فقرة والدرجة الكلية للاختبار، حيث اعتبرت الدرجة الكلية محكاً لصدق فقرات الاختبار. وتم حساب معاملات الارتباط البينية بين الدرجة الفرعية للفقرات، والدرجة الكلية للاختبار، وقد كانت معاملات الارتباط لجميع فقرات المقياس والدرجة الكلية تتراوح بين (0.87 - 0.84) وجميعها معاملات قوية وموجبة.

صدق المحكمين: للحكم على صدق الاختبار تم عرض الاختبار على لجنة من المختصين تألفت من مختصين اثنين في القياس والتقويم من كلية التربية، وثلاثة من أخصائيين التربية الخاصة بدرجة الدكتوراه وثلاثة من المختصين الحاصلين على درجة الدكتوراه في علم النفس. وبعد استعراض أراء المحكمين، أجريت التعديلات الضرورية على فقرات الاختبار حسب الاقتراحات المقدمة، فتمت إزالة الصور التي لا تناسب البيئة السعودية والمستويات التي ستتم عليها الدراسة، كما أضيفت فقرات جديدة على الاختبار.

ثبات الاختبار :قامت الباحثة بحساب معامل الثبات عن طريق التجزئة النصفية, وكان معامل الثبات للمقياس ككل مساوياً (0.62) وهو دال عند مستوى (0.01) ثم قامت الباحثة بتصحيح هذا المعامل باستخدام معادلة (سبيرمان- براون) فكان معامل الثبات بعد التصحيح مساوياً (0.76) وهو دال عند مستوى (0.01)

5-5. تصميم الدراسة:

1. اعتمدت الباحثة في دراستها الحالية على المنهج التجريبي، وقامت بتوزيع أفراد العينة عشوائيا على مجموعتين قوامها (16) طفلاً مقسمة بالتساوي على مجموعة تجريبية ومجموعة ضابطة، ثم عينت المجموعة التي ستخضع للبرنامج بشكل عشوائي. وسميت المجموعة التي خضعت للبرنامج العلاجي المجموعة التجريبية والأخرى ضابطة.
2. طبق مقياس التآزر الحسحركي على أفراد كلا المجموعتين قبل البدء بتنفيذ الدراسة للتأكد من وجود مشكلة ضعف التآزر الحسحركي بين أفراد العينة.
3. طبق اختبار قوودانف للذكاء على أفراد كلا المجموعتين كذلك للتأكد من وجود مشكلة تدني مستوى الذكاء بين أفراد العينة عند مستوى الاعاقة العقلية البسيطة.
4. ايضا تم تطبيق مقياس الانتباه على أفراد كلا المجموعتين قبل البدء بتنفيذ الدراسة للتأكد من وجود مشكلة ضعف الانتباه بين أفراد العينة.
5. طبق البرنامج التجريبي على أفراد المجموعة التجريبية، أما أفراد المجموعة الضابطة فتم تدريبهم على البرامج المستخدمة في مركزهم أسوة ببقية الطالبات بالمركز.

تضمنت **متغيرات الدراسة** المتغير المستقل: هو إعطاء البرنامج من عدمه ويتكون من مستويين:

اولهما المجموعة التجريبية وهي التي خضعت للبرنامج التجريبي , والثانية المجموعة الضابطة وهي التي لم تخضع للبرنامج التجريبي. وشملت المتغيرات التابعة: الدفعة الحيوية ممثلة في درجة التآزر الحركي ومستوى الانتباه ودرجة الذكاء..

6-5. البرنامج العلاجي المقترح

ويتكون من عدد من الأنشطة الفنية في شكل برنامج تربوي صمم وفق الأسس العلمية للنظريات السلوكية, التحليلية, والمعرفية. يستهدف البرنامج الجوانب الإنمائية للطفل في عدد من المهارات أهمها الانتباه والتآزر العضلي وتطور استخدام الذكاء.

1-6-5.الأهداف الفرعية للبرنامج:

1. مساعدة المحيطين والمهتمين برعاية الأطفال ذوي الإعاقة العقلية على إدراك مفهوم نقص الدفعة الحيوية، والأعراض المصاحبة لها، وأسس البرنامج المقترح لعلاج هذه الاضطرابات.
2. تحسين قدرة الأطفال ذوي الإعاقة العقلية على مهارة التآزر الحسحركي.
3. إكساب الأطفال ذوي الإعاقة العقلية مهارات تواصلية سليمة خالية من الأخطاء، وتشجيعهم على تطوير الانتباه لديهم .
5. التأكيد على دور الأطفال ذوي الإعاقة العقلية، كمشاركين نشطين في العملية العلاجية.

2-6-5.المسئول عن تنفيذ البرنامج:

لقد قامت بالقياس القبلي الباحثات المساعدات بإشراف مباشر ويومي من الباحثة الرئيس، ومشاركة الباحثة نفسها في العديد من الجلسات التشخيصية، أما بالنسبة للجلسات العلاجية للمجموعة التجريبية فقد قامت بها الباحثة نفسها بمساعدة معلمات متخصصات في التربية الفكرية.

3-6-5.جلسات البرنامج:

لقد تم تقسيم البرنامج على خمسة وأربعين جلسة علاجية، وكانت المدة الزمنية لكل جلسة نصف ساعة وذلك وفقاً للنظام المتبع في التدريس، وقد تم توزيع الجلسات العلاجية على النحو التالي:

1. الجلسات الثلاث الأولى في البرنامج خصصت لإرشاد الباحثات المساعدات والمعلمات، وذلك لتعريفهن بأسس تشخيص الطفل، وخطة العلاج، ودورهم في تطبيق البرنامج العلاجي المقترح.
2. تم توزيع الجلسات العلاجية المتبقية وعددها اثنين وأربعون جلسة على اربعة عشر أسبوعاً بواقع ثلاث جلسات أسبوعياً.
3. طبقت بعد ذلك الاختبارات البعدية في الذكاء والانتباه والتازرالحركي على أفراد الدراسة وذلك لقياس مدى فاعلية البرنامج المقترح، ونسبة التحسن في مستوى قدرات المعاقات.

6. التحليل الاحصائي والمناقشة

للتاكد من صدق فرضيات الدراسة تم تحليل البيانات احصائيا على برنامج ويلكوكسون لقياس الفرق قبل وبعد تطبيق البرنامج العلاجي على المجموعة التجريبية. ايضا تم تطبيق اختبار ت لمقارنة المتوسطات الحسابية في الأداء بين المجموعتين الضابطة والتجريبية للتاكد من فعالية البرنامج المقترح, فكانت النتائج كالتالي:

1-6. جدول (1): يوضح نتائج اختبار ويلكوكسون للفروقات قبل وبعد تطبيق البرنامج للعينة التجريبية في مستوى التآزر الحس حركي.

Ranks				
Sum of Ranks	Mean Rank	N		
.00	.00	0[a]	Negative Ranks	درجةتآزر2 - درجةتآزر1
28.00	4.00	7[b]	Positive Ranks	
		1[c]	Ties	
		8	Total	

تشير درجة تآزر 1 إلى مستوى التآزر الحركي لدى العينة قبل تطبيق البرنامج كما تشير درجة تآزر2 إلى مستوى التآزر بعد تطبيق البرنامج العلاجي.

ويتضح من الجدول اعلاه وجود فروق دالة احصائيا على فعالية البرنامج المقترح على تطور مستوى التآزر الحسحركي بين أفراد المجموعة التجريبية. حيث تشير نتائج الاختبار إلى تطور الأداء لمعظم أفراد العينة التجريبية, بخلاف طفلة واحدة فقط من المجموعة كانت قد اظهرت استقرارا على الأداء السابق وبقيت على ما كانت عليه في مستوى التازر الحسحركي قبل تطبيق البرنامج.

2-6. جد ول (2): يوضح نتائج اختبارT-test في حساب الفروق في المتوسطات على درجات التآزر الحسحركي بين المجموعتين الضابطة والتجريبية قبل وبعد تطبيق البرنامج المقترح.

Sig.	T	Std. Deviation	Mean	N	المجموعة	
.334	-.509-	.51755	2.6250	8	تجريبية	درجةتآزر1
	-.509-	.46291	2.7500	8	ضابطة	
.031	-6.769-	.35355	1.1250	8	تجريبية	درجةتآزر2
	-6.769-	.51755	2.6250	8	ضابطة	

يشير الجدول اعلاه إلى وجود تجانس بين المجموعتين في مستويات الأداء القبلي على مقياس التآزر الحسحركي قبل تطبيق البرنامج بدلالة احصائية واضحة تشير إلى عدم وجود أي فروق بين المجموعتين في الخصائص الحركية.. وتختلف هذه النتيجة في القياس البعدي لذات المجموعتين, اذ تشير النتائج في الجدول اعلاه إلى وجود فروق دالة احصائيا عند مستوى دلالة 0,031 تؤكد تطور الأداء لدى المجموعة التجريبية في مستوى التآزر الحسحركي.. وهذا تعزيه الباحثة الى فعالية البرنامج المقترح في تطور مستوى التازر الحسحركي.

3-6. جدول (3): نتائج ويلكوكسون للفروقات في الذكاء قبل وبعد تطبيق البرنامج للعينة التجريبية.

Ranks

Sum of Ranks	Mean Rank	N		
.00	.00	0[g]	Negative Ranks	درجةذكاء2 - درجةذكاء1
36.00	4.50	8[h]	Positive Ranks	
		0[i]	Ties	
		8	Total	

تشير درجة الذكاء 1 إلى مستوى ذكاء العينة قبل تطبيق البرنامج كما تشير درجة الذكاء2 إلى مستوى الذكاء بعد تطبيق البرنامج العلاجي. وتشير نتائج الجدول اعلاه إلى وجود تغير واضح في مستوى الذكاء بدلالة موجبة لأثر البرنامج على جميع أفراد المجموعة التجريبية. حيث تشير الدلالات الاحصائية في الجدول اعلاه إلى وجود تغير واضح في مستوى الذكاء بين جميع أفراد المجموعة التجريبية وذلك عند مقارنة نتائج القياس القبلي والبعدي للمجموعة, ويعزى هذا التطور لصالح البرنامج العلاجي.

وللتاكد من مدى هذا التطور في الذكاء تمت مقارنة نتائج القياسات في الذكاء للمجموعة التجريبية مع ذات النتائج للمجموعة الضابطة على اختبار ت كما هو واضح في الجدول (4) ادناه

4-6. جدول (5): نتائج ويلكوكسون للفروقات قبل وبعد تطبيق البرنامج للعينة التجريبية في الانتباه.

Ranks

Sum of Ranks	Mean Rank	N		
36.00	4.50	8[d]	Negative Ranks	درجةانتباه2 - درجةانتباه1
.00	.00	0[e]	Positive Ranks	
		0[f]	Ties	
		8	Total	

كما يوضح الجدول اعلاه نجد ان جميع أفراد المجموعة التجريبية قد اظهروا دلالة سالبة في نتاج القياس على اثر البرنامج على تطور مستوى الانتباه. حيث تشير "درجة انتباه 1" إلى مستوى الانتباه لدى العينة قبل تطبيق البرنامج كما تشير "درجة انتباه2" إلى مستوى الانتباه بعد تطبيق البرنامج العلاجي. وتشير الدلالة الاحصائية لاختبار ويلكوكسن إلى عدم فعالية البرنامج في تطور مستوى الانتباه بين أفراد المجموعة التجريبية

5-6. جدول (6) يوضح نتائج اختبارT-test في حساب الفروق في المتوسطات على مستوى الانتباه, بين المجموعتين الضابطة والتجريبية قبل وبعد تطبيق البرنامج المقترح.

المجموعة		N	Mean	Std. Deviation	T	Sig.
درجةانتباه1	تجريبية	8	30.8750	3.52288	-.454-	.404
	ضابطة	8	31.7500	4.16619	-.454-	
درجةانتباه2	تجريبية	8	28.5000	4.20883	-.631-	.859
	ضابطة	8	29.7500	3.69362	-.631-	

يتضح من الجدول اعلاه عدم وجود أي فروق ذات دلالة احصائية في قيمة ت بين المجموعتين الضابطة والتجريبية.. فقد كانت المتوسطات الحسابية متجانسة في القياسات القبلية وايضا كانت كذلك عند القياس البعدي موضحة وجود مستوى تطور متساو بين المجموعتين التجريبية والضابطة. وتشير هذه الدلالة الاحصائية إلى عدم وجود أي فروق يمكن ان تعزى لصالح البرنامج في تطور مستوى الانتباه لدى المجموعة التجريبية.

6-6. نتائج التحليل الإحصائي للبيانات

على ضوء البيانات التي تم جمعها ميدانيا واستنادا على الاختبارات الاحصائية تم التوصل للنتائج الاتية:

أولا: فعالية البرنامج العلاجي المقترح في تنمية التآزر الحسحركي وفي تطور مستوى الذكاء بدلالة احصائية عالية على اختبار ت في قياس الفروق في المتوسطات وفي قيمة ت بين المجموعتين التجريبية والضابطة, وكذلك بدلالة اختبار ويلكوكسن لقياس الفروق في القياس القبلي والبعدي للمجموعة التجريبية.

ثانياً: عدم فعالية البرنامج العلاجي المقترح في تنمية الانتباه لدى أفراد العينة التجريبية. حيث اشارت جميع الاختبارات الاحصائية المطبقة (اختبار ت واختبار ويلكوكسن) إلى عدم وجود فروق دالة احصائيا على تطور الأداء لافراد المجموعة التجريبية على القياسات البعدية.

7. مناقشة النتائج

استنادا إلى المسح النظري لاراء العلماء ونتائج الدراسات السابقة حول قضية البحث, قامت الباحثة بجمع البيانات ميدانيا وتحليلها احصائيا للتحقق من مصداقية فروض الدراسة والمتمثلة في الآتي:

1. توجد فروق ذات دلالة إحصائية واضحة بين المجموعتين التجريبية والضابطة في تطور التآزر الحركي - بعد تطبيق البرنامج المقترح - تعزى لصالح المجموعة التجريبية.
2. توجد دلالة إحصائية على تطور مستوى الذكاء للمجموعة التجريبية في القياسات البعدية لتطبيق البرنامج المقترح.
3. توجد دلالة إحصائية على تطور الانتباه للمجموعة التجريبية في القياسات البعيدة لتطبيق البرنامج المقترح.

1-7. أولاً: التحقق من صدق الفرضية الاولى للدراسة:

اشارت دراسة ايمان نور الدين,1993م, إلى تأثير استخدام القصة الحركية بمصاحبة الاغنية الشعبية ايجابيا على تطور مستوى اللياقة الحركية وذلك في دراستها لاثر الفنون على سلوك المعاقين عقليا.

ومن خلال المسح الميداني أظهرت نتائج الدراسة وجود فروق ذات دلالة إحصائية في الأداء البعدي بين المجموعتين التجريبية والضابطة على اختبار ت لصالح المجموعة التجريبية في تطور مستوى التآزر الحسحركي عند مستوى دلالة 0,031 ، جدول (1) كذلك اشارت نتائج القياسات على اختبار ويلكوكسن لافراد المجموعة التجريبية إلى وجود فروق احصائية واضحة بين نتائج الأداء القبلي والبعدي جدول (4). وتشير مثل هذه النتائج إلى فعالية البرنامج العلاجي. وفيما يلي عرض لأبرز المجالات التي كان قد تم علاجها عند أطفال المجموعة التجريبية:

أ. حركة العضلات الصغرى: وقد تحسن مستوى حركة اليدين من خلال التدريبات المكثفة التي قامت الباحثة بعملها لإزالة مشكلة القصور الحركي وضعف الضبط لحركة اليدين بين التلميذات المعاقات عقليا.

ب. التآزر الحسحركي: حيث تم تدريب التلميذات على الاستجابة الحسية للاصوات والصور المعروضة امامهن وتنفيذ التعليمات الخاصة باداء العمل الفني, ومن ثم تدريبهن على التركيز الحسي حركي وتآزر حركة العينين والاصابع. تم تطبيق هذه التدريبات جميعها من خلال تنفيذ عدد من الأنشطة الفنية التي تم ترتيبها تسلسليا مع متطلبات التطور التدريجي للمهارة الحركية والحسية والحسحركية.

كما أكدت المعلمات وجود تحسن واضح في حركة الكتابة ومستوى المتابعة البصرية للتلميذات الخاضعات للبرنامج العلاجي. ومن خلال ملاحظة الباحثة للفرق في مستوى الأداء للمجموعة التجريبية تمثل التطور في السرعة النسبية وتدني مستوى الخطأ بالاضافة إلى ظهور مستوى جيد في ضبط حركة اليد. وهذا يؤكد صدق الفرضية الاولى للدراسة.

2-7. ثانياً: التحقق من صدق الفرضية الثانية للدراسة:

هدفت الدراسة الحالية إلى التحقق من اثر البرنامج المقترح في تنمية الذكاء للأطفال المعاقين عقليا من خلال الأنشطة الفنية, الا أن الباحثة لم تجد دراسات عربية أو أجنبية مماثلة يمكن المقارنة بها. فقط نجد دراسة شيماء الدياسطي, 2006م, اثبتت فاعلية برنامجها في تنمية مهارات التفكير الابتكاري لاطفال ماقبل المدرسة.

ومن خلال التطبيق الميداني اوضحت النتائج الاحصائية وجود دلالة احصائية على تطور مستوى الذكاء بين أفراد المجموعة التجريبية على مقياس قوودانف, وهو مقياس ادائي يتناسب وخصائص العينة واهداف الدراسة. فقد اوضحت القياسات البعدية على اختبارويلكوكسن وجود فروق دالة احصائيا في مستوى ذكاء المجموعة التجريبية (جدول 2).

والمعلوم حسب اراء بعض النظريات ان الذكاء لا ينمو لدى المعاقين عقليا, ولكن يمكن ان تتطور قدرة الفرد في توظيف هذا الذكاء واستخدامه. وعليه تعتقد الباحثة ان ما ظهر من تطور بعدي يعود إلى نجاح التدريب في تنمية القدرة في استخدام الذكاء المحدود لدى المجموعة التجريبية. فظهر الفرق في أداء المجموعة بين القياسات القبلية والبعدية للبرنامج المطبق. وللتاكد قامت الباحثة باجراء مقارنة بين المجموعتين التجريبية والضابطة على مستوى الذكاء باستخدام اختبار ت, فاتضح وجود تباين في نتائج اختبار ت مقارنة باختبار ويلكوكسون. حيث اشار اختبار ت إلى عدم وجود فروق ذات دلالة احصائية واضحة في مستوى الذكاء بين المجموعتين الضابطة والتجريبية على اختبار ت تعزى لصالح المجموعة التجريبية (0.09).. (جدول5). وهذا يوكد على ان التطور في مستوى الذكاء الذي اظهرته نتائج ويلكوكسن يدل على تطور في استخدام الذكاء وليس في نمو الذكاء نفسه.

وبالرغم من الاختلافات بين النتائج الاحصائية كانت قد اكدت معلمات التلميذات إلى ظهور تحسن واضح في المستوى التحصيلي وفهم التعليمات بين المجموعة التجريبية بعد انتهاء فترة تطبيق البرنامج العلاجي, كذلك ظهر تطور المهارات العقلية للمجموعة التجريبية من خلال ملاحظات الباحثة لمستوى السلوك الظاهري. وهذا يؤكد صدق الفرضية الثانية للدراسة والتي تشير إلى دلالة البرنامج في تطور مستوى الذكاء للمجموعة التجريبية في القياسات البعيدة لتطبيق البرنامج المقترح.

7-3. ثالثاً: التحقق من صدق الفرضية الثالثة للدراسة:

تشير نتائج التطبيق الميداني إلى وجود اختلافات ضئيلة جدا وليست ذات دلالة احصائية واضحة في تطور مستوى الانتباه للعينة التجريبية في القياسات البعدية حسب نتائج اختبار ويلكوكسن حيث لم يظهر تطور في مستوى الانتباه لجميع أفراد العينة وجاءت النتائج سلبية (جدول 6). وعند مقارنة المجموعتين التجريبية والضابطة اتضح ايضا عدم وجود فروق دالة احصائيا علي تطور الأداء لصالح المجموعة التجريبية (جدول 3), وجميع هذه النتائج تشير إلى عدم وجود اثر دال احصائيا على فعالية البرنامج العلاجي في تنمية مستوى الانتباه .. مما يدلل على عدم تحقق الفرضية الثالثة للدراسة.

في نهاية هذه الدراسة يمكن القول إن نجاح البرنامج العلاجي في تطور مستوى التآزر الحسحركي يعود إلى طبيعة الوسائل المستخدمة من تدريبات على التآزر و تدريبات عضلية باستخدام انشطة فنية تعتمد على القص واللصق والنسج ومتابعة المثيرات البصرية والسمعية, والتي كان لها الدور البارز في تطور مستوى التآزر الحسحركي لافراد العينة. بالإضافة لاستخدام أسلوب تحليل ومناقشة الانتاجات الفنية واسلوب التحفيز للابتكارات الفنية وأسلوب تكملة الاشكال والرسومات الفنية فكان للبرنامج ايضا الدور البارز في تطور مستوى الذكاء العملي للفئة التجريبية.

وهذه النتائج تتفق مع الدراسات السابقة التي ركزت على استخدام الأنشطة الفنية في معالجة بعض المهارات السلوكية . وبشكل عام أظهرت نتائج الدراسة فاعلية البرنامج في معالجة القصور الحسحركي وتطور مستوى الذكاء.

1-8. خلاصة الدراسة

كانت قد هدفت الدراسة إلى تصميم برنامج تربوي علاجي يساهم في تنمية مهارات الطفل المعاق عقليا في عدد من الجوانب الإنمائية وقياس مدى فعالية هذا البرنامج في تنمية الدفعة الحيوية لديه. بالاضافة الى المساهمة في تطوير مهارات الطفل المعاق عقليا في عدد من الجوانب الإنمائية بما يحقق تنمية الدفعة الحيوية لديه. ايضا سعت الباحثة الى المساهمة في إثراء المنهج المدرسي ببرنامج تربوي يمكن أن يكون رافد أو نواة لتصميم مادة علمية في التربية الفنية تقدم ضمن المنهج المدرسي الأساسي . ايضا إثراء مجال البحث العلمي بدراسة يمكن أن تفيد الجانب الثقافي, التربوي, والاجتماعي في عدد من قطاعات المجتمع ذات الاختصاص والتي تُعنى بهذه الفئة. وقد تم من خلال هذه الدراسة التحقق من مدى فعالية برنامج علاجي مقترح لعلاج مشكلة نقص الدفعة الحيوية للمعاقين عقليا. والمتمثلة بشكل كبير في التآزر الحركي واستخدام الذكاء بجانب مستوى الانتباه- من خلال استخدام الأنشطة الفنية كاسلوب علاجي تم تصميمه في شكل برنامج تربوي علاجي. وقد امكن من خلال الجلسات التدريبية لفئة من المعاقات عقليا تطوير مهاراتهن في عدد من الجوانب النمائية, بعضها كان مستهدفا في الدراسة بالاضافة إلى تحقق النمو في جوانب اخرى اضافية لم تكن ضمن اهداف البرنامج. وقد نجحت الباحثة في تنمية مستوى التآزر الحسحركي لافراد المجموعة التجريبية بدلالة احصائية واضحة, كذلك تم النجاح في تنمية مستوى الذكاء وظيفيا بدرجة واضحة ظهرت من خلال الفروق الاحصائية على الاختبارات التي تم تطبيقها. ومع ذلك لم تثبت النتائج الإحصائية وجود أي دلالة موجبة لأثر البرنامج العلاجي المقترح في تطور مستوى الانتباه للمعاقين عقليا. ان البرنامج المستخدم في الدراسة اثبت فعاليته ايضا في تنمية عدد من الجوانب الاخرى غير التي كانت مستهدفة في الدراسة. فمن خلال المقابلة مع المعلمات وملاحظة الباحثة اتضح وجود تغيرا موجبا في السلوك الاجتماعي وفي مستوى الضبط الحركي لفئة المعاقات عقليا وفي مستواهن التحصيلي. وجميع هذه النتائج الايجابية دفعت معلمات التربية الفكرية للتفكير جديا باستدخال الأنشطة الفنية بشكل مستمر في الخطط التعليمية التي تقدم لفئة المعاقات عقليا.

وعليه فقد تحققت جميع اهداف هذه الدراسة كما امكن للباحثة التحقق من مدى صدق فرضيات الدراسة وتوصلت إلى النتائج الاتية:

1. وجود فروق ذات دلالة إحصائية واضحة بين المجموعتين التجريبية والضابطة في تطور التآزر الحركي - بعد تطبيق البرنامج المقترح - تعزى لصالح المجموعة التجريبية.
2. وجود دلالة إحصائية على تطور مستوى الذكاء للمجموعة التجريبية في القياسات البعدية لتطبيق البرنامج المقترح..تعزى لفعالية البرنامج.
3. عدم وجود دلالة إحصائية على تطور الانتباه للمجموعة التجريبية في القياسات البعدية لتطبيق البرنامج المقترح, وفشل البرنامج في علاج قصور الانتباه.

2-8. التوصيات:

ونتيجة للدلالات الموجبة لأثر البرنامج في عدد من الجوانب النمائية توصي الباحثة بالاتي:

أولاً: توصيات موجهة إلى المعلمين ومراكز التربية الفكرية:

أ. الاهتمام بتفعيل الأنشطة والممارسات الفنية المتنوعة أثناء تطبيق المنهج الدراسي وتدريس المقررات.
ب. حث التلميذات \ التلاميذ المعاقين عقليا على تقديم الابتكارات الفنية على المدى الذي تسمح به القدرة العقلية المتاحة لهم.
ت. تحفيز المعاقين عقليا على المناقشة وإبداء الرأي حول أي إنتاج فني يقومون بتقديمه.
ث. ضرورة الابتعاد عن الاستهزاء والسخرية من المعاقين عقليا لما لذلك من أثر على نفسية الطفل وإشعاره بالخجل من عيوبه وفشل تقدمه في كافة الجوانب النمائية.

ثانياَ: توصيات موجهة إلى إدارات التربية الخاصة:

أ. إن المرحلة الابتدائية من أفضل المراحل التي يتم من خلالها الكشف عن مشكلات الدفعة الحيوية والعمل على علاجها وتنمية قدرات الطفل المعاق، ولذلك يجب توجيه مراكز التربية الفكرية على أن تقوم بالتنسيق بين مهام الاختصاصي النفسي واختصاصي التربية الفنية ومعلم التربية الفكرية للعمل على إنجاح البرامج التربوية والعلاجية الهادفة.

ب. استخدام الأنشطة الفنية المقننة - كالبرنامج الحالي- في مراكز التربية الفكرية، وذلك لعدم وجود منهج في التربية الفنية, واستخدام هذا البرنامج كنواة لإنتاج كتاب مدرسي في التربية الفنية يقدم للمعاقين عقليا في المرحلة الابتدائية.

بحوث مستقبلية مقترحة:-

أ. أثر القصة في تطور مفهوم الذات وخفض العدوان لدى المعاقين عقليا.

ب. فعالية مسرح العرائس في تطور اللغة والتخاطب لدى المعاقين عقليا.

ت. دراسة تحليلية للمفاهيم النظرية حول فعالية الأنشطة الفنية في تشكيل شخصية الطفل المعاق عقليا.

المراجع العربية:

1. أبو حلتم ، ،سعيد . (2005). مهارات السمع والتخاطب والنطق المبكرة . ط1 . عمان : دار أسامة.
2. أبو علام, رجاء محمود (2001م)**: مناهج البحث في العلوم النفسية والتربوية،** ط3 ، القاهرة, دار النشر للجامعات.
3. جلجل ، نصره محمد . (2005 . (التعليم العلاجي . ط1 . القاهرة : مكتبة النهضة.
4. الخطيب, جمال (2008م): **مقدمة في التربية الخاصة**,عمان, دار الفكر العربي.
5. الخطيب, جمال(2004م), تعليم الطلبة ذوي الحاجات الخاصة في المدارس العادية, الطبعة الاولى, دار وائل. عمان, الاردن.
6. الروسان, فاروق (2010م): **سيكولوجية الأطفال غير العاديين**, عمان دار الفكر.
7. الروسان, فاروق(2001م), الذكاء والسلوك التكيفي, الطبعة الاولى, دار الفكر, عمان , الاردن.
8. سليمان ، عبد الرحمن . (1998) . سيكولوجية ذوي الحاجات الخاصة(أساليب التعرف والتشخيص) . ط1. القاهرة : مكتبة زهراء الشرق.
9. السيد عبيد, ماجدة (2001م): **مناهج وأساليب تدريس ذوي الاحتياجات الخاصة**, عمان, دار صفاء للنشر والتوزيع.
10. شقير ، زينب . (2005) . خدمات ذوي الحاجات الخاصة . ط2 .القاهرة : مكتبة النهضة.
11. شقير, زينب (2013): **خدمات التأهيل الشامل لذوي الاحتياجات الخاصة**, القاهرة, النهضة العربية.
12. الشناوي, محمد محروس.1997م, التخلف العقلي, الطبعة الاولى, دار غريب, القاهرة,مصر.
13. الظاهر ، قحطان . (2005) . مدخل إلى التربية الخاصة . ط1. عمان : دار وائل.
14. عامر ، طارق و محمد، ربيع .(2008) . التربية الخاصة . ط1. القاهرة : طيبة للنشر.
15. عبد المطلب امين القريطي (1995م.), مدخل الى سيكولوجية رسوم الاطفال, القاهرة, دار المعارف,
16. عبد المنعم, فاطمة (2012م): **معلم التربية الخاصة توجهات عالمية في إعداده واعتماده**, دار الزهراء , الرياض.
17. الكيلاني, السيد (2012م): **استراتيجيات التدخل المبكر على ذوي الاحتياجات الخاصة**, القاهرة, جامعة عين شمس.
18. مرسي,كمال إبراهيم (1994م): **التدخل المبكر في رعاية التخلف العقلي ودور الإرشاد فيه**, القاهرة, جامعة عين شمس.
19. هارون صالح (2000م), تدريس ذوي الاعاقات البسيطة في الفصل العادي, الطبعة الاولى , دار الزهراء, الرياض, المملكة العربية السعودية.

دراسة شيماء محمد الدياسطي, 2006م, بعنوان فاعلية برنامج لتنمية مهارات التفكير الابتكاري لاطفال ماقبل المدرسة من خلال مسرح العرائس- لنيل درجة الدكتوراة في دراسات الطفولة, معهد الدراسات العليا للطفولة, مصر

20. دراسة سوزان عبدالله العيسوي رضوان,2009م بعنوان: أثر استخدام العرائس في اكساب التلاميذ ذوي الاحتياجات الخاصة القابلين للتعلم بعض القيم- رسالة دكتوراة.
21. دراسة (إبراهيم،2006 م): بعنوان " إجراءات تعليمية يستخدمها معلمي التربية الفكرية في تعليم وتدريب التلاميذ المتخلفين عقلياً نموذج خطة مقترحة ". مقدم لجائزة حمدان بن راشد آل مكتوم – للأداء التعليمي المتميز

REFERENCES

[1] APA, (1979), *Rehabilitation: Position statement.* The American Psychiatric Association, Arlington, VA.

[2] Gibson, Ann McKinnon. Windows to Imagination "The Art of puppetry" (Simon Fraser University, Canada), (Vol32,1999) p.213

[3] Kingsley Publishers Ltd., London.

[4] Malchiodi,C.(Ed.),(1999a), *Medical Art Therapy with Children,* Jassica

[5] Malchiodi,C.(Ed.),(1999b), *Medical Art Therapy with Adults,* Jassica Kingsley Publishers Ltd., London.

[6] Nainis, N. and Paice, J."Relieving Symptoms in Cancer: Innovative use of art

[7] therapy", *Journal of Pain and Symptom Management,*31,2,2006,pp162-169.

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Enquête préliminaire auprès des consommateurs sur la qualité organoleptique de l'eau dans la commune de Tipaza (Algérie)

[Preliminary investigation for consumer perceptions of drinking water quality in Tipaza (Algeria)]

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ABSTRACT: Although many people expect their drinking water to be "flavorless", natural and processed drinking waters have flavors due to minerals and organics in the natural water. Since people can detect the flavor of water, the idea has been proposed that drinking water consumers be considered as sentinels who monitor water quality.
This paper explores specific sensory components of drinking water, how humans perceive their drinking water distributed by SEAAL (Société des Eaux et de l'Assainissement d'Alger) in Tipaza for safety water. The results show that most consumers (40% of urban and 54% rural area) found that tap water is safety; however some consumers have reservations about the taste, color and odor.

KEYWORDS: flavor, odor, sensory perception, taste, consumers, Tipaza.

RESUME: Garantir une eau potable de qualité acceptable jusqu'au robinet du consommateur est un véritable défi tant les conditions de dégradation de l'eau dans le réseau de distribution sont complexes et multiples. Cette étude vise à évaluer l'opinion des consommateurs sur la qualité de l'eau distribuée dans la ville de Tipaza et ce à travers un sondage effectué auprès de 100 ménages. Les résultats montrent que la plupart des consommateurs (40 % de la région urbaine et 54 % de la région rurale) trouvent que l'eau du robinet est de bonne qualité néanmoins certains émettent des réserves sur le goût, la couleur et l'odeur.

MOTS-CLEFS: paramètres organoleptiques, abonnés, Tipaza.

1 INTRODUCTION

Depuis les temps les plus reculés, l'homme a dû résoudre le problème de l'alimentation en eau, en effectuant des travaux hydrauliques lorsque les ressources hydriques locales étaient insuffisantes ou trop irrégulières. Néanmoins, l'adduction d'eau au cœur des villes, dans chaque logement, est un phénomène très récent et encore réservé « dans bien des pays » à une minorité de privilégiés [1]. Les réseaux d'alimentation et les installations permettant l'approvisionnement des consommateurs en eau sont considérés comme un patrimoine du service de l'eau pour lequel une bonne gestion est nécessaire pour en assurer la survie et le bon fonctionnement [2].

En effet, la qualité de l'eau peut subir des modifications au cours de son transfert. Le moyen le plus efficace pour garantir en permanence la salubrité dans l'approvisionnement en eau de boisson consiste à appliquer une stratégie générale d'évaluation et de gestion des risques, couvrant toutes les étapes de l'approvisionnement en eau, du captage jusqu'au consommateur [3].

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La qualité de l'eau du robinet est surtout évaluée en fonction de son goût, de son odeur et de son aspect comme l'ont déjà souligné de nombreux auteurs [4], [5], [6]. Les consommateurs d'eau potable sont de plus en plus préoccupés par la sécurité de l'eau distribuée par les réseaux d'aqueduc publics [7].

Le but de cette étude est d'enquêter pour la première fois sur la qualité des eaux de consommation distribuées par la SEAAL dans la commune de Tipaza durant une période de trois mois (mars-mai 2012) par un questionnaire relatif à la qualité organoleptique des eaux de consommation proposées aux abonnés de cette région.

2 MATERIEL ET METHODES

La ville de Tipaza est l'actuel chef lieu de la Wilaya de Tipaza, positionnée sur le littoral à 69 Km à l'Ouest d'Alger. Elle est limitée au Nord par la mer Méditerranée, au Sud par les communes de Hadjout et Sidi Rached, à l'Est par les communes d'Aïn-Tagourait et de Sidi-Rached et à l'Ouest par les communes de Nador et de Cherchell (Figure 1). L'alimentation en eau potable de la ville de Tipaza est assurée depuis Décembre 2011 par la Société des Eaux et de l'Assainissement d'Alger (SEAAL). La ressource en eau est celle produite par la station de traitement des eaux de Sidi-Amar à partir des eaux brutes du barrage du lac de Boukourdane.

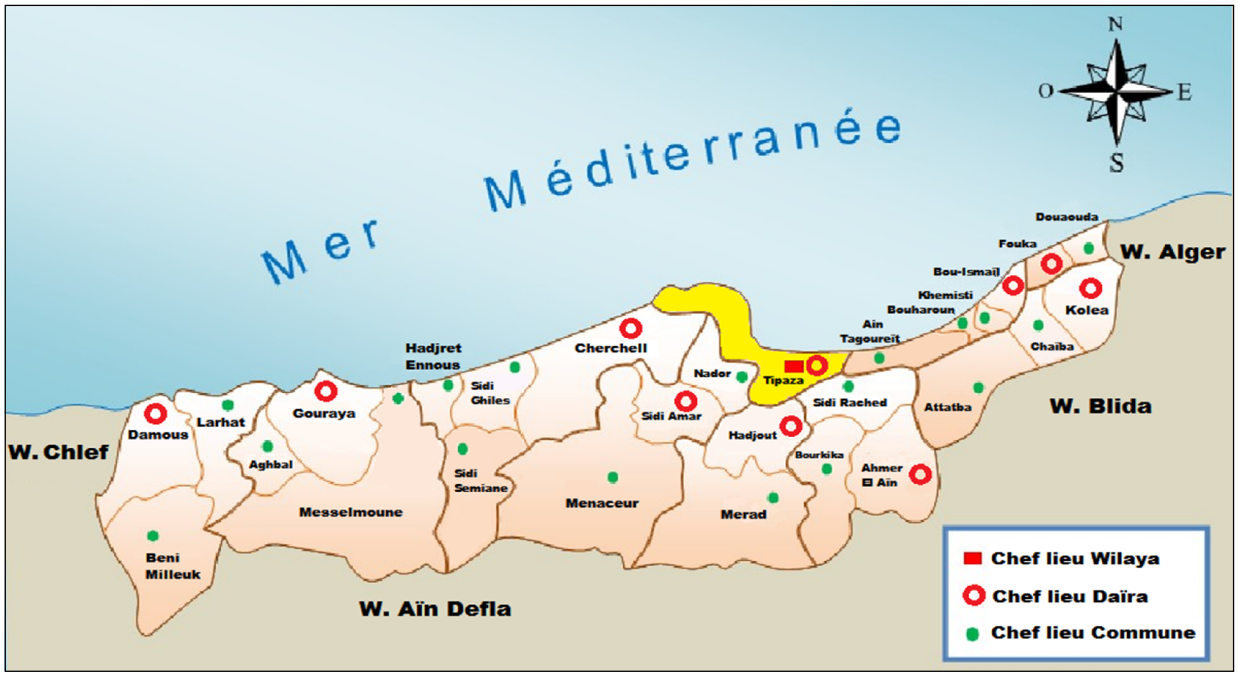

Fig. 1. Situation géographique de la ville de Tipaza

En vue d'un sondage sur la qualité des eaux de robinet de la ville de Tipaza, un questionnaire a été soumis auprès de 100 consommateurs (50 en zone urbaine et 50 en zone rurale) appartenant à différentes localités et Douars (Tableau 1, Figure 2).

Tableau 1. Choix des sites alimentés par la SEAAL à partir de la station de traitement de Sidi Amar

Zone urbaine	Zone rurale
Agglomération chef lieu	Douar Belloundja
Centre ville	Douar Mansour
Oued Merzoug	Douar Si Djillali Berkane
Ouzakou, Chenoua plage	Douar Guebli
Centre touristique Matares	Douar Abdelhak

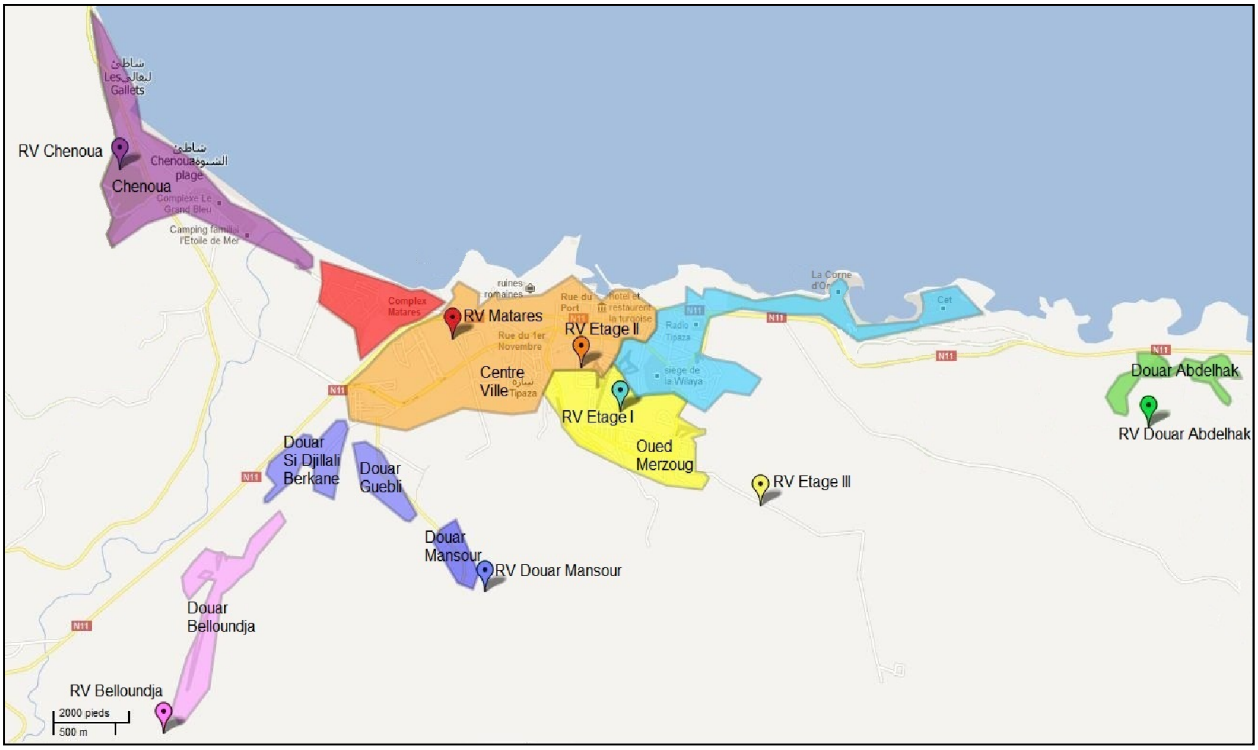

Fig. 2. Localisation géographique des localités (urbaine/et ou rurale) alimentés par de la station de traitement des eaux de Sidi Amar (Google Earth modifié).

3 RESULTATS ET DISCUSSION

L'enquête effectuée auprès des 100 abonnés de la SEAAL de Tipaza (50 du secteur urbain et 50 du secteur rural) interrogés sur la qualité des eaux distribuées dans la ville de Tipaza a montré les résultats suivants :

3.1 PRINCIPALE SOURCE D'APPROVISIONNEMENT EN EAU DE CONSOMMATION

Sur leur principale source d'approvisionnement en eau de consommation (Figure 3), les 100 individus questionnés selon la zone (urbaine et/ou rurale) ont répondu:

- Eau de robinet pour 64 % des consommateurs du secteur urbain et 82 % du secteur rural,
- Eau minérale pour 30 % des consommateurs du secteur urbain et 4 % du secteur rural,
- Eau de puits pour 4 % de la population questionnée de la zone urbaine et 12 % de la zone rurale,
- Eau de source pour 2 % des consommateurs interrogés de la zone urbaine et 2 % de la zone rurale.

Dans une enquête menée par [8], 87 % des personnes interrogées déclarent acheter de l'eau en bouteille; les 13 % restant n'en achètent jamais ou très peu.

Les consommateurs qui préfèrent acheter les eaux en bouteille trouvent qu'elles ont meilleur goût. L'importance de la qualité organoleptique pour les consommateurs d'eau embouteillée a été également signalée dans certaines études [9] [10]. Elles sont jugées de meilleur goût parce que nous nous attendons à ce qu'elles aient meilleur goût [11], [12].

Certains consommateurs questionnés préfèrent l'eau de puits à celle du robinet la trouvant ainsi plus douce. Ces constatations rejoignent celles de [13]. D'autres personnes préfèrent l'eau de source car c'est une eau potable très claire [14].

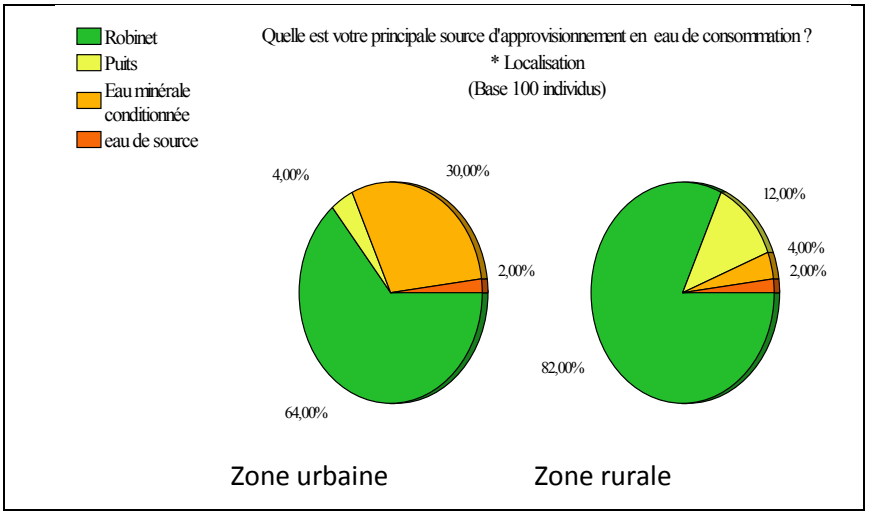

Fig. 3. Principale source d' approvisionnement en eau de consommation.

3.2 GOUT (OU SAVEUR) DE L'EAU DU ROBINET

Pour la question, l'eau du robinet présente-elle un goût particulier? Les réponses étaient les suivantes (Figure 4):

-Non, aucune saveur particulière, pour 44 % des consommateurs du secteur urbain et 48 % du secteur rural,

- Oui, de manière occasionnelle, pour 44 % des consommateurs de la zone urbaine et 40 % de la zone rurale,

- Oui, et de manière récurrente pour 12 % des consommateurs de chaque secteur.

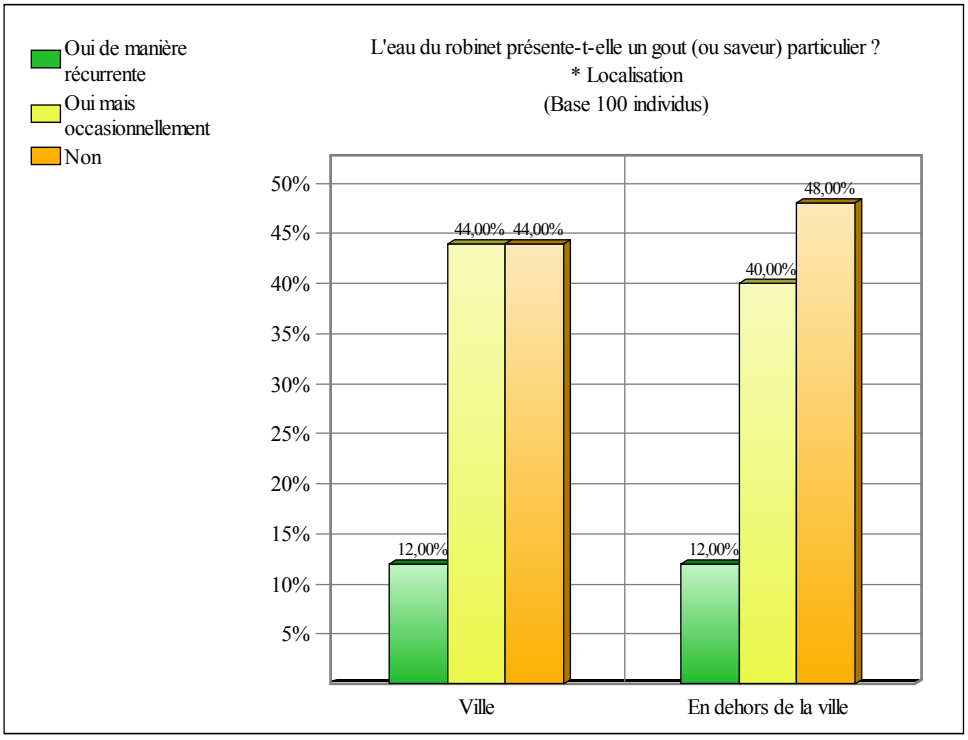

Fig. 4. Appréciation du goût (saveur) de l'eau de robinet.

Sur les 54 consommateurs qui ont jugé que l'eau du robinet présentait un goût particulier (figure 5), 50 % de la zone urbaine et 65,38 % de la zone rurale ont répondu qu'elle présentait un goût de chlore.

En effet, le chlore est un désinfectant puissant, traditionnellement utilisé pour le traitement de l'eau potable donnant ainsi un goût caractéristique à l'eau [15]. La perception du goût de chlore varie aussi d'une personne à une autre et d'une population à une autre [16], [17]. La plupart des individus détectent le chlore à partir de 0,2 mg/l, les plus sensibles à des seuils proches de 0,05 mg/l [18]. Le Biofilm permet aux micro-organismes de se développer et de produire des métabolites. Des réactions chimiques pendant le stockage et le transport peuvent également produire des odeurs désagréables comme la réaction du chlore avec la tuyauterie [19].

Les autres abonnés ont jugé qu'elle était soit désagréable soit avec un arrière goût de terre. La sensation d'une eau ayant un goût terreux comme celle constaté dans cette étude, signifie la présence de terre ou d'argile ce qui pourrait être dû à une défaillance dans l'étape de clarification dans l'eau. Des composés organiques synthétisés par des micro-organismes en particulier par des actinomycètes, des cyanobactéries et des algues sont également à l'origine de goûts de terre et de moisi du respectivement à la géosmine et au 2-méthylisobornéol [20], [21].

Les résultats de cette enquête montrent que les principaux facteurs expliquant le rejet de l'eau du robinet sont la perception du risque et la non satisfaction organoleptique globale comme l'ont déjà constaté dans leur étude [22].

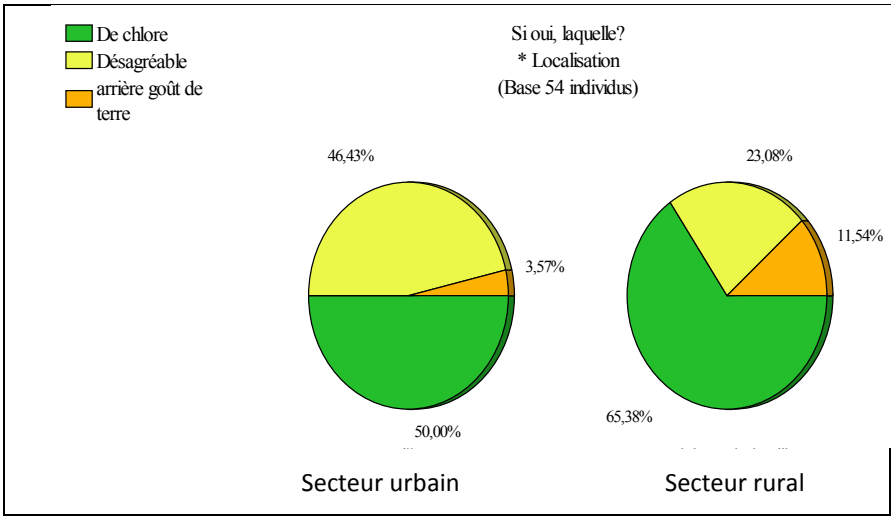

Fig.5. Nature du goût (saveur) de l'eau du robinet.

3.3 ODEUR DE L'EAU DU ROBINET

Sur les 100 individus interrogés sur la présence d'odeur dans l'eau du robinet (Figure 6):

- 52% des personnes interrogées de la zone urbaine et 64% de la zone rurale ont jugé que l'eau ne présentait aucune odeur particulière,

- 44 % des personnes interrogées de la zone urbaine et 24 % de la zone rurale ont répondu oui mais rarement, - 4 % des personnes interrogées de la zone urbaine et 12 % de la zone rurale ont répondu oui mais de manière récurrente.

Sur les 42 individus qui ont répondu que l'eau présentait une odeur, 37,50 % des consommateurs appartenaient au secteur urbain et 33, 33% au secteur rural, toutefois ils n'arrivaient pas à identifier la nature de cette odeur. Cependant 37,50 % des consommateurs de la zone urbaine et 22,22 % de la zone rurale disaient sentir une odeur nauséabonde (Figure 7). L'eutrophisation des plans d'eau de surface conduit à la prolifération des algues qui entrainent la libération de substances odorantes. Même si les métabolites d'algues ne constituent pas un risque pour la santé des consommateurs, leur goût et leur odeur désagréables ont tendance à les inquiéter et à donner lieu à des plaintes [7]. Ceci a été constaté durant cette enquête.

25% des consommateurs en milieu urbain et 44,44 % en milieu rural ont répondu que l'eau avait une odeur de chlore. Dans une enquête auprès des consommateurs de l'eau du robinet au Cap, neuf des 21 répondants se plaignaient de mauvais

goût due au chlore [23]. La chloration de l'eau potable est l'une des premières causes de plaintes reliées aux goûts et aux odeurs dans l'eau potable [24], [25]. La chloration peut aussi entraîner la formation de trihalométhanes iodés qui confèrent à l'eau un goût « médical » [26].

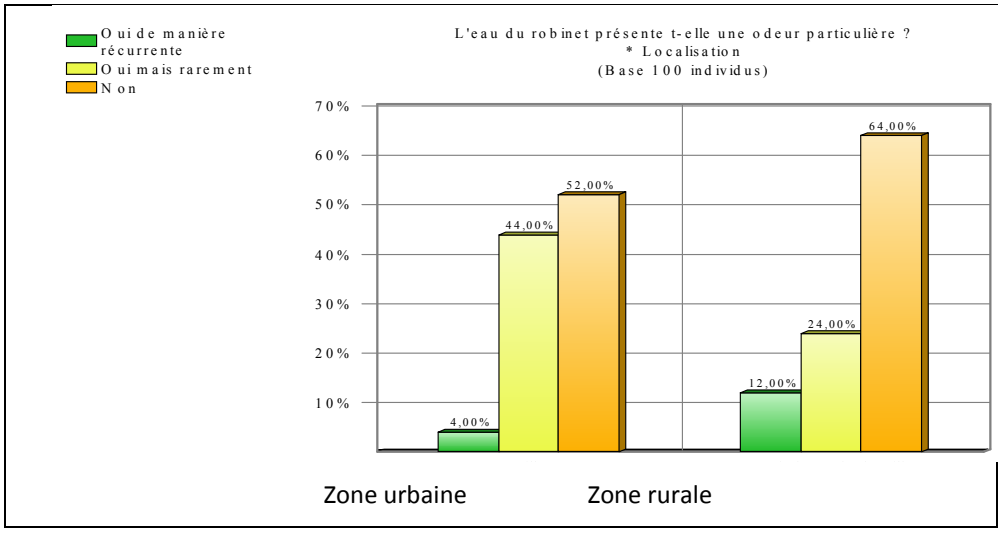

Fig. 6. Appréciation de l'odeur de l'eau du robinet.

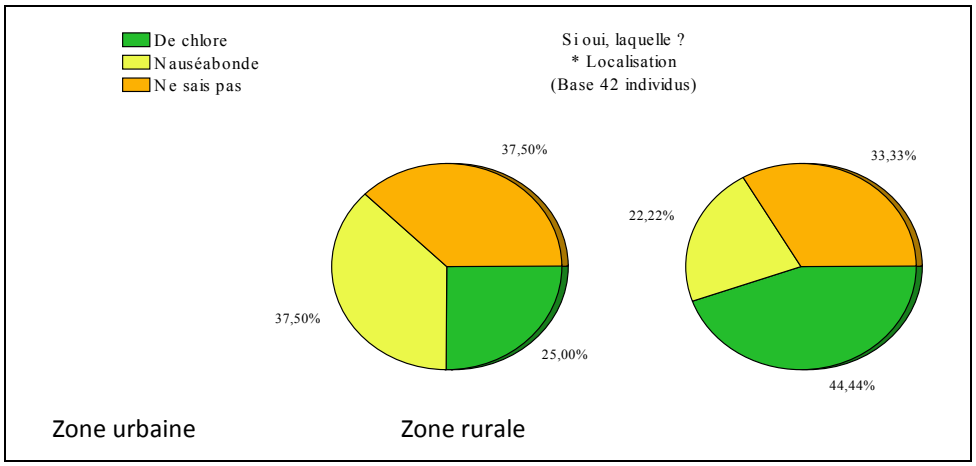

Fig. 7. Nature de l'odeur des eaux du robinet.

3.4 COLORATION DE L'EAU DU ROBINET

Pour la question, l'eau du robinet présente-t-elle une coloration particulière ? Les réponses ont été les suivantes (Figure 8) :

- Non, elle est limpide pour 48 % des consommateurs questionnés de la zone urbaine et 64 % de la zone rurale, - Oui, mais rarement pour 50 % des consommateurs questionnés de la zone urbaine et 36 % de la zone rurale, - Oui, de manière récurrente uniquement pour 2% des individus questionnés de la zone urbaine.

Sur les 44 % individus qui ont répondu que l'eau présentait une couleur (Figure 9):

- 50 % des personnes interrogées de la zone urbaine et 66,67% de la zone rurale ont jugé qu'elle était peu claire avec des débris visibles.

- 38,46 % des personnes interrogées de la zone urbaine et 27,78 % de la zone rurale ont répondu qu'elle était blanchâtre.

Cette couleur est la conséquence de la présence de fines bulles d'air dans l'eau. Cet air est libéré dans l'eau à l'intérieur des canalisations de la maison lors d'une baisse de pression ou d'une élévation de la température. Ce qui lui donne un aspect laiteux. Ce phénomène n'a aucune influence sur la santé [27].

- 11,54 % des personnes interrogées de la zone urbaine et 5,56 % de la zone rurale, ont répondu qu'elle était sombre et turbide.

La coloration d'une eau est dite vraie ou réelle lorsqu'elle est due aux seules substances en solution. Elle est dite apparente, quand les substances en suspension y ajoutent leur propre coloration. Les couleurs réelles et apparentes sont approximativement identiques dans les eaux claires et les eaux à faible turbidité [28].

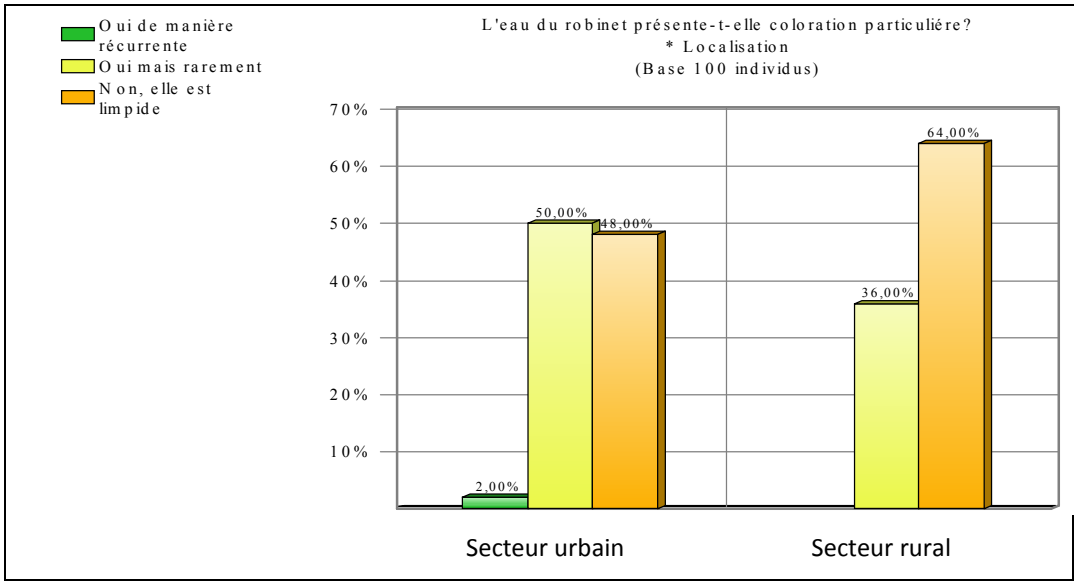

Fig. 8. Appréciation de la coloration de l'eau du robinet.

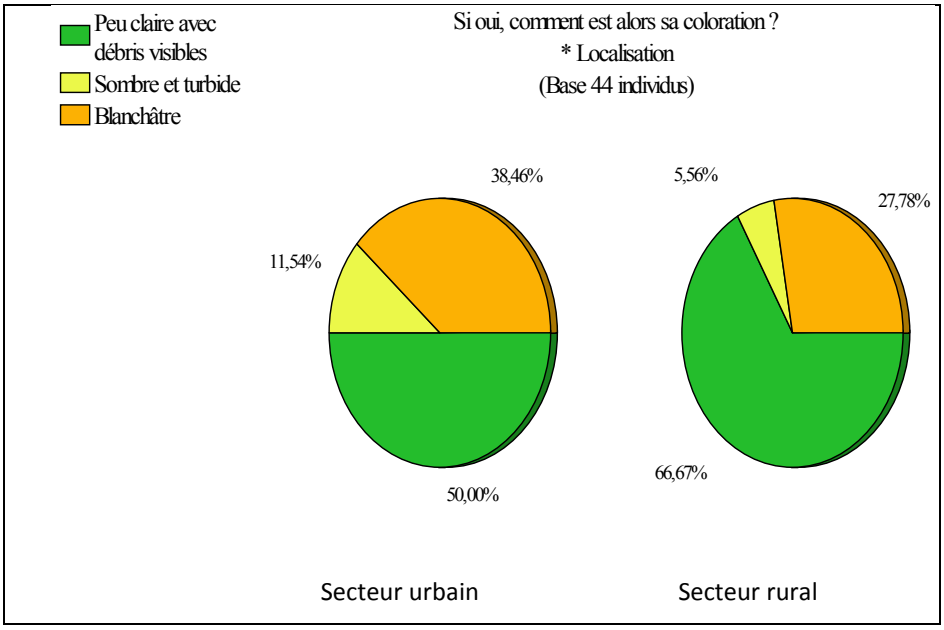

Fig. 9. Type de coloration de l'eau du robinet.

3.5 TRAITEMENT DE L'EAU DU ROBINET AVANT SA CONSOMMATION

Sur les 100 consommateurs questionnés, seulement 8% pour le secteur urbain et 8% pour le secteur rural ont répondu qu'ils traitaient l'eau du robinet avant de la consommer (Figure 10).

Parmi ces 8 consommateurs, 3 (75 %) de la zone urbaine et 4 (100 %) de la zone rurale ont signalé qu'ils ajoutaient de l'eau de javel et seulement 1 (25 %) appartenant à la zone urbaine ont répondu qu'ils filtraient l'eau avant sa consommation (Figure 11).

Les méthodes de traitement chez les ménages comprennent : l'ébullition, la filtration et la chloration. Le procédé de chloration empêche la reviviscence microbienne [29].

En effet, l'eau du robinet au point d'admission peut ne plus contenir assez de chlore, aussi d'autres traitements tels que la filtration et l'ébullition sont nécessaires [30].

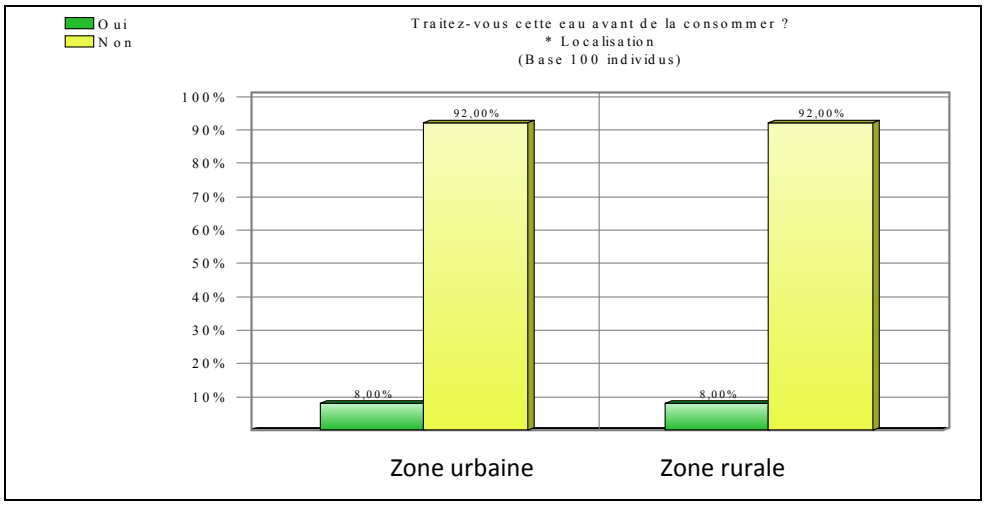

Fig. 10. Traitement des eaux du robinet.

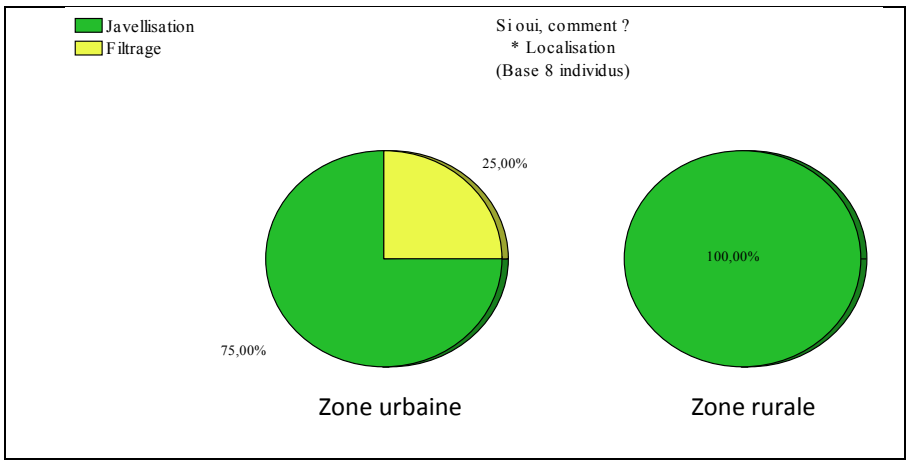

Fig. 11. Type de traitement des eaux du robinet.

3.6 SYMPTOMES CAUSEES PAR LA CONSOMMATION DE L'EAU DU ROBINET

Pour la question pensez-vous avoir déjà été malade après avoir consommé l'eau de robinet ? Seulement 3 % des individus dans la région rurale ont répondu oui (Figure 12). Parmi, les consommateurs qui ont jugé avoir déjà été malades en consommant l'eau du robinet : 66,67 % ont jugé avoir eu des nausées et 33,33 % ont jugé avoir eu des diarrhées (Figure 13).

Il semble que le goût, l'odeur et les soucis de santé soient les principales raisons de rejet des eaux de robinet par les personnes interrogées [22]. En effet certains consommateurs pensent que la consommation d'eau de robinet est la cause de leurs problèmes de santé. De même, 60% des répondants pour un sondage américain sur la qualité de l'eau municipal ont déclaré que la qualité de l'eau potable affecte leur santé et 50% étaient préoccupés par leur santé vis-à-vis des contaminants possibles liés à l'alimentation en eau [31].

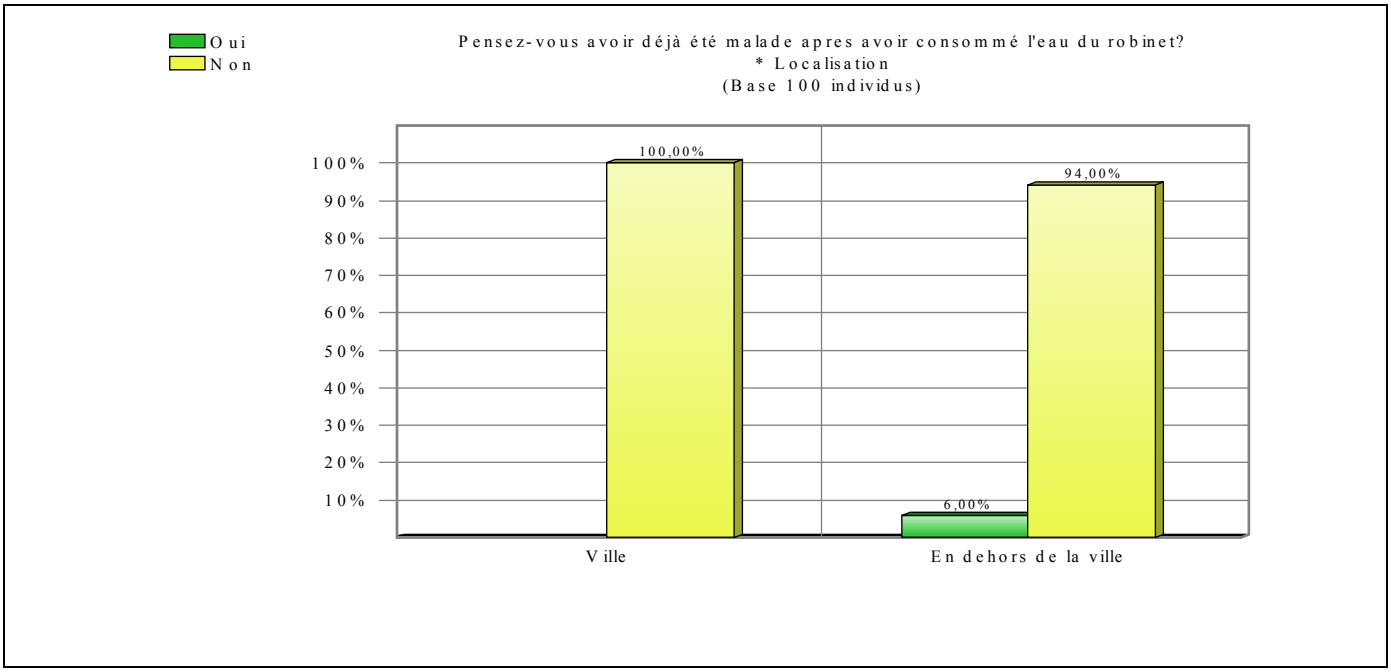

Fig. 12. Taux de malades suite à la consommation des eaux de robinet.

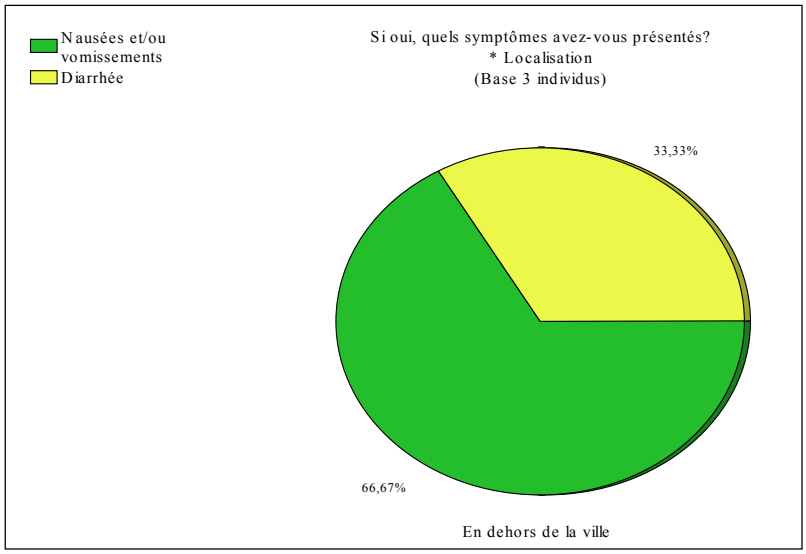

Fig. 13. Symptômes présentés suite à la consommation des eaux de robinet.

3.7 APPRECIATION DE LA QUALITE DE L'EAU DU ROBINET

Sur les 100 individus interrogés:

- 40 % de la région urbaine et 54 % du secteur rural ont répondu que l'eau du robinet distribuée dans la ville de Tipaza était de bonne qualité,

- 46 % du secteur urbain et 40 % du secteur rural l'ont jugé de qualité moyenne,

- 14 % de la zone urbaine et 4 % de la zone rurale ont jugé qu'elle était de mauvaise qualité. Nous avons noté que chaque abonné possède sa propre idée quant à la qualité de l'eau.

Les consommateurs utilisent leurs sens et leurs opinions personnelles pour évaluer la qualité de l'eau potable [13].

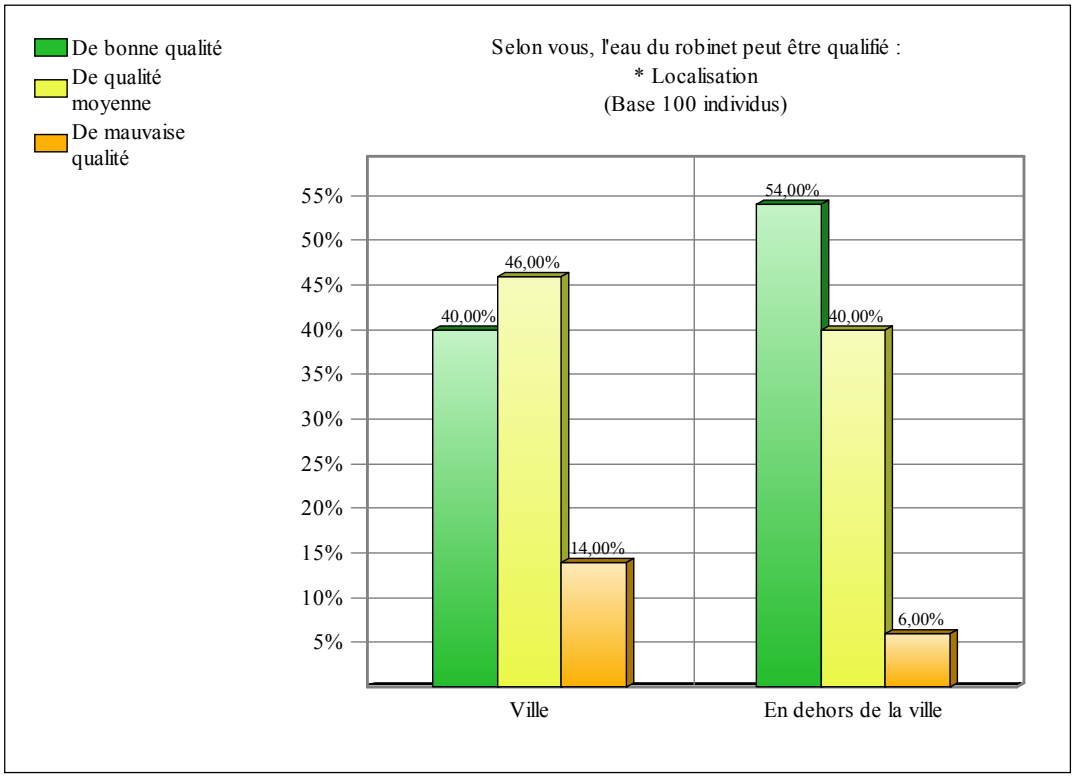

Fig. 13. Appréciation de la qualité des eaux de robinet.

4 CONCLUSION

D'après les réponses des consommateurs, nous avons noté qu'ils avaient tendance à associer facilement la présence de goûts et d'odeurs à une mauvaise qualité de l'eau.

L'usager considère que le service public de l'eau doit être à la hauteur de sa contribution et se plaint notamment lorsqu'il détecte des goûts qu'il juge désagréables ou anormaux. Les consommateurs devraient être conscients de l'importance de la qualité de l'eau en utilisant des méthodes de traitement de l'eau comme la filtration ou l'ébullition qui peuvent être bénéfiques pour éviter les maladies d'origine hydrique.

REFERENCES

[1] M.A. Bordonneau, "L'eau destinée a la consommation humaine, d'un usage prioritaire à un droit à L'eau", *Journal International Network Environnemental Management Conflicts*, Santa Catarina, Brazil. Vol. 1. n°1, pp. 173-182, 2010.

[2] A. Nafi, "La programmation pluriannuelle du renouvellement des réseaux d'eau potable", Thèse de Doctorat en Sciences de Gestion. Université Louis Pasteur Strasbourg I, France, 2006.

[3] OMS, "Directives de qualité pour l'eau de boisson", 3eme édition, Vol.1 Recommandations. Genève, Suisse.

[4] G. Jardine, N. Gibson, S.E. Hrudey, "Detection of Odour and Health Risk Perception of Drinking Water", *Water Science and Technology*, vol. 40, n° 6, pp. 91–98, 1999.

[5] E.C. Anadu, A.K. Harding, 2000, "Risk perception and bottled water use", *Journal of the American Water Works Association* , vol. 92, n° 11, pp. 82-92, 2000.

[6] J.C. Lou, W.L. Lee, J.Y. Han, "Influence of alkalinity, hardness and dissolved solids on drinking water taste: A case study of consumer satisfaction", *Journal of Environmental Management*, vol. 82, n° 1, pp. 1-12, 2007.

[7] F. Proulx, M. Rodriguez, J.B. Serodes, "Les goûts et les odeurs dans l'eau potable : revue des composés responsables et des techniques de mesure", *Revue des Sciences de l'Eau*, vol 23, n°3, pp.303-323, 2010.

[8] M. Montginoul, V. Waechter, "Les ménages et l'eau du robinet : perceptions et pratiques dans une communauté urbaine", *Ingénieries EAT*, n° 51, pp. 33-46, 2007.

[9] IFEN, Institut Français de L'Environnement, "La préoccupation des Français pour la qualité de l'eau", *Les Données de L'Environnement*, pp. 1-4, 2004.

[10] C. Ferrier, "Bottled Water: A Social Phenomenon". *A Journal of the Human Environment*, vol 30, n°2, pp. 118–119, 2002.

[11] Z. Hu, L. Wright Morton, R. L. Mahler, "Bottled Water: United States Consumers and Their Perceptions of Water Quality", *Int. J. Environ. Res. Public Health*, pp. 8565-578, 2011.

[12] K.A. Reynolds, K.D. Mena, C.P. Gerba, "Risk of waterborne illness via drinking water in the United States", In *Reviews of environmental contamination and toxicology*, Springer, pp. 117-158, 2008.

[13] J. Bouju, S. Tinta, B. Poudiougo, " Approche anthropologique des stratégies d'acteurs et des jeux de pouvoirs locaux autour du service de l'eau. Bandiagara, Koro et Mopti, Mali". Programme alimentation en eau potable dans les quartiers périurbains et les petits centres, CNRS, France, 1998.

[14] A. Illes, L. Csepanyi, F. Cui, D. Wagenaar, "Bottled Water vs Tap Water, Athens program course". *European Water and Sanitation services*, (AGROPT09), 2011.

[15] E. Riboni, M. Robert., " Les méthodes de désinfection de l'eau. Avantages et inconvénients respectifs entre chlore - U.V.- ozone- microfiltration, quelle méthode choisir en fonction des objectifs ?, quelques exemples d'applications", *Ozone. Ch. Sàrl*. Switzerland, 2001.

[16] E. Mackey, H. Baribeau, G. Crozes, I. Suffet, P. Piriou, "Public perception of tap water chlorinous flavor", *Water Science Technology*, Vol. 49, n°9, pp. 335–340, 2004.

[17] P. Piriou, E. Mackey, I.H. Suffet, A. Bruchet, "Chlorinous flavor perception in tap water", Water Science Technology, Vol. 49. n° 9, pp 321–328, 2004.

[18] P. Piriou, E.D. Mackey, I.H. Suffet, A. Bruchet, "Chlorinous flavor perception in drinking water", *Water Science and Technology*, n°49, pp.321-328, 2004.

[19] A.M. Dietrich, "Aesthetic issues for drinking water",. Journal of Water and Health, vol 4, pp.11-16, 2006.

[20] S.B. Watson, "Aquatic taste and odor: a primary signal of drinking water integrity", *J. Toxicol. Envir. Health, Part 1*, 67, pp.1779-1795, 2004.

[21] O.P. Ozbek, "Consumers detect odd odors, tastes in water despite government guidelines, scientist says". *PhysOrg*. Com., 2011.

[22] F. Proulx, M.J. Rodriguez, J.B. Serodes, L.F. Miranda, "Factors influencing public perception and water use of municipal drinking water". Water Science and Technology, *Water Supply*, vol 10, pp. 472-485, 2010.

[23] Water Services City of Cape *Town:* Customer Perception Survey, 2007. [Online] Available: http://www.capetown.gov.za/en/Water/Pages/WaterConsumptionSurvey2007.aspx

[24] I.H. Suffet, A. Corado, D. Chou, M.J. McGuire, S. Butterworth, "AWWA taste and odor survey", *Journal of American Water Work Association*, 88, pp. 168-180, 1996.

[25] B. Welté, A. Montiel, "Study of the possible origins of chlorinous taste and odour episodes in a distribution network", *Water Sci. Technol*., 40, pp.257-263, 1999.

[26] B. Cancho, C. Fabrellas, A. Diaz, F. Ventura, M.T. Galceran, "Determination of the odor threshold concentrations of iodinated trihalomethanes in drinking water". *J. Agric. Food Chem*, 49, pp.1881-1884, 2001.

[27] A. Bernard, T. Denies, J.P. Bourguignon, J.P. Ducart, "L'eau du robinet et la santé », Aquawal, 2007.

[28] J. Rodier, B. Legube, N. Merlet, R. Brunet, "L'analyse de l'eau : eaux naturelles, eaux résiduaires, eaux de mer ". 8ème édition. Dunod, Paris, France, 2009.

[29] M.H. Mahmud Amar, I. Liabwel, S. Kumar, S.M. Donkor, "Technical Guidelines for the Construction and Management of Drinking Water Treatment Plant", A Manual for Field Staff and Practitioners, Ministry of Water Resources and Irrigation, Government of Southern Sudan,Developed in partnership with UNICEF, 2009.

[30] R.H.J Sarbatly, D. Krishnaiah, "Free chlorine residual content within the drinking water distribution system", *International Journal of Physical Sciences*, vol.2, n° 8, pp. 196-201, 2005.

[31] Water Quality Association, "Perceptions about household water", Lisle, Illinois, 1999.

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Application of Fuzzy Delphi Method for the selection of factors influencing the selection of best bridge site

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ABSTRACT: The present paper describes about the application of one of the well structured technique called Fuzzy Delphi Method for the selection of factors influencing the selection of best bridge site. Selection of bridge site depends on various factors and it requires expertise knowledge of the domain Experts. Fuzzy Delphi Method which relies on expert opinion is one of the efficient technique to identify the influential factors which are to be considered for the selection of bridge site. Fuzzy Delphi Method involves two stages. The first stage involves set of interviews with the experts and responses are collected using Likert scale which is then reduced to 1-10 point scale for the selection of influential factors. In the second stage some of the non influential factors are eliminated by appropriate threshold value.

KEYWORDS: Fuzzy Delphi, Expert, Threshold, Knowledge, Domain.

1 INTRODUCTION

The selection of site for a bridge is usually influenced by engineering, aesthetic, social and economic considerations. The existing roadway or railway alignments may also govern the bridge site to be selected in which case the choice is very limited. On the other hand, in the case of a new alignment, the consideration of providing maximum commercial and social benefits is also not to be ignored. For river bridges in rural areas, usually a wider choice may be available. To the extent possible, it is desirable to align the bridge at a square crossing and sometimes, a skew crossing has to be provided in order to avoid costly land acquisition or sharp curves on the approaches. In selecting a site, care should be taken to consider all the factors which really influence the selection of site which is likely to serve the needs of the bridge at the least cost. Identification of factors is usually done by studying the problem domain and by negotiation with the domain experts. The present paper introduces one of the well structure techniques called Fuzzy Delphi Method to collect the Experts opinion.

2 SCOPE OF STUDY

Selection of a bridge site is one of the important steps to be carried out before planning and design of a bridge. Selection of bridge site involves selection of influential factors, which requires expert knowledge. Knowledge from the experts can be collected in the form of interviews using set of questionnaires. In this context, Fuzzy Delphi Method which relies on Expert opinion is used as an effective method to select the influential factors which are to be considered in the selection of best

Bridge site. The Scope is fulfilled by the following stages of work: Indentifying the Experts, Interaction with the Experts, Data collection and Research, Selection of factors.

3 METHODOLOGY

To establish a set of influential factors for the selection of bridge site, a questionnaire survey of experts and academics in the domain is done as described below.

1. A total of 11 experts in the industry, profession, academia and government organizations were selected for the survey. A set of questionnaires were consigned among all the experts. Experts give a set of factors for the selection of best bridge site. All these responses are combined and listed together.

2. In the second round a set of questionnaires are prepared on these listed factors and the questionnaires are distributed among the experts. The questionnaires are prepared in such a way that the responses are collected in the Likert scale, which is one of the effective tool to handle the ambiguous knowledge. Responses collected using Likert scale can be easily brought to numbered form and finally expressed in 1-10 point scale.

3. The collected response from the Experts for some of the factors is depicted in Table 1.

Table 1. Experts Response in 1-10 scale

Experts \ Factors	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11
E1	10	8	10	8	9	7	9	8	7	6	8
E2	9	8	9	7	9	7	8	7	7	5	8
E3	10	7	9	9	9	6	9	7	8	4	9
E4	9	7	10	7	10	6	9	6	8	5	7
E5	8	9	8	9	8	8	9	5	9	5	8
E6	8	7	10	7	8	7	8	8	7	6	6
E7	9	8	9	8	9	7	8	7	6	7	7
E8	10	8	8	9	10	6	7	6	5	7	9
E9	10	7	8	9	9	8	9	9	7	6	9
E10	10	6	10	7	8	8	9	7	7	6	8
E11	10	7	10	8	7	5	6	5	8	7	7
Experts \ Factors	**F12**	**F13**	**F14**	**F15**	**F16**	**F17**	**F18**	**F19**	**F20**	**F21**	**F22**
E1	9	10	9	10	9	8	9	7	8	9	10
E2	9	8	10	10	9	7	7	8	9	5	6
E3	9	9	10	9	10	7	9	9	8	9	9
E4	9	8	9	10	9	6	7	5	6	5	8
E5	10	7	8	8	8	5	8	8	7	6	6
E6	8	7	8	9	9	8	9	8	9	8	9
E7	9	6	7	9	7	8	10	6	7	6	5
E8	7	5	9	8	8	7	7	8	9	9	8
E9	7	6	9	10	9	7	9	5	9	5	8
E10	8	8	8	10	8	8	9	8	9	8	9
E11	6	7	10	9	10	9	9	5	9	5	8

4. The definite value of each alternate factor are found using equation,

$$Sj = \underline{(Pij+Qij+Rij)} \text{ where, } i= 1, 2,...n.\ j= 1, 2,\ldots m.$$

3

Where,

{Pij} is minimum assessment from expert i for the factor j

{Qij} is average of all the assessment from the expert i for the factor j

{Rij} is maximum assessment from the expert i for the factor j

5. Normalization is done for the values obtained for each alternate factor using suitable normalization technique. Normalization is defined as the more advanced and experienced adjustments, where the objective is to bring the entire probability distribution of adjusted values into alignment. The equation is as given below.

$$\text{Normalized } (e_i) = \frac{e_i - E_{min}}{E_{max} - E_{min}}$$

6. A proper threshold value is selected to eliminate the non influential factors from the selected factors in the second stage. There are various methods to select the threshold value. The type of method depends on the consistency of the normalized values. In the present research the threshold value is selected based on the consistency of occurrence. The normalized value which has the more consistency of occurrence is selected as the threshold value(r). Based on the above said criteria the threshold value is chosen as 0.52. Therefore the factors which have the normalized values less than the threshold value is filtered off and the values greater than the threshold value are selected as the most influential factors for the selection of best bridge site. The principle of screening is as follows:

If $S_j > r$, then no. j factor is the evaluation index

If $S_j < r$, then delete no. j factor.

4 CONCLUSION

The study involves the selection of influential factors for the bridge site selection using one of the effective, well structured techniques called Fuzzy Delphi Method which relies on Expert opinion. In the first step a total of 38 factors are obtained and some of the non influential factors are filtered using suitable normalization technique and finally arrived at 27 most influential factors for the selection of bridge site under Experts concise.

The finally selected factors along with list of their appraisal values given which indicates the importance of the factors brought to 1-10 point scale are listed below.

SL.No.	Factor	Sj
1	Social and economic benefits	9.12
2	Reasonable proximity to direct alignment	7.48
3	location of bridge site	9.06
4	Government interference	8
5	commercial influence	8.57
6	Adjacent property consideration	6.6
7	Future growth	7.75
8	Availability of local material	6.93
9	Traffic volume	7.06
10	Time consideration	5.6
11	Aesthetics	7.6
12	Environmental impact	8.09
13	secure straight approaches without obstacles	7.45
14	Direct alignment	8.39
15	Geological considerations	9.09
16	Well defined narrow channel	8.57
17	Approaches facing upstream	7.09
18	High bank above flood level	8.63
19	Sharp curve in the approaches	8.06
20	under water construction	8.66
21	costly river training work	6.51
22	space for bridge foundation	7.51
23	Navigation purposes	7.96
24	Maintenance and repair work	7.06
25	Confluence of large tributaries	7.57
26	Slope and banking conditions	7.1
27	Community participation	7.06

REFERENCES

[1] YU-LUNG HSU et.al. “The Application of Fuzzy Delphi Method and Fuzzy Analytical Hierarchy Process in lubricant regenerative technology selection”. Expert System with Applications. 37(2010) 419-425.

[2] TAPAN KUMAR ROY et.al. “Intuitionistic Fuzzy Delphi Method: More realistic and interactive forecasting tool” Notes on Intuitionistic fuzzy sets .Vol.18,2012, No. 2,37-50

[3] Takayukhi Nishido, “Study on practical expert system for selecting the type of river crossing bridges”. Structural Engineering/ Earthquake Eng. Vol.7.no.2, 239s-250s.october 1990.

[4] Akbar Etebarian et. al. “Applying Fuzzy Delphi Method and Fuzzy Analytical Hierarchy Process for ranking Marine casualties”. Recent advances in Neural Networks and Fuzzy systems. ISBN 978-1-61804-227-9.

[5] yu-feng ho et.al. “Applying Fuzzy Delphi Method to select the variables of a Sustainable Urban System Dynamics Model”. Chaoyang University of Technology.

[6] M. Emin EMIROGLU, ‘Influences on Selection of the Type of Dam Firat University, Faculty of Engineering’, Civil Eng. Dept. Elazig, TURKIYE. Internationa, l Journal of cience and Technology. Volume 3, No. 2,173-189, 2008.

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Production of a Curve Number map for Hydrological simulation - Case study: Kalaya Watershed located in Northern Morocco

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ABSTRACT: The purpose of this study is to apply various techniques and models for catchment delineation, and developing methods to calculate a Curve Number values for the Kalaya river basin located in Northern Morocco, by implementing GIS software (ArcGIS, HEC-GeoHMS), Erdas Imagine and hydrologic modeling (HEC-HMS), in which the estimation of the direct runoff under the scenario with precipitation of 80 mm during the storm event that have occurred between 23 and 24 December 2009. In particular, SCS-CN (Soil Conservation Curve Number) is a model through which the estimation of the direct runoff can be achieved. This method includes several important properties of the watershed such as Hydrological Soil Groups and land use, which will be input for the HEC-HMS model.

KEYWORDS: Catchment delineation, Kalaya River, HEC-HMS model, Soil Conservation Curve Number.

1 INTRODUCTION

The traditional method used to delineate a watershed area from the topographic map takes time and is inaccurate. This method has been replaced by the automatic extraction from a Digital Elevation Model (DEM). The DEM data have been used to derive geomorphic and topographic characteristics such as terrain slope, Elevation, aspect, contour line, hillshade and view shade [1].

A catchment is usually delineated as many sub basins or one single basin using Geographical Information System (GIS) before the use of HEC-HMS model. To proceed the study through the ArcGIS and HEC-GeoHMS, selecting study area and collecting data are needed. These collected data were used in preprocessing in the ArcGIS 9.3 and ArcHydro 9 for computing Hydrologic parameters through HEC-GeoHMS which is capable to generate the watershed's boundary, and acts as an interface between ArcGIS and HEC-HMS software [2].

The HEC-HMS hydrologic model is among the most applicable ones. It has been chosen to estimate and simulate the flow in the hydrological units of the area. Among the different models provided in the HEC – HMS to estimate rainfall-runoff, the method developed by Natural Resources Conservation Service (NRCS) of the United States Department of Agriculture (USDA) is one of the most popular methods for estimating the volume and peak rates of surface runoff [3]. To simulate rainfall-runoff for the Kalaya watershed through the HEC-HMS model, SCS Curve Number method was selected as an infiltration part of the model and direct runoff was transformed by US SCS unit hydrograph (UH).

In order to perform rainfall-runoff modeling, various types of information are required. Part of the necessary model input can be provided through processing and analysis of a Digital Elevation Model (DEM) of a selected area, Hydrological Soil Groups, and land use. SCS curve number grid is used by many hydrologic models to extract the curve number for watersheds. It is extracted from the soil type and land use data using HEC-GeoHMS (ArcGIS 9.3 version), which both affect the infiltration capacity of the soil.

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2 STUDY AREA

Kalaya basin is located in the southern part of Tangier city in Northern Morocco. The basin is located between 35°38' and 35°44' northern latitudes and 5°38' et 5°47' eastern longitudes. The area of the basin is 37.3 km2 and the length of the main channel is 20 km with an elevation of 513 m above the mean sea level and a maximum of slope of 35.97°.The Average annual rainfall of the area is 720 mm.

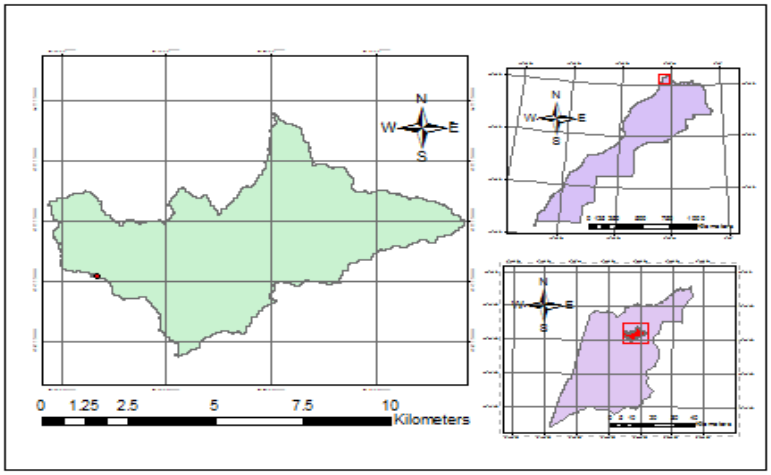

Fig. 1. Geographical position of the studied area

3 DATA PREPROCESSING

ArcGIS 9.3 and Arc Hydro Tools were used for pre-processing the collected data for the study area: ASTER-DEM (The Advanced Spaceborne Thermal Emission and Reflection Radiometer) at a horizontal spatial resolution of 30 meters has been downloaded freely, mosaiced and processed in this study. The land use and Hydrological Soil Group map (HSG) were generated to calculate the Curve Number and for the preparation of rainfall-runoff model by the mean of HEC-HMS.

3.1 DELINEATION OF THE KALAYA WATERSHED FROM ASTER DEM

The extraction of the drainage network of the study area was carried out from an ASTER DEM, in raster format with a 30m*30m grid cell size. Archydro tools in ArcGIS software, version 9.3 (ESRI 2008) was used to extract drainage channels through ArcHydro. The delineation of the watershed is followed by running the following functions (figure 4): Fill , flow accumulation, Flow direction, Stream definition, Stream Segmentation, Catchment Grid Delineation, Catchment Polygon, Drainage line, Adjoint Catchment processing and Drainage point [4].

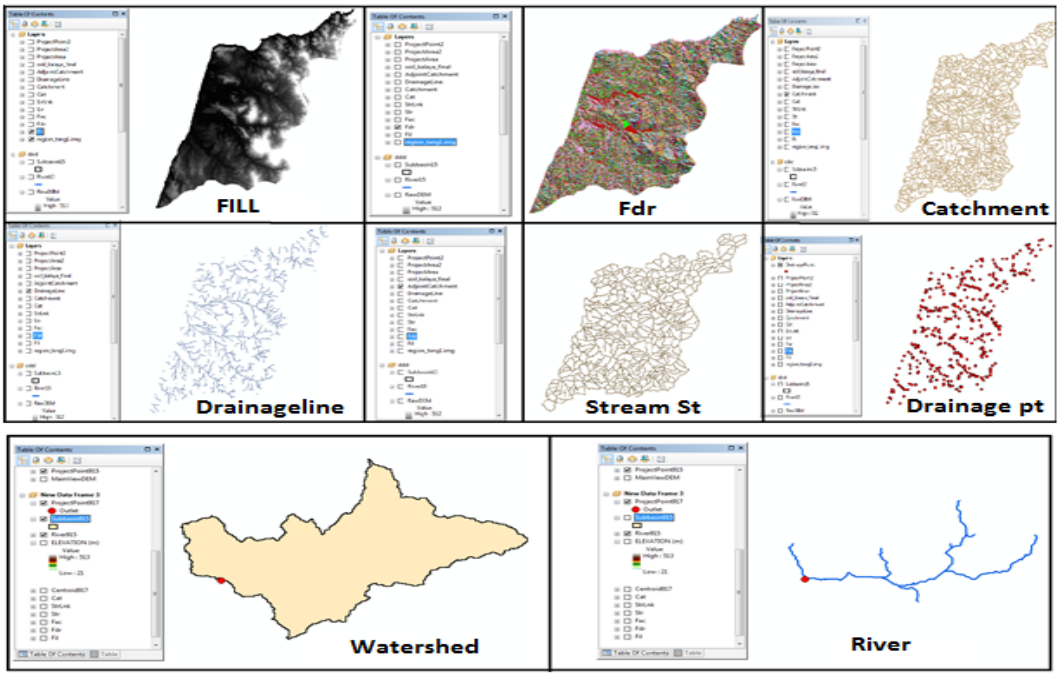

Fig. 2. Some results of Archydro model

Basin area, River length, the average slope value, CN lag time and Curve Number value are resulted from HEC-GeoHMS of US Army Corps Engineering (USACE) [5]. This Computed Hydrological data will be the input parameters of Rainfall-Runoff model in HEC-HMS. The basin characteristics such as the area, length, basin slope, CN Lag and initial abstraction are shown in Figure 3:

Subbasin917

Name	Area	Perimeter	LossMet	TransMet	BasinSlope	BasinCN	LagMeth	BasinLag	InitAbst
W230	37	51	SCS	SCS	8.474816	82.075851	CNLag	2.082715	7.46

Fig. 3. Hydrologic characteristics of kalaya basin from HEC-GEOHMS

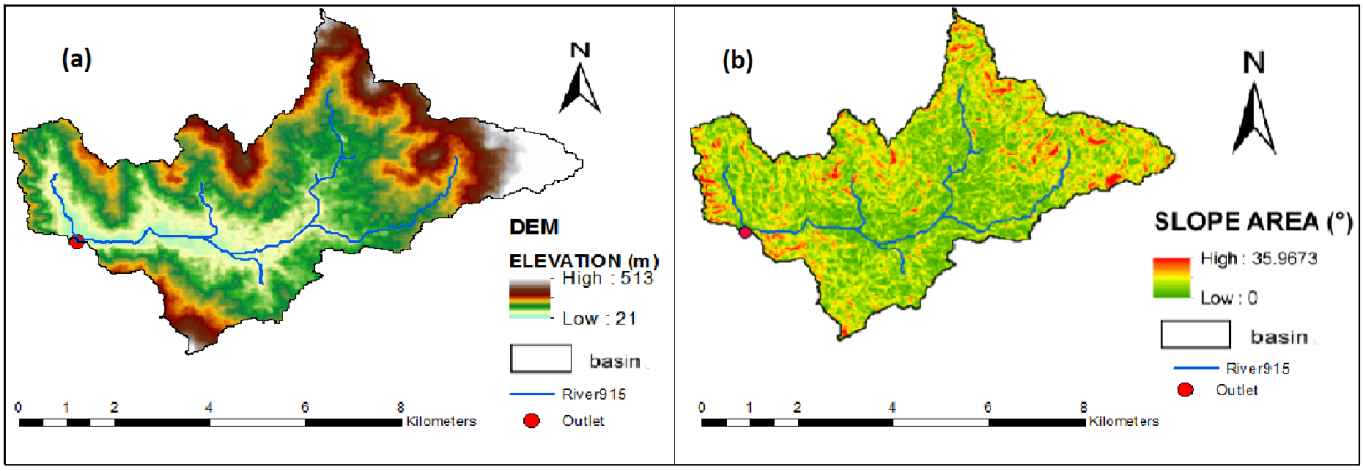

Fig. 4. (a) Topographies map of Kalaya Watershed, (b) Slope Area of Kalaya watershed

3.2 LAND USE MAP

Land use map was generated from Spot-5 image satellite data from 2005 with a resolution of 2.5 m. The supervised classification method with maximum likelihood clustering was employed for image classification through ERDAS 9.3 Software [6]. The Land use identified in watershed is primarily urban, bare soil, agricultural and forest areas. The Kalaya River basin is classified into 4 classes as shown in Table I:

Table 1. Land use classification

Land Use	Surface Area	
	In sq.km	%
Urban	11.465	30.74
Bare soil	7.1154	19.08
Agricultural	4.170	11.18
Forest	14.551	39.01
Total	37.30	100

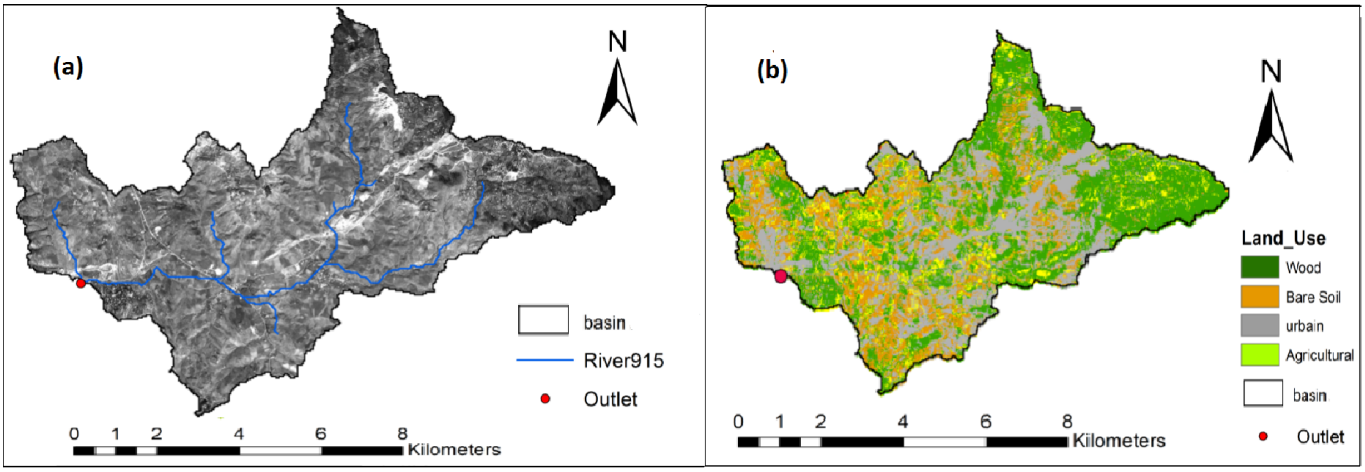

Fig. 5. (a) spot-5 image for the study area, (b) Basin Land use types

3.3 HYDROLOGIC SOIL GROUPS MAP

Different soil textures were digitized from the pedologic map of the region (digitized 1: 100000). It was assigned to represent different soil categories such as vertisol soil, paravertisol soil, lithosol soil and sesquioxides Soil [7]. Based on the rules of hydrologic soil group classifications developed by the US Natural Resource Conservation Service (NRCS), the hydrologic soil map of Kalaya watershed was generated and displayed in Figure 6:

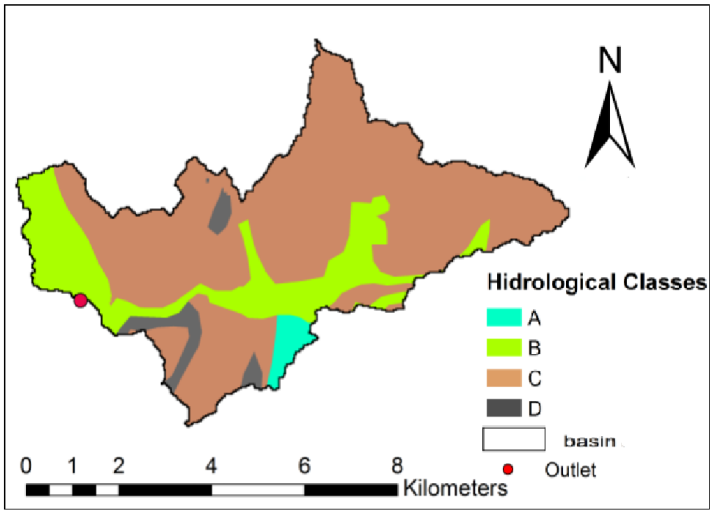

Fig. 6. Hydrologic soil groups of Kalaya watershed

Infiltration rates of soils are affected by subsurface permeability. As defined by SCS soil scientists, Soils may be classified into four hydrologic groups (A, B, C and D), (USDA, 1986): A; soil having high infiltration rates, B; soils having moderate infiltration rates, C; soils having slow infiltration rates, and D; soils having very slow infiltration rates [8]. The hydrologic soil group of Kalaya basin corresponds to the soil class that was obtained as shown in Table II:

Table 2. Surface of Hydrologic soil group of Kalaya watershed

Hydrologic Soil Groups	Surface Area	
	In sq.km	%
A	0.806	2.16
B	7.968	21.36
C	27.171	72.85
D	1.353	3.63
Total	37.30	100

3.4 Generation Of Curve Number Grid

The SCS curve number method (SCS, 1972), also known as the Hydrologic Soil Cover Complex Method was based on an empirical equation that estimates land use and soil type, the SCS CN method was also used to estimate excess rainfall and losses [9]. The CN is used to compute the volume of rainfall excess in the HEC-HMS and is therefore used as the description of watershed soil and land use characteristics in this modeling study.

The Curve number is calculated in ArcGIS trough the union processing attributes combined to one of the land and Hydrological soil groups. Using the SCS TR55 report from 1986, the creation of the CN table that has curve numbers values for different combinations of soil hydrologic groups and land uses has been made as shown in the table below:

CnLookUp

OID	OBJECTID	LUvalue	Descriptio	A	B	C	D
0	1	1	Water	100	100	100	100
1	2	2	Urban	77	85	90	92
2	3	3	Bare soil	77	86	91	94
3	4	4	Agricultural	64	75	82	85
4	5	5	Forest	43	65	76	82

Fig. 7. CN Lookup table

The SCS CN table gives CN for different combinations of land use and soil group, the Curve Number parameter is dimensionless and varies from 0 (maximum infiltration) to 100 (zero infiltration) [8]. After elaborating of the data necessary to compute the CN indicator, the CN map has been obtained from the intersection of the soil hydrological group and land use.

The values of CN of the Kalaya basin is between 94 and 43, the average CN is 82.0.75 as shown the figure above.

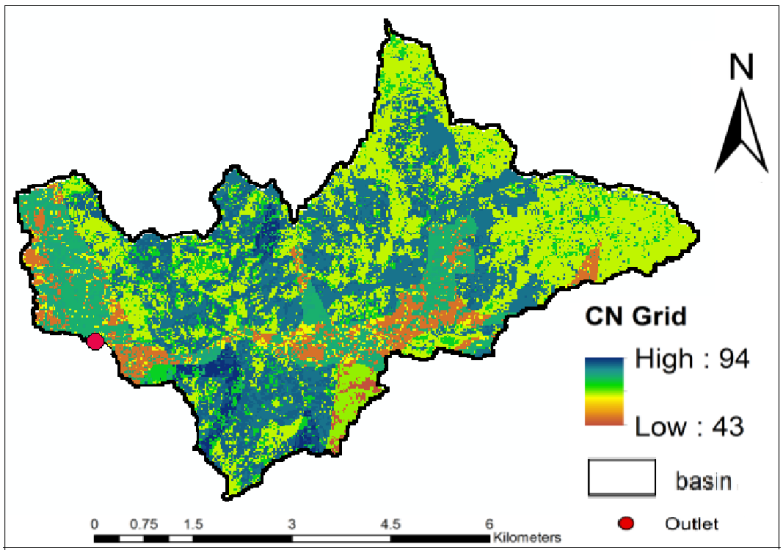

Fig. 8. Curve Number Grid map of Kalaya basin

4 **HEC-HMS** Model

HEC-HMS is designed to simulate the precipitation-runoff processes of watershed systems to identify drainage and overland flow and forecasting based on the resulted hydrograph. The physical representation of a watershed is accomplished with a basin model, where hydrologic elements (sub-basin, reach, junction, reservoir, diversion, source, and sink) are connected in a dendritic network to simulate runoff processes [10].

To calculate runoff for the kalaya watershed, the adopted method is SCS Curve Number Loss. This method computes incremental precipitation during a storm by recalculating the infiltration volume at the end of each time interval. The second approach was the application of the SCS Unit Hydrograph method as a transform method. In this case, the hydrograph is scaled by the lag time to produce unit hydrograph. The SCS runoff equation is:

$$Q = \frac{(P - I_a)^2}{(P - I_a) + S} \qquad (1)$$

Where:

Q = direct runoff (mm)

P = rainfall (mm)

S = potential maximum retention after runoff begins (mm)

I_a = initial abstraction (mm)

Initial abstraction computes all losses before runoff begin such as ponding in surface depressions, interception by vegetation, evaporation, and infiltration.” Ia” can be approximated by equation:

$$I_a = 0.2S \qquad (2)$$

Combining equations (1) and (2) results in equation 3:

$$Q = \frac{(P - 0.2I_a)^2}{P + 0.8S} \quad (3)$$

Where the parameters S are related to soil and land use condition of basin through the Curve Number which has range of 43 to 94. The equation for the potential maximum retention is:

$$S = \frac{1000}{CN} - 10 \quad (4)$$

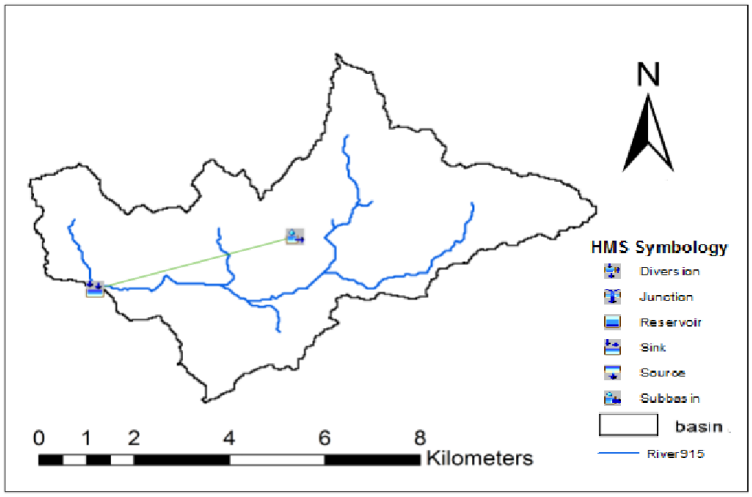

Fig. 9. HMS Schematic

For this study the soil conservation service (SCS), design storm with a Type II distribution was used to simulate rainfall event. This method requires 24-hour storm rainfall depths (80 mm) for Kalaya watershed, dated October 23, 2008. It is considered to have the severest intensity, and was selected for simulation in the HEC-HMS model [10].

Runoff of stream flow was finally estimated using HEC-HMS. All parameters needed for the HMS model were computed through ARCGIS and HEC-GeoHMS. The result of HEC-HMS is the hydrograph which generates the rainfall in function of the runoff. This results show the hydrograph of Kalaya basin located in the downstream in the periods from oct.23.2008 to oct.24.2008.

The figure below represents the summary of Peak discharge and discharge volume of the SCS methods:

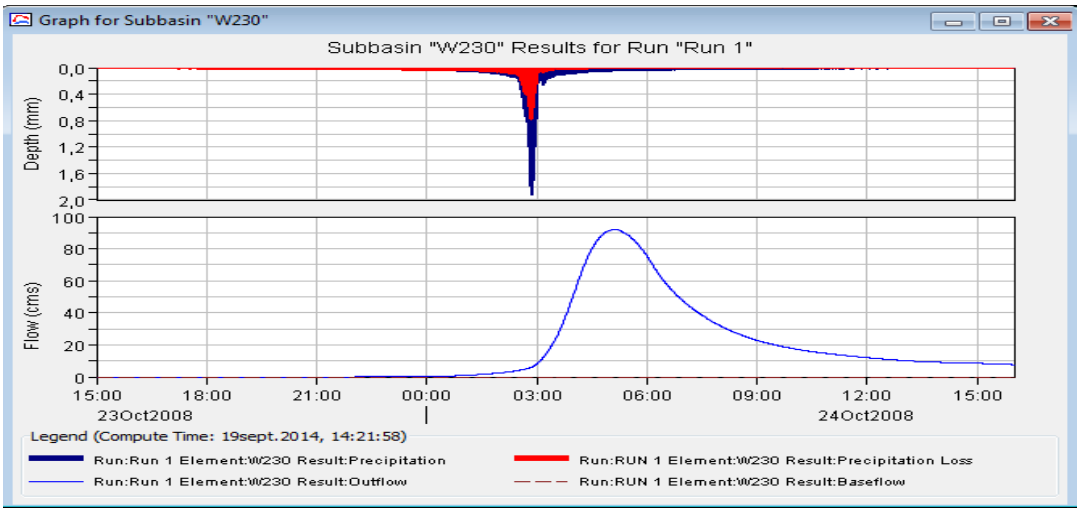

Fig. 10. runoff of SCS transform method

Figure 11 represents the summary of Peak discharge, discharge volume and Data derived from the Simulation of the hydrologic model for the event storm by SCS CN method:

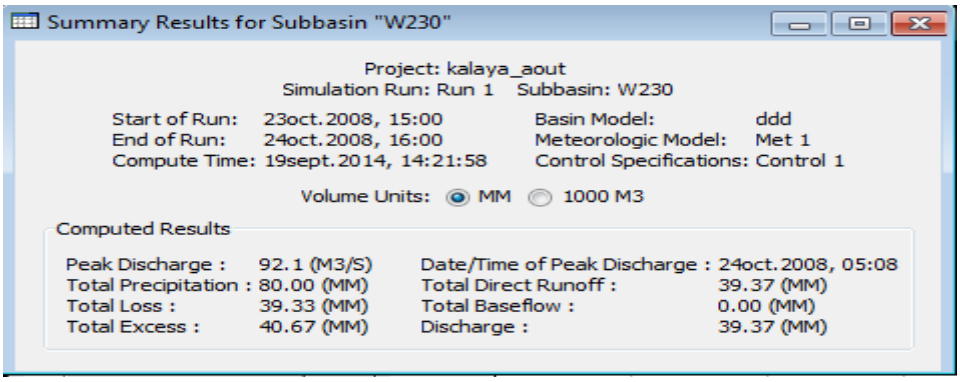

Fig. 11. Data derived from the Simulation of the hydrologic model

From the results of the hydrographs, the runoff volume, peak discharge and percent loss were determined. For the event storms, the peak discharge was 92.1 m3/s, the total precipitation was 80 mm, the total loss was 39.33 mm, and the total rainfall excess was 40.67 mm. Therefore, the total direct runoff volume is about 1468.3 m3.

5 CONCLUSION

As a result, the Kalaya basin was modeled using HEC-HMS through ArcGIS, Archydro and HEC-GEOHMS to determine Hydrologic parameters which have spatial characteristic and to compute the peak Discharge and loss infiltration using the SCS-CN method.

The present study demonstrates the interest of GIS techniques and remote sensing, and the utility of the delineation and estimation of the runoff for the storm event for the Kalaya watershed. This paper presents a reliable method for computing the CN values, which combines Land use and Hydrological soil group. The computation of the CN values was the key to a successful SCS-CN modeling. In order to test the feasibility and effectiveness of this method, surface runoff is simulated under the scenario of 80 mm precipitation for the Kalaya watershed. The result demonstrated that the SCS-CN method by using remote sensing to estimate runoff is convenient and effective.

REFERENCES

[1] Gyozo Jordan, "Morphometric Analysis and Tectonic Interpretation of Terrain Data: a case study," *Earth Surf. Process and Landforms 28, 807–822 (2003).*

[2] Kabiri, R.A, Ramani Baiv., B and Chan, A., "Using Green-Ampt Loss Method in Surface Runoff Simulation off Klang Watershed in West Malaysia)," *Advances in Environment, Computational Chemistry and Bioscience.*

[3] Fenglei Fan, Yingbin Deng, Xuefei Hu and Qihao Weng, "Estimating Composite Curve Number Using an Improved SCS-CN Method with Remotely Sensed Variables in Guangzhou, China," Remote Sensing ISSN 2072-4292

[4] Okirya Martin, Albert Rugumayo & Janka Ovcharovichova, "Application of Hec-Hms/Ras and GIs Tools in Flood Modeling: A Case Study for River Sironko,"*GLOBAL journal of engineering, design & technology, Vol. 1(2) 2012, pp.19-31, UGANDA.*

[5] USACE United States Army Corps of Engineers. (2010). Geospatial hydrologic modeling extension, HEC-GeoHMS, user's manual version 10. Davis, CA, USA.

[6] Rajesh.R Sawant, "*Land Use Land Cover Change Projection for use in Municipal Water Resource Planning in the Saugahatchee Watershed*," Thesis, Faculty of Auburn University, 2012.

[7] Osrirhi A. ElOumri M. Moussadek R. Moatamid Z. Ambri A. Goebel W., "Vocation agricole des terres de la Province de Tanger", Mars 2007, Ministère de l'Agriculture, du Développement Rural et des Pêches Maritimes.

[8] United States Department of Agriculture, Natural Resources Conservation Service (USDA-NRCS). "Urban Hydrology for Small Watersheds"; Technical Release 55, United States Department of Agriculture, Natural Resources Conservation Services, Conservation Engineering Division, Washington, DC, USA, 1986.

[9] Brian C. McCormick,"*Distributed Hydrologic Modeling of the Upper Roanoke River Watershed using GIS and NEXRAD*" Thesis, faculty of Virginia Polytechnic Institute and State University, 2003.

[10] USACE United States Army Corps of Engineers. (2010). Hydrological modeling system HEC-HMS, user's manual, version 3.5. Davis, CA, USA.

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Qualité de vie des parents d'enfants et adolescents souffrants d'infirmité motrice cérébrale

[The quality of life of parents with children and adolescents suffering from cerebral palsy]

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ABSTRACT: The parents of child with Cerebral Palsy through difficult periods in their lives, both in childhood of their son and in his adolescence. Adolescents with physical disabilities become more difficult to treat. This transition period often associated with disorders of behavior is an important factor in parental stress and causes deterioration in the quality of life. There are few studies that seek to assess the impact of cerebral palsy on the quality of life and mental health of parents.
A study protocol consisting of questionnaires, scales and grid clinical interview were distributed and completed by 67 relatives (34 mothers and 33 fathers) of children with cerebral palsy, to measure the impact of the weakness of their children on their psychological and social well- being and their quality of life.
Most of our results support our hypothesis and confirm data from the literature in this area little studied in Morocco. Indeed it seems that the suffering of parents with cerebral palsied children is more pronounced at the age of adolescence than during the phase of childhood. The impact of this pain on mothers seems more intense than on fathers. In conclusion, more having a social support and a psychological counseling, more the parent's quality of life is better.

KEYWORDS: Children, Adolescents, Cerebral palsy, Quality of life, Perceived stress, Social support

RESUME: Les parents d'un enfant souffrant d'Infirmité Motrice Cérébrale, traversent des périodes difficiles durant leur vie, tant pendant l'enfance de leur fils qu'à son adolescence. Les adolescents ayant un handicap physique deviennent plus difficiles à soigner. Cette période de transition souvent associée à des troubles de comportement est un facteur important de stress parental et provoque une détérioration de la qualité de vie. Rares sont les études qui cherchent à évaluer les conséquences de l'infirmité motrice cérébrale sur la qualité de vie et la santé mentale des parents.
Un protocole d'étude composé de questionnaires, d'échelles et de grille d'entretien clinique ont été distribués et remplis par 67 parents (34 mères et 33 pères) d'enfants infirmes moteurs cérébraux, permettant de mesurer l'impact de l'infirmité de leurs enfants sur leurs bien être psychique et social et leurs qualité de vie.
L'essentiel de nos résultats corroborent nos hypothèses et confirment les données de la littérature dans ce domaine peu étudié au Maroc. En effet il semble que la souffrance des parents d'enfants infirmes moteurs cérébraux est plus accentuée à l'âge de l'adolescence que durant la phase de l'enfance. L'impact de cette souffrance sur les mères semble plus intense que chez les pères. En conclusion, plus les parents ont un soutien social et un suivi psychologique, plus leur qualité de vie est meilleure.

MOTS-CLEFS: Enfants, Adolescents, Infirmité motrice cérébrale, Qualité de vie, Stress perçu, Soutien social.

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1 INTRODUCTION

L'infirmité motrice cérébrale est définie comme un trouble persistant du mouvement et de la posture, secondaire à un processus pathologique non progressif affectant le cerveau immature [1].Outre les atteintes motrices, l'infirmité motrice cérébrale (IMC) entraine souvent la présence de troubles neuropsychologiques, à des degrés de gravité divers [2].En raison de leur problème moteur, ces enfants dépendent plus longtemps que les autres de leur entourage, et une certaine immaturité affective peut parfois en découler [2]. De ce fait la vie des parents est généralement perturbée et ils s'organisent entièrement autour de l'enfant et de son avenir. Certaines familles ont des ressources nécessaires pour assurer une bonne adaptation à la problématique de santé [3]. Cependant, chez d'autres familles, les stress associés à une problématique de santé créeraient des tensions dans les relations familiales ou accentueraient celle déjà existantes entre certains membres [4]. Par ailleurs la plupart des recherches concernent le stress et l'ajustement des mères qui assument la principale responsabilité des soins médicaux de l'enfant [5]. Cependant il est nécessaire que d'autres recherches soient mises à contribution afin de clarifier le rôle que joue le couple au sein des familles dont un enfant est atteint de maladie chronique [6]. Le soutien social est défini comme étant les ressources procurées (instrumental, émotionnel et de socialisation)par d'autres personnes qui peuvent provenir du réseau intrafamilial ou extrafamilial [7],de ce fait le soutien social perçu est une ressource reconnue comme ayant des effets positifs qui favorise une meilleure adaptation de l'individu à son environnement ou à certaines situations familiales stressantes [8].

Les hypothèses postulent (i) que les parents d'enfant IMC souffrent d'une perturbation de leur qualité de vie à l'adolescence plus qu'à l'enfance de leur enfant, (ii) que les mères présenteraient une moins bonne qualité de vie que les pères, (iii) que plus les parents ont un soutien social plus leur qualité de vie serait meilleure. Pour ces raisons, notre étude globale, de nature exploratoire, a pour objectifs :d'étudier l'impact de l'infirmité motrice cérébrale de l'enfant et de l'adolescent sur la qualité de vie des parents, et de relever les liens qui existent entre le stress perçu, la qualité de vie ressentie par les parents, et le soutien social qui est ici comme étant un facteur pouvant contribuer à l'adaptation des parents, au nord-ouest du Maroc, face à leur situation.

2 MÉTHODES

2.1 SUJETS

La majorité des parents recrutés au hasard vivaient en couple (98,5%) et une seule mère divorcée (1,5%). Les familles invitées à participer volontairement à cette recherche, étaient des parents d'un enfant ou d'un adolescent ayant reçu un diagnostic d'IMC. Les participants ont été recrutés en collaboration avec le centre d'Action Médico Social Précoce à Kénitra (CAMSP) et le centre d'accueil et de rééducation des enfants inadaptés gérés par l'Association Marocaine Pour Vie Meilleure (AMVIM) Il était convenu de fixer des rendez vous avec les parents selon leur disponibilité. Nous leur laissons également la possibilité de choisir l'endroit de la rencontre. La majorité ont préféré le centre où les soins sont prodigués à leur enfant.

L'absence du diagnostic clairement posé constitue le seul critère d'exclusion. Le consentement de chaque participant a été obtenu.

2.2 INSTRUMENTS DE MESURES

2.2.1 QUESTIONNAIRE DES RENSEIGNEMENTS SOCIODÉMOGRAPHIQUES

Le questionnaire contient certains renseignements pertinents à la recherche et à l'analyse des résultats concernant l'enfant ayant une IMC tels que sexe, âge, rang dans la fratrie, âge de diagnostic, prise en charge, troubles associés et autonomie. La situation parentale a été décrite par les renseignements suivants : sexe, âge, situation familiale, niveau socio-économique, profession et le nombre d'enfants.

2.2.2 QUESTIONNAIRE DE SOUTIEN SOCIAL PERÇU (QSSP)

Cette échelle permet d'évaluer le type de soutien reçu, les ressources de ce soutien, le nombre de personnes qui le procure (ou disponibilité) et la qualité perçue (ou satisfaction). Elle est constituée de quatre questions reflétant les principales formes de soutien social : le soutien d'estime (réconfort, écoute dans les moments difficiles), le soutien matériel ou financier (assistance directe quand c'est nécessaire), le soutien informatif (conseils ou suggestions de la part d'autrui), le soutien émotionnel (rassurer, redonner confiance) pour chaque type de soutien, cela permet de savoir combien de personnes le dispensent, qui sont ces personnes (famille, amis, collègues, spécialistes …) et si le sujet est satisfait de ce

soutien. On obtient donc deux scores pour chaque sujet : disponibilité (nombre de personnes ayant participé au soutien) et satisfaction perçues (qualité de ce soutien). Cet outil informe également sur la nature du soutien social perçu par la personne [9].

2.2.3 STRESS PERÇU (PSS 14)

Afin de mesurer le stress perçu lié au fait d'être parent d'un enfant IMC, nous avons utilisé l'échelle PSS 14, selon Cohen et al. en 1983[10], cette échelle permet d'évaluer l'importance avec laquelle des situations de la vie sont perçues comme menaçante, c'est-à-dire non prévisibles, incontrôlables et pénibles. La PSS mesure le stress de manière générale et non pas de manière spécifique [10].

2.2.4 QUALITÉ DE VIE (SF12)

C'est une échelle qui a été construite à partir de l'échelle SF36, mise au point et analysée par Ware et al.[11]. Elle est largement utilisée actuellement en langue anglaise mais dans 15 autres traductions. L'étude de choix et de validation des items a été effectuée dans 9 pays européens et auprès de 9000 personnes [12].

Le SF12 permet de calculer deux scores: un score de qualité de vie mentale(MCS) et un score de qualité de vie physique (PCS). A partir de huit scores, le score activité physique (PF), le score limitations dues à l'état physique (RP), le score douleurs physiques (BP), le score santé perçue (GH), le score vitalité (VT), le score vie et relation avec les autres (SF), le score limitations dues à l'état psychique (RE), et le score santé psychique (MH). Les moyennes et écarts types des deux scores ont été publiés pour les 9 pays européens dans lesquels s'est déroulée l'étude de validation [12]. Les scores sont calculés de façon qu'un score élevé corresponde à un meilleur état de santé.

2.2.5 ANALYSES STATISTIQUES

Toutes les analyses statistiques ont été réalisées à l'aide du logiciel de statistique pour les sciences sociales (SPSS, version 20.0). La normalité de la distribution de variables a été testée par le test de Kolmogorov-Smirnov. Les variables distribuées normalement ont été représentées en moyenne ± écart-type, et celles distribuées anormalement en médiane (interquartile à 25 et 75%). L'homogénéité des variances a été testée en utilisant le test de Levene, et la correction de Welch a été utilisée dans le cas des variances hétérogènes. L'ANOVA ou le test de Mann-Whitney ont été effectués pour tester la signification entre des échantillons indépendants. Le test de chi-carré ou le test de Fisher ont été utilisés pour tester l'indépendance entre les variables nominales. Les valeurs de p inférieures à 0,05 étaient considérées statistiquement significatives.

3 RÉSULTAT

Au total, 67 parents dont 34 mères (50,7 %) et 33 pères (49,3 %) ont participé à notre étude, l'âge moyen des parents est d'environ (43,0±8,5).La majorité vivaient en couple n=66 (98,5 %) et une mère divorcée (1,5 %), 16,4 % de la population n'a qu'un seul enfant. La majorité des mères estiment que se sont elles qui supportent la charge lourde, alors que (11,8 %) estiment que les charges familiales sont équitablement réparties.

23 (67,6 %) des mères sont femmes de foyer 6 (17,6 %) travaillent en mains d'œuvres, 4 (11,8 %) sont des cadres moyen et 1 (2,9 %) est une cadre supérieure et 22 (66,7 %) des pères travaillent en mains d'œuvres, 10 (30,3 %) sont des cadres moyens, et un seul père est cadre supérieur. En ce qui concerne le niveau socio-économique 19 (28,4 %) de la population avait un niveau plus bas que la moyenne, 40 (59,7 %) de la population est dans la moyenne, or 8 (11,9 %) avait un niveau plus haut que la moyenne.

Les enfants étaient 67, dont 43(64,2 %) de sexe masculin et 24 (35,8 %) de sexe féminin, 10 (14,9 %) avaient moins de 6 ans, 22 (32,8 %) entre 6 et 9ans, 14 (20,9 %) entre 9 et 12 ans, 21 (33,3 %) étaient adolescents entre (12 et 18 ans). L'âge moyen des enfants est d'environ 10,15±4,76 ans.

2 (3 %) des enfants ont été diagnostiqués comme IMC à, l'âge de 1 mois, 6 (9 %) à l'âge de 5 mois, 34 (50,7 %) à l'âge de 6 mois, 6 (9 %) à l'âge de 8 mois, 2 (3 %) à l'âge de 9 mois,2 (3 %) à l'âge de 10 mois, 13 (19,4 %) à l'âge de 12 mois et 2 (3,0 %) à l'âge de 24 mois, 55 (82,1 %) des parents estiment que la prise en charge de leurs enfant est insuffisante c'est-à-dire qu'ils jugent que leur enfant aurait aussi besoin d'une autre prise en charge. Or 12 (17,9 %) sont satisfait de leur prise en charge. 65 (97 %) des enfants sont non autonomes et dépendent des adultes pour toutes les activités de la vie quotidienne, 2 (3,0 %) sont autonomes, mais la totalité des enfants présente des troubles associés à leur handicap moteur.

D'après les tableaux 1 et 2, on constate que la majorité des scores des différentes formes et figures de la qualité de vie et du soutien sociale perçu sont hautement significatifs avec des valeurs p<0,0001, très remarquable chez les mères que chez les pères.

Tableau 1. Caractéristiques sur la qualité de vie des parents d'enfants Infirmes Moteur Cérébraux.

	Total (n=67)	Pères (n=33)	Mères (n=34)	p-valeur1
GH	75,0(50,0-75,0)	75,0(75,0-100,0)	50,0(50,0-75,0)	0,000
PF	100,0(100,0-100,0)	100,0(100,0-100,0)	100,0(75,0-100,0)	0,000
RP	62,5(50,0-87,5)	87,5(75,0-100,0)	50,0(50,0-50,0)	0,000
RE	50,0(25,0-62,5)	62,5(50,0-68,8)	25,0(25,0-40,6)	0,000
BP	80,0(60,0-80,0)	80,0(80,0-80,0)	60,0(60,0-80,0)	0,000
MH	30,0(30,0-40,0)	40,0(30,0-40,0)	30,0(30,0-30,0)	0,000
VT	40,0(40,0-60,0)	40,0(40,0-60,0)	60,0(40,0-60,0)	0,021
SF	25,0(25,0-50,0)	50,0(25,0-50,0)	25,0(25,0-25,0)	0,000

1p-valeurs déterminées avec le test de Mann-Whitney.

Tableau 2. Caractéristiques sur le soutien et la satisfaction des parents d'enfants Infirmes Moteur Cérébraux.

	Total (n=67)	Pères (n=33)	Mères (n=34)	p-valeur1
Soutien d'estime	3,0(2,0-5,0)	3,0(2,0-3,5)	3,0(2,8-5,0)	0,000
Satisfaction d'estime	3,0(2,0-4,0)	3,0(2,0-4,0)	3,0(2,0-3,0)	0,001
Soutien matériel	1,0(1,0-2,0)	2,0(1,0-2,0)	1,0(1,0-1,0)	0,000
Satisfaction au soutien matériel	3,0(2,0-4,0)	3,0(2,0-4,0)	2,0(1,8-4,0)	0,010
Soutien informatif	2,0(2,0-3,0)	2,0(1,0-2,0)	3,0(2,0-3,3)	0,013
Satisfaction informative	3,0(2,0-3,0)	3,0(2,0-4,0)	3,0(2,8-3,0)	0,000
Soutien émotionnel	1,0(1,0-2,0)	1,0(1,0-3,0)	1,0(1,0-2,0)	0,000
Satisfaction au soutien.émotionnel	3,0(2,0-4,0)	4,0(3,0-5,0)	3,0(2,0-3,0)	0,002

1p-valeurs déterminées avec le test de Mann-Whitney.

D'après les résultats présentés au tableau 3, le stress perçu et la qualité de vie psychique sont significativement élevés chez les mères des enfants et des adolescents IMC que chez les pères. De même la satisfaction au soutien est significativement élevée chez les mères des adolescents que chez les pères.

Tableau 3. Description de la qualité de vie, de stress perçu et de satisfactions aux soutiens.

	Total (n=67)	Pères (n=33)	Mères (n=34)	p-valeur1
Enfant (<12 ans)				
PSS score		24,48±3,55	32,70±3,09	0,000
PCS score		62,49 ± 4,96	61,24 ± 8,06	0,530
MCS score		54,14 ± 7,91	33,23 ± 7,30	0,000
Score satisfaction		13,09 ± 3,96	11,22 ± 2,69	0,068
Ado (>=12 ans)				
PSS score		25,00 ± 3,59	37,55 ± 3,80	0,000
PCS score		54,57 ± 8,66	55,81 ± 3,04	0,659
MCS score		47,25 ± 13,19	21,92 ± 6,55	0,000
Score satisfaction		13,10 ± 2,47	10,18 ± 1,53	0,004

1p-valeurs déterminées avec le test d'ANOVA.

Selon les résultats présentés aux tableaux 4 et 5, il est démontré que le score de la qualité de vie psychique (MCS) des pères des enfants IMC est négativement corrélé avec le score du stress perçu (PSS) (r = - 0,43);c'est-à-dire un score élevé de qualité de vie est associé à une diminution du niveau de stress, et avec le score de la qualité de vie physique (PCS)(r = - 0,66), mais il est positivement corrélé avec le score de satisfaction (QSSP) (r = 0,45). La qualité de vie psychique des pères des adolescents est aussi négativement corrélée avec le score de la qualité physique (r = - 0,61) mais très fortement corrélée avec le soutien social (r = 0,78).

Pour les mères des enfants, la qualité de vie psychique est négativement corrélée avec le score du stress et le score de la qualité physique respectivement avec (r = - 0,25 et r = - 0,71) mais elle est positivement corrélée avec le soutien social perçu (r = 0,60) c'est-à-dire que plus les mères sont satisfaites de leur réseau social plus elles rapportent une bonne qualité de vie psychique.

Tableau 4. Corrélation entre les dimensions de la qualité de vie, de stress perçu et des satisfactions aux soutiens (Enfants).

	PSS score	PCS score	MCS score	Score satisfaction
Pères				
PSS score	1,00	0,02	- 0,43*	- 0,31
PCS score	0,02	1,00	- 0,66**	0,03
MCS score	- 0,43*	- 0,66**	1,00	0,45*
Score satisfaction	- 0,31	0,03	0,452*	1,00
Mères				
PSS score	1,00	0,10	- 0,25	- 0,15
PCS score	0,10	1,00	- 0,71**	- 0,34
MCS score	- 0,25	- 0,71**	1,00	0,60**
Score satisfaction	- 0,15	- 0,34	0,60**	1,00

*Signification à 0.05 ; **Signification à 0.01 ; *** Signification à 0.001.

Pour les mères des adolescents les analyses corrélationnelles ont également montré que la qualité de vie psychique est négativement corrélée avec la qualité de vie physique et le stress perçu respectivement (r = - 0,68) et (r = - 0,16). Une forte corrélation existe encore entre la qualité de vie psychique et le soutien social perçu (r = 0,57).

Tableau 5. Corrélation entre les dimensions de qualité de vie, de stress perçu et des satisfactions aux soutiens (Adolescents).

	PSS score	PCS score	MCS score	Score satisfaction
Pères				
PSS score	1,00	0,35	0,03	- 0,18
PCS score	0,35	1,00	- 0,61	- 0,45
MCS score	0,03	- 0,61	1,00	0,78**
Score satisfaction	- 0,18	- 0,45	0,78**	1,00
Mères				
PSS score	1,00	- 0,14	- 0,16	0,08
PCS score	- 0,14	1,00	- 0,68*	- 0,35
MCS score	- 0,16	- 0,68*	1,00	0,57
Score satisfaction	0,08	- 0,35	0,57	1,00

* Signification à 0.05 ; ** Signification à 0.01 ; *** Signification à 0.001.

Pour ce qui est de la qualité de vie physique d'autres corrélations significatives ont été enregistrées. Ainsi la qualité de vie physique est négativement corrélée avec le soutien social chez les mères des enfants (r = - 0,34) et chez celles des adolescents (r = - 0,35) alors que la qualité de vie physique des pères des adolescents est négativement corrélée avec le soutien social à avec (r = - 0,45).

4 DISCUSSION

La population étudiée est caractérisée par le fait que l'échantillon est composé de pères et de mères et qu'il s'agit des parents d'enfants et d'adolescents alors que la plupart des recherches recensées ne concernent que les mères ou les parents

d'un enfant tout en négligeant la phase d'adolescence qui est une phase critique de transition. La participation des pères permet de mieux comprendre le vécu des parents ayant un enfant IMC tout en distinguant respectivement le vécu des pères et des mères.

Les résultats de notre étude indiquent que les parents des enfants IMC ont une perturbation dans leur qualité de vie et ressentent généralement un niveau de stress élevé, ce qui fait écho à la littérature [13], [14], [15]. Typiquement la mère assume la principale responsabilité des soins médicaux de l'enfant [16]. De ce fait nos résultats indiquent également que les mères ont une moins bonne qualité de vie que les pères de point de vue MCS,PSS et QSSP, à ce propos, rappelons que dans notre échantillon presque la totalité des enfants sont dépendants des adultes pour la plupart des activités de la vie quotidienne et qu'ils présentent tous plusieurs troubles associés et que les pères se sont révélés beaucoup moins disponibles, évoquant notamment leur activité professionnelle, la mère se trouve dans une situation où elle assume la charge lourde qui va se multiplier à l'âge de l'adolescence. Les enfants IMC en grandissant présentent un tableau clinique particulier avec parfois de scolioses (complication chez 25 à 65 % des patients IMC vivant en institution) [17].Le risque évolutif est d'autant plus important que la scoliose est sévère [18], une aggravation est de 1,4ºpar an en moyenne est observée à l'âge adulte lorsque l'angulation dépasse 50º en fin de croissance [17], [19]. Le risque de majorer les difficultés doit donc demander une surveillance particulière auprès de son entourage. Les déformations orthopédiques génèrent des douleurs et contribuent aux altérations fonctionnelles [20], [21]. Scwartz et al. [22] estiment que 67% des adultes atteints de paralysie cérébrale souffrent de douleurs chroniques des membres inférieurs [22]. En plus des troubles sphinctériens, les enfants IMC souffrent de troubles nutritionnels et digestifs, le risque de fausse route persiste et reste un facteur important de surinfection respiratoire, justifiant parfois une rééducation particulière et une éducation du patient et de son entourage. Comment peut on donc imaginer la qualité de vie des parents qui vivent devant cette panoplie de complications et parfois devant un problème majeur de communication qui peut donner des troubles de comportement, un manque de compréhension peut générer des cris des pleures voire même des agressions, certains de ces troubles sont plus ou moins gérables par les parents à l'âge de l'enfance mais deviennent insupportables et perturbe la qualité de vie à l'âge de l'adolescence quand l'enfant grandisse et la force physique évolue.

Quelques études épidémiologiques consacrées à la santé des jeunes adultes handicapés montrent bien qu'il existe une sur-morbidité et une sur mortalité dans cette population [18], [21], [23], [24], [2], [25]. L'espérance de vie des patients est liée à la sévérité des déficiences [2], [25], [26], la perte des capacités de mobilité et d'alimentation autonome étant des facteurs prédictifs de surmortalité [18].

Nos résultats mettent également en évidence une perturbation quant à la satisfaction des parents aux prestations prodiguées. Les besoins particuliers de l'enfant exigent une prise en charge multidisciplinaire (82,1 % des parents estiment que la prise en charge de leurs enfants est insuffisante) et un investissement financier considérable, puisque plus de 28 % ont un niveau socio-économique moins bas que la moyenne, leurs ressources sont donc insuffisantes pour répondre correctement à leurs besoins.

Par ailleurs, nous constatons que le PCS n'est pas perturbé chez les parent de notre étude, ceci peut être expliqué par le fait que leur âge moyen ne dépasse pas 43 ans et que les parents développent un ajustement physique dans le cadre d'un défi à l'encontre des troubles psychiques et émotionnels et devant une insatisfaction du soutien social perçu, sachant que certaines recherches indiquent que la maladie infantile aurait des effets positifs sur la famille [3] et que certains parents démontrent un bon ajustement à la maladie [27], [28], [29].

Nos résultats mettent également en évidence l'insatisfaction des parents d'enfants IMC de leur entourage. On observe également que le soutien social y compris celui du conjoint par ces différentes figures occupe une place privilégiée au sein de la famille et constituerait le facteur prédominant dans la diminution de stress perçu et l'amélioration de la qualité de vie des parents d'enfants IMC. Au regard de l'intervention, ceci confirme l'importance de soutenir le système conjugale et familiale et d'impliquer autant les pères que les mères dans les différentes stratégies de coping, d'ajustement et d'adaptation reliés à l'infirmité motrice cérébrale.

Finalement, cette recherche présente certaines limites. Si nos données ont permis de clarifier en partie la réalité des parents, elles ne nous permettent pas d'en avoir une connaissance parfaite par la limite des possibilités statistiques et la capacité de généralisation des résultats. Dans la mesure où la taille de l'échantillon est restreinte et le groupe comparatif est absent.

5 CONCLUSION

Cette recherche démontre l'existence d'une souffrance des parents d'enfants IMC et particulièrement la mère avec une moins bonne qualité de vie psychique et un niveau de stress élevé. Cette souffrance est plus accentuée à l'âge de

l'adolescence que durant l'enfance. Cette étude a mis également en évidence l'existence de lien et de corrélations entre le soutien social perçu, la qualité de vie et le stress perçu. Ainsi, le soutien social y compris celui du conjoint améliore la qualité de vie psychique et favorise la diminution du stress et il contribuerait à diminuer la charge que représente le fait de prendre soin et d'éduquer un enfant et plus particulièrement un adolescent souffrant d'une infirmité motrice cérébrale spécialement vrai pour les mères.

Il ressort que le PCS des parents n'est pas détérioré du fait de la jeunesse de notre population et de l'ajustement physique dans le cadre d'un défi aux besoins émotionnels et devant un soutien social médiocre.

En fin une recherche similaire serait intéressante si elle porterait sur un éventail plus large de parents d'enfants et adolescents souffrant de troubles somatiques et cognitifs dans le but de mettre en place une stratégie d'adaptation et de soutien. Notre contexte social actuel exige des réformes et incite les intervenants (assistantes sociales, corps médical et paramédical, etc.) à être en contact avec une clientèle dont le besoin est pluridisciplinaire et la souffrance est plus ou moins accrue.

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REFERENCES

[1] Serge Dalla Piazza – Bernard Dan, *Handicaps et déficiences de l'enfant*, éd. DeBoekUniversité coll. Questions de personne, p.374, 2001.

[2] Hutton JL, Cooke T, Pharoah PO. « Life expectancy in children with cerebral palsy ». *BMJ*; 309:431–5, 1994.

[3] Barbarin,O.A., Hughes, D ; et Chesler M.A. « Stress, coping, and marital functioning among parents of children with cancer ». *Journal of Mariage and the Family*, 47,473-480, 1985.

[4] Rolland,J.S . *Families, illness and disability: an integrative treatment model*. New York: Basic books, 320P, 1994.

[5] Quittner, A.L., Glueckauf, R.L. et Jackson, D.N. « Chronic parenting stress : Moderating vs. Mediating effects of social support », *Journal of Personality and Social Psychology*, 59, 1266-1278, 1990.

[6] Eiser, C., *Chronic childhood disease: an introduction to psychological theory and research*. New York: Cambridge University Press, 174p, 1990.

[7] Dunst, C.J.,Trivette, C.M. et Deal,A.G. *Enabling and empowering families : principales and guidelines for practice*. Cambridge: Brookline Books, 219p, 1988.

[8] Cohen, S. et Wills, T.A. « Stress, social support and the buffering hypothesis ». *Psychological Bulletin*, 98(2), 320-357, 1985.

[9] Bruchon-Schweitzer M., Quintard B. *Personnalité et maladies. Stress, coping et ajustement*. Ed. Dubod: Paris.[Online]Available:(http://www.invs.sante.fr/publications/2005/epidemiologie_catastrophes/module7.pdf), 2001.

[10] Cohen, S., Kamarck, T., & Mermelstein, R. « A global measure of perceived stress ». *Journal of Health and Social Behavior*, 24(4), 386-396, 1983.

[11] Ware JE, Sherbourne CD. The MOS 36-items short-form health survey (SF36). I. Conceptual framework and item selection. *Med Care*; 30 : 473-4, 1992.

[12] Gandek B, Ware JE, Aaronson NK, Apolone G, Bjorner JB, Brazier JE, Bullinger M, Kaasa S, Leplege A, Prieto L, Sullivan M. Cross-validation of item selection and scoring for the SF-12 Health Survey in nine countries: Results from the IQOLA Project. International Quality of Life Project. *J Clin Epidemiol*; 51(11):1171–78, 1998.

[13] Wintgens A, Hayez JY. « Guidance psychopédagogique des parents d'enfants atteints d'autisme ». *Psychiatr Enfant*;49(1):207-26, 2006.

[14] Baghdadli, A., Beuzon, S., Bursztjen, C., Constant, J., Desguerre, I., Rogé, B., Squillante, M., Voisin, J. et Aussilloux, C. In B. Rogé, C. Barthélémy et G. Magerotte (dir.), « Améliorer la qualité de vie des personnes autistes » (p. 193-211). Paris : Dunod, 2008.

[15] Cappe E., Marion Wolff, René Bobet, Jean-Louis Adrien « étude de la qualité de vie et des processus d'ajustement des parents d'un enfant ayant un trouble autistique ou un syndrome d'Asperger : effet de plusieurs variables socio-biographiques parentales et caractéristiques liées à l'enfant ».*Evolpsychiatr*;77(2), 2012.

[16] Quittner, A. L. ,Digirolamo, A., Michel, M. et Eigen,H. « Parental Response to cystic fibrose : A contextual analysis in the diagnosis phase »,.*Journal of pédiatrique psychology*, 17(6),683-704, 1992.

[17] Majd ME, Muldowny DS, Holt RT. « Natural history of scoliosis in the institutionalized adult cerebral palsy population ». *Spine*;22:1461–6, 1997.

[18] Tiffreau V.Schill A., Popielarz S., Herbau C., Blanchard A., Thevenon A. « La continuité de prise en charge lors de la transition des soins de l'enfant à l'adulte handicapé », *Annales de réadaptation et de médecine physique* 49,652–658, 2006.
[19] Thometz JG, Simon SR. « Progression of scoliosis after skeletal maturity in institutionalized adults who have cerebral palsy ». *J Bone Joint Surg Am*;70:1290–6, 1988.
[20] Murphy KP, Molnar GE, Lankasky K. « Medical and functional status of adults with cerebral palsy ». *Dev Med Child Neurol*;37:1075–84, 1995.
[21] Klingbeil H, Baer HR, Wilson PE. « Aging with a disability ». *Arch Phys Med Rehabil*;85:S68–73.31, 2004.
[22] Schwartz L, Engel JM, Jensen MP. « Pain in persons with cerebral palsy ».*ArchPhys Med Rehabil*;80:1243–6, 1999.
[23] Singhal B, Mathew KM. « Factors affecting mortality and morbidity in adult spina bifida ». *Eur J PediatrSurg*; 9(Suppl 1):31–2, 1999.
[24] Muller T, Arbeiter K, Aufricht C. « Renal function in meningomyelocele: risk factors, chronic renal failure, renal replacement therapy and transplantation ». *Curr Opin Urol*;12:479–484, 2002.
[25] Strauss D, Cable W, Shavelle R. « Causes of excess mortality in cerebral palsy ». *Dev Med Child Neurol*;41:580–5, 1999.
[26] Strauss D, Shavelle R. « Life expectancy of adults with cerebral palsy ». *Dev Med Child Neurol*;40:369–75, 1998.
[27] RW Olmsted, BL Lewis, KT Khaw « Family functioning as a mediating variable affecting psychosocial adjustement of children with cystic fibrosis », *Journal of pediatrics*, 101,636-640, 1982.
[28] Thompson, R.J.,Gustafson, K.E., Hamlett, K.W. et Spock, A.Stress, coping, and family functioning in the psychological adjustment of mothers of children and adolescent with cystic fibrosis. *Journal of Pediatric Psychology*, 15(5), 573-585,1992.
[29] Walker, L.S., Ford, M.B., et Donald, W.D. Cystic fibrosis and family stress: Effects of age and severity of illness. *Pediatrics*, 79(2),239-245,1987.

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Evaluation of Local Space-time Descriptors based on Cuboid Detector in Human Action Recognition

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ABSTRACT: Human action recognition remains a challenging problem for researchers. Several action representation approaches have been proposed to improve the action recognition performance. Recently, local space-time features have become a popular representation approach for human actions in video sequences. Many different space-time detectors and descriptors have been proposed. They are evaluated on different datasets using different experimental conditions. In this paper, the performance of Cuboid detector is evaluated with four space-time description methods; namely, Gradient, HOG, HOF and HOG-HOF. All descriptors were tested on two datasets (KTH and Weizmann) using the bag-of-words model and Support Vector Machine.

KEYWORDS: Space-time features; Cuboid detector; space-time feature descriptors; bag-of-words; human action recognition.

1 INTRODUCTION

With the wide use of digital cameras, video sequences have become an important source of information in our life. More and more videos are generated for many applications, e.g. internet sharing, traffic monitoring, health care, security surveillance of public places, etc. Manually extracting and analyzing this information are exhausting and time consuming. Recently, computer vision researchers have shown interest in automatically recognizing human actions in video sequences. In Aggarwal and Ryoo [1], the term "action" refers to a simple human activity that has been carried out for a period of time in video, such as walking, running and waving. Much research in human action recognition has been done; however, it is still a challenging problem. The challenge is how to recognize human actions under cluttered backgrounds, illumination changes, different physiques of humans, variety of clothing, camera motion, partial occlusions, viewpoint changes, scale variation of video screen, etc.

In the survey paper by Weinland et al. [2], human action representation approaches are classified into two main approaches: global and local representations. Two vision tasks are required for each representation approach: First, detection of features (local or global) from the video; second, description of motion using the detected features. Global representation approaches focus on detecting the whole body of the person by using background subtraction or tracking. Silhouettes, contours or optical flow are usually used for representing the localized person. These representations are more sensitive to viewpoint changes, personal appearance variations and partial occlusions.

In local representation approaches, videos are represented as a collection of small independent patches (named cuboids). These patches involve the regions of high variations in both the spatial and the temporal domain in the video [3]. Centres of the cuboids are called space-time interest points. After detecting the interest points, the cuboids are described and a model

based on independent features (Bag of Words) is built. Due to its invariant to viewpoint changes, the person's appearance variations and partial occlusions, space-time local features have become a popular representation approach for human action recognition. Different space-time interest point detectors have been proposed such as Harris3D detector [3], Cuboid detector [4], Hessian detector [5]. They differ in the type and sparsity of selected points. Also, several descriptors have been proposed to capture appearance and/or motion cues from the cuboids. For example [4] proposed Gradient descriptor, [6] proposed Histogram of Oriented Gradients (HOG) and Histogram of Optical Flow (HOF) descriptors, [7] proposed 3D Scale-Invariant Feature Transform (3D SIFT), [8] proposed a Spatio-Temporal Descriptor based on 3D Gradients descriptor (HOG3D) and [5] proposed the extended Speeded Up Robust Features descriptor (ESURF).

Several evaluations of local space-time detectors and descriptors were reported [4], [8]–[11] to find the best combinations that can be used in the human action recognition framework. Dollár et al. [4] evaluated the Cuboid detector with brightness, gradient and optical flow descriptors. Wang et al.[9] evaluated the detectors HOG/HOF, HOG3D and ESURF with the descriptors Harris3D, Cuboid, Hessian and Dense sampling. All of these evaluations were carried out on different datasets and using different experimental methods.

In this paper, we evaluate the performance of Cuboid detector with four widely used space-time descriptors: Gradient, HOG, HOF, and HOG-HOF. All experiments are performed on two datasets: KTH, and Weizmann. The experiments are based on the bag-of-words approach to find the correlations between cuboids and the use of non-linear Support Vector Machine (SVM) for classification.

The paper is organized as follows. In section two, the feature detection and feature description methods used in evaluation are summarized, respectively. In section three, the evaluation framework is illustrated. In section four, the experiments and their results are discussed in detail. Finally, section five presents the conclusion.

2 LOCAL SPACE-TIME FEATURES

This section describes the applied space-time interest point detector (cuboid detector) and the four selected descriptors (Gradient, HOG, HOF and HOG-HOF). The selection of descriptors is based on their previous evaluation in Wang et al.[9]. All detection and description methods are implemented in the Matlab environment.

2.1 CUBOID DETECTOR

Dollár et al.[4] proposed the Cuboid detector based on applying a set of separable linear filters (Gaussian filter applied on the spatial domain and 1-D Gabor filter applied temporally). The response function for a stack of images denoted by *I(x,y,t)* is given by

$$\boldsymbol{R} = (\boldsymbol{I} * \mathbf{g} * \boldsymbol{h_{even}})^2 + (\boldsymbol{I} * \mathbf{g} * \boldsymbol{h_{odd}})^2 \qquad \textbf{(1)}$$

where *g(x,y;σ)* is the 2D spatial Gaussian smoothing kernel, and $\boldsymbol{h_{even}}$ and $\boldsymbol{h_{odd}}$ are a quadrature pair of 1D Gabor filters which are applied temporally. They are defined as

$$\boldsymbol{h_{even}}(\boldsymbol{t};\boldsymbol{\tau},\boldsymbol{\omega}) = -\mathbf{cos}(\mathbf{2}\boldsymbol{\pi t\omega})\boldsymbol{e}^{-\boldsymbol{t}^2/\boldsymbol{\tau}^2}$$

and $$\boldsymbol{h_{odd}}(\boldsymbol{t};\boldsymbol{\tau},\boldsymbol{\omega}) = -\mathbf{sin}(\mathbf{2}\boldsymbol{\pi t\omega})\boldsymbol{e}^{-\boldsymbol{t}^2/\boldsymbol{\tau}^2} \qquad \textbf{(2)}$$

with $\omega = 4/\tau$. The two parameters σ and τ of the response function R correspond roughly to the spatial and temporal scale of the detector. The local maxima of the response function are the interest points. These interest points correspond to the local regions where the complex motion patterns are occurred. Examples of local space-time features detected by Cuboid detector for different human actions are shown in figure 1. In our experiments, the Cuboid detector parameters $1 \le \sigma \le 4$ and $1 \le \tau \le 4$ were tested to select the best for each dataset according to Dollár et al.[4].

Fig. 1. Sample sequences with detected interest points by Cuboid detector for the KTH dataset. (a) boxing action. (b) running action.

2.2 SPACE-TIME DESCRIPTORS

Describing the patches around the detected interest points is an important step in the human action recognition framework in which the appearance and/or motion information are captured. The spatial and temporal sizes of a patch are functions of σ and τ respectively. Examples of extracted cuboids at interest points are shown in figure 2. In our experiments, the number of cuboids is fixed to 100 for all video sequences based on Shao et al.[10] and the patch size provided by the authors is used.

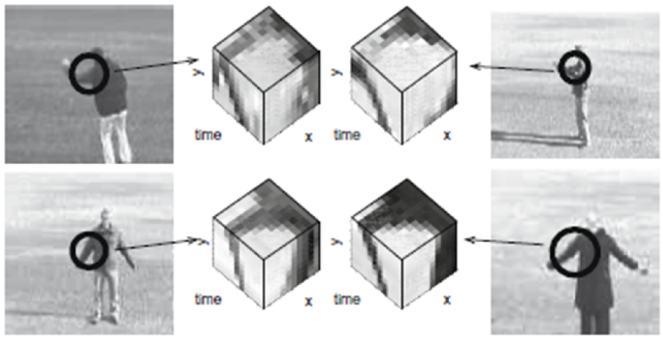

Fig. 2. Extraction of space–time cuboids at interest points from similar actions performed by different persons [12].

Cuboid descriptor proposed by Dollár et al. [4]. The cuboid is firstly smoothed before computing the image gradients. Then, the gradients are computed for each pixel in the patch along x, y and t directions. The computed gradients are concatenated into a single vector. A principal component analysis (PCA) is then used to project the feature vector into a lower dimensional space. The spatial size for the descriptor is given by 2 * ceil (3σ) + 1 and the temporal size by 2* ceil (3τ) + 1. After PCA projection, the Gradient feature vector length is reduced to 100.

Histogram of Oriented Gradients (HOG) descriptor was introduced by Laptev et al. [6] which describes the local appearance in each cuboid by computing the histograms of spatial gradient. The authors subdivide each cuboid into a grid $n_x \times n_y \times n_t$. For each cell, 4-bins histogram of gradient orientations (HOG) is computed. The default grid parameters (3 × 3 × 2) which yield a feature vector of length 72 is used. The spatial size for the descriptor is given by (18σ) and the temporal size by (8τ). In the implementation, we follow the author's descriptor scales [9] for the Cuboid detector which set $\sigma^2=4$ and $\tau^2=2$.

Histogram of Optical Flow (HOF) descriptor is another descriptor proposed by Laptev et al. [6] with the same idea of HOG descriptor. It describes the local motion in each cuboid by computing 5-bins histogram of optical flow (HOF) for its cells. The HOF descriptor vector length is 90.

HOG-HOF descriptor is a combination of HOF and HOG descriptors provided by Laptev et al. [6] that captures both local appearance and motion information to enhance human action recognition performance. After combining both descriptors, a feature vector of length 162 is obtained.

3 EVALUATION FRAMEWORK

Final representation of videos is done by applying a common bag-of-words approach on the described space-time features [13]. The visual words (or codebook) are built from training data by using k-means clustering algorithm. Then, each video is represented as the frequency histogram of the codebook elements. The dimension of each video descriptor is equal to the size of the codebook. In our experiments, six codebook sizes (250, 500, 750, 1000, 1250 and 1500) are used. Due to the random initialization of k-means clustering algorithm, we report the best result over 10 runs.

For classification, we use a non-linear Support Vector Machine (SVM) with radial basis function (RBF) kernel;

$$\boldsymbol{K(H_i, H_j) = exp(-\gamma \sum_{n=1}^{V} \left\| h_{in} - h_{jn} \right\|^2). \quad \gamma > 0} \qquad \textbf{(2)}$$

Where, $H_i = h_{in}$, $H_j = h_{jn}$ are the histograms of feature, V is the codebook size and γ parameter defines how far the distance of a single training example reaches, with low values meaning 'far' and high values meaning 'close'. The library libSVM [14] was used for multi-class classification and the performance is reported as the average accuracy over all classes. The best classification parameters *C* and γ are selected by a grid search on all values of 2^x where *x* is in the range −5 to 16 and 2^y where *y* is in the range 3 to −15, respectively as provided by P. Bilinski et al. [11]. The C parameter trades off misclassification of training examples against simplicity of the decision surface. A low C makes the decision surface smooth, while a high C aims to classify all training examples correctly.

4 EXPERIMENTS AND RESULTS

In this section, the datasets and scenarios in which experiments were performed are described, and the results are explored.

4.1 DATASETS

Our experiments are carried out on two commonly used datasets for human action recognition: the KTH and Weizmann datasets. **KTH actions dataset** contains six actions: walking, jogging, running, boxing, hand waving and hand clapping (Figure 3) [13][1]. Each action is performed by 25 different actors in four different scenarios: outdoors, outdoors with scale variation, outdoors with different clothes and indoors. In total, the dataset consists of 600 video sequences. The video resolution is 160×120 pixel. All videos were taken over homogeneous backgrounds with a static camera with 25 fps. We follow the original authors setup dividing the dataset into testing set (9 subjects: 2, 3, 5, 6, 7, 8, 9, 10, and 22) and training set (the remaining 16 subjects). The length of every video sequence is limited to the first 300 frames, as it has been done in [10]. The Cuboid detector is run on this dataset with parameters σ=3 and τ=1.5, which gave better results in our evaluations. To limit the complexity, 25% of training data is randomly selected to construct the visual words. The 5-fold cross-validation technique is used on the training set to choose the best classification parameters.

Fig. 3. A few sample frames from video sequences of KTH dataset. From (a) to (e), the actions are walking, boxing, waving, clapping and running.

[1] *http://www.nada.kth.se/cvap/actions/*

Weizmann actions dataset contains 10 actions: walk, run, jump, gallop sideways, bend, one-hand wave, two-hands wave, jump in place, jumping jack and skip (Figure 4) [15][2]. Each action is performed by 9 persons. The Weizmann dataset contains 93 video sequences with spatial resolution 180 × 144 pixel. All videos were taken over homogeneous backgrounds with a static camera with 50 fps. In our experiments, the best Cuboid detector parameters for Weizmann dataset are σ=2, τ=1.5. The Evaluation on this dataset is done using leave-one-person-out cross-validation technique.

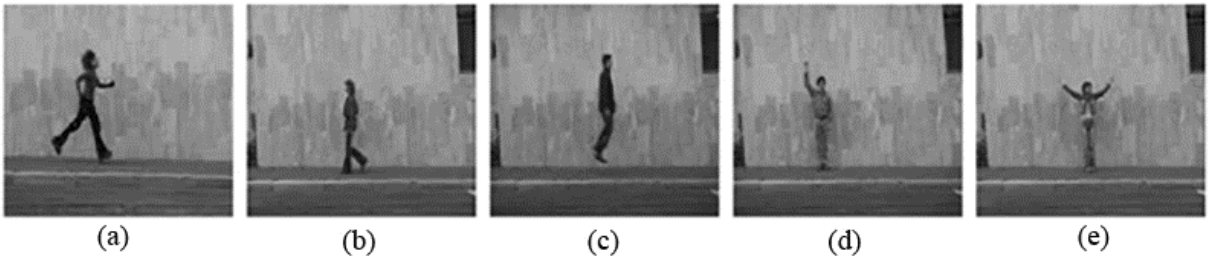

Fig. 4. A few sample frames from video sequences of Weizmann dataset. From (a) to (e), the actions are run, walk, jump, wave1 and wave2.

4.2 RESULTS

For KTH dataset, the results are presented in table 1. The best result of 92.12% is obtained with the HOG-HOF descriptor. Both Gradient and HOG-HOF descriptors preform best for codebook 750 and HOG for codebook 1250 and HOF for codebook 1500. According to the results, we can rank the descriptors as: HOG-HOF > HOF > Gradient > HOG. Wang et al. [9] obtained 89.1% for the Gradient descriptor, 82.3% accuracy for the HOG descriptor, 88.2% for the HOF descriptor and 88.7% for the HOG-HOF. They tested the Cuboid detector and the descriptors by choosing a subset of 100, 000 randomly selected training features and using codebook size 4000. Shao et al. [10], report around 91% for Gradient descriptor , however, we reached only 89.81%. This could be due to the subset of the training data used in our evaluation for codebook construction. It should also be noted that many evaluations of HOG, HOF, HOG-HOF descriptors [8]–[11] have been proposed using Harris3D detector. For example, P. Bilinski et al. [11] obtained 83.33% accuracy for the HOG descriptor, 95.37% for the HOF descriptor and 94.44% for the HOG-HOF. The use of Cuboid detector achieved up to 2.78% better results for HOG descriptor.

Table 1. Action recognition accuracy for various Codebook's size /descriptor on the KTH dataset

	GRADIENT	HOG	HOF	HOG-HOF
250	85.18%	79.16%	86.57%	89.35%
500	87.5%	81.48%	87.5%	90.27%
750	**89.81 %**	82.40%	89.35%	**92.12%**
1000	88.88%	85.18%	88.42%	91.20%
1250	89.35%	**86.11%**	89.81%	90.74%
1500	88.42%	84.25%	**91.66%**	90.74%

In tables 2, 3, 4, 5, we show the confusion matrices of the best classification result for each descriptor on the KTH dataset. As the tables show, there is some confusion among the actions “walk”, “run” and “jog”. Similarly, the actions “box”, “wave” and “clap” always confuse each other. This is expected because these actions include some similar features in their representation. Among all descriptors, the worst error ratio of “run” which is recognized as “jog” 25% is obtained by using the HOF descriptor. This ratio is decreased to 22.22% for HOG-HOF descriptor, 19.44% for HOG descriptor and reached its

[2] *http://www.wisdom.weizmann.ac.il/~vision/SpaceTimeActions.html*

lowest value 13.89% when the Gradient descriptor is used. In contrast to all descriptors, HOG descriptor reports a high error ratio of "clap" which is recognized as "box" 22.22%. This confusion may explain the low performance of HOG descriptor on KTH dataset. The performance of all tested descriptors for each action is shown in table 6.

Table 2. Confusion matrix for the best classification result of the Gradient descriptor on KTH dataset.

(%)	BOX	CLAP	WAVE	JOG	RUN	WALK
BOX	100	0	0	0	0	0
CLAP	0	91.67	0	0	0	8.33
WAVE	11.11	0	83.33	2.78	0	2.78
JOG	0	0	0	83.33	11.11	5.56
RUN	0	0	0	13.89	83.33	2.78
WALK	0	0	0	2.78	0	97.22

Table 3. Confusion matrix for the best classification result of the HOG descriptor on KTH dataset.

(%)	BOX	CLAP	WAVE	JOG	RUN	WALK
BOX	88.89	2.78	0	5.56	2.78	0
CLAP	22.22	72.22	5.56	0	0	0
WAVE	2.78	2.78	91.67	0	2.78	0
JOG	0	0	0	86.11	8.33	5.55
RUN	0	0	0	19.44	80.65	0
WALK	0	0	0	2.78	0	97.22

Table 4. Confusion matrix for the best classification result of the HOF descriptor on KTH dataset.

(%)	BOX	CLAPP	WAVE	JOG	RUN	WALK
BOX	100	0	0	0	0	0
CLAP	0	100	0	0	0	0
WAVE	0	5.56	91.67	0	0	2.78
JOG	0	0	0	86.11	11.11	2.78
RUN	0	0	0	25	75	0
WALK	0	0	0	2.78	0	97.22

Table 5. Confusion matrix for the best classification result of the HOG-HOF descriptor on KTH dataset.

(%)	BOX	CLAP	WAVE	JOG	RUN	WALK
BOX	100	0	0	0	0	0
CLAP	0	97.22	2.78	0	0	0
WAVE	0	8.33	88.89	2.78	0	0
JOG	0	0	0	91.67	5.56	2.78
RUN	0	0	0	22.22	77.77	0
WALK	0	0	0	2.78	0	97.22

Table 6. Comparison of recognition accuracy for each action.

DESCRIPTION METHOD	BOX	CLAP	WAVE	JOG	RUN	WALK
GRADIENT	100	91.67	83.33	83.33	83.33	97.22
HOG	88.89	72.22	91.67	86.11	80.65	97.22
HOF	100	100	91.67	86.11	75	97.22
HOG-HOF	100	97.22	88.89	91.67	77.78	97.22

Weizmann dataset evaluation results are presented in table 7. As shown, the HOF is the best descriptor for the Weizmann dataset as it obtained 92.22% accuracy. Furthermore, all descriptors (except the HOG descriptor) perform the best for codebook size 750. This may be explained by the little variations in this dataset that the videos were captured in one scenario unlike KTH dataset (which has four scenarios). The HOG descriptor performs best for codebook size 1000. P. Bilinski et al. [11] used the Harris3D detector in their evaluation and obtained 86.02% accuracy for the HOG descriptor, 91.40% for the HOF descriptor and 92.74% for the HOG-HOF. The Cuboid detector obtained up to 1.75% better results for HOG descriptor and 0.82% better results for HOF descriptor.

Table 7. Action recognition accuracy for various Codebook's size /descriptor on the Weizmann dataset.

	GRADIENT	HOG	HOF	HOG-HOF
250	87.77%	84.44%	88.88%	88.88%
500	87.77%	84.44%	91.11%	90%
750	**88.88%**	85.55%	**92.22%**	**91.11%**
1000	87.77%	**87.77%**	91.11%	91.11%
1250	86.66%	85.55%	90%	91.11%
1500	84.44%	86.66%	90%	90%

Table 8. Confusion matrix for the best classification result of the Gradient descriptor on Weizmann dataset.

(%)	BEND	JACK	JUMP	P-JUMP	RUN	SIDE	SKIP	WALK	WAVE1	WAVE2
BEND	100	0	0	0	0	0	0	0	0	0
JACK	0	100	0	0	0	0	0	0	0	0
JUMP	0	0	77.77	0	11.11	0	11.11	0	0	0
P-JUMP	0	0	0	100	0	0	0	0	0	0
RUN	0	0	22.22	0	66.66	0	11.11	0	0	0
SIDE	0	0	0	0	0	88.88	11.11	0	0	0
SKIP	0	0	33.33	0	11.11	0	55.55	0	0	0
WALK	0	0	0	0	0	0	0	100	0	0
WAVE1	0	0	0	0	0	0	0	0	100	0
WAVE2	0	0	0	0	0	0	0	0	0	100

Table 9. Confusion matrix for the best classification result of the HOG descriptor on Weizmann dataset.

(%)	BEND	JACK	JUMP	P-JUMP	RUN	SIDE	SKIP	WALK	WAVE1	WAVE2
BEND	100	0	0	0	0	0	0	0	0	0
JACK	0	100	0	0	0	0	0	0	0	0
JUMP	0	0	77.77	0	11.11	0	11.11	0	0	0
P-JUMP	0	0	0	100	0	0	0	0	0	0
RUN	0	0	11.11	0	77.77	0	11.11	0	0	0
SIDE	0	0	0	0	11.11	88.88	0	0	0	0
SKIP	0	0	33.33	0	11.11	0	44.44	11.11	0	0
WALK	0	0	0	0	0	0	0	100	0	0
WAVE1	0	0	0	0	0	0	0	0	100	0
WAVE2	0	0	0	0	0	0	0	0	11.11	88.88

The confusion matrices of the best classification result for each descriptor on the Weizmann dataset are presented in tables 8, 9, 10, 11. For all descriptors, the recognition accuracies of actions “bend,” “jack,” “p-jump,” “walk” and “wave1” reach 100%. The confusion also occurs between the actions “jump,” “run” and “skip”. The 33.33% of “skip” are recognized as “jump” when we use Gradient, HOG and HOG-HOF descriptors. Only the HOF descriptor can decrease this confusion to 22.22%. Another high confusion is obtained by using Gradient descriptor where 22.22% of “run” samples are recognized as “jump”. This confusion is enhanced by using HOG descriptor and it disappeared with HOF and HOG-HOF descriptors. Table 12 summarizes the performance of all tested descriptors for each action.

Table 10. Confusion matrix for the best classification result of the HOF descriptor on Weizmann dataset.

(%)	BEND	JACK	JUMP	P-JUMP	RUN	SIDE	SKIP	WALK	WAVE1	WAVE2
BEND	100	0	0	0	0	0	0	0	0	0
JACK	0	100	0	0	0	0	0	0	0	0
JUMP	0	0	77.77	0	11.11	0	11.11	0	0	0
P-JUMP	0	0	0	100	0	0	0	0	0	0
RUN	0	0	0	0	100	0	0	0	0	0
SIDE	0	0	0	0	11.11	88.88	0	0	0	0
SKIP	0	0	22.22	0	11.11	0	66.66	0	0	0
WALK	0	0	0	0	0	0	0	100	0	0
WAVE1	0	0	0	0	0	0	0	0	100	0
WAVE2	0	0	0	0	0	0	0	0	11.11	88.88

Table 11. Confusion matrix for the best classification result of the HOG-HOF descriptor on Weizmann dataset.

(%)	BEND	JACK	JUMP	P-JUMP	RUN	SIDE	SKIP	WALK	WAVE1	WAVE2
BEND	100	0	0	0	0	0	0	0	0	0
JACK	0	100	0	0	0	0	0	0	0	0
JUMP	0	0	88.88	0	11.11	0	0	0	0	0
P-JUMP	0	0	0	100	0	0	0	0	0	0
RUN	0	0	0	0	100	0	0	0	0	0
SIDE	0	0	0	0	11.11	77.77	11.11	0	0	0
SKIP	0	0	33.33	0	22.22	0	44.44	0	0	0
WALK	0	0	0	0	0	0	0	100	0	0
WAVE1	0	0	0	0	0	0	0	0	100	0
WAVE2	0	0	0	0	0	0	0	0	0	100

Finally, the computational time of the tested descriptors are compared as shown in table 13. The time is calculated in seconds for one cuboid on a PC with Core 2 Duo 2.13GHz processor and 4GB RAM. The comparison is performed on a video sequence from KTH dataset and the average over 10 runs is reported. As the results show, the Gradient descriptor is the fastest one. HOG descriptor is also quite fast. They are based on gradient computations but slightly differ in the following description step. HOF and HOG-HOF descriptors are quite similar in time and they are much slower than other descriptors. This can be explained by the optical flow computations which take more time than the gradient computations.

Table 12. Computational Time in seconds for one cuboid's descriptors.

DESCRIPTION METHOD	COMP TIME
GRADIENT	0.0122
HOG	0.0189
HOF	0.5645
HOG-HOF	0.5995

5 CONCLUSIONS

In this paper, an evaluation of four widely used local space-time descriptors for human action recognition is presented. In contrast to other existing evaluations, a Cuboid detector is chosen to extract the space-time interest points in videos and the evaluation is performed on several codebook sizes. The experiments are carried out on two popular datasets (KTH Action Dataset, Weizmann Action Dataset) under the framework based on the bag-of-words approach and non-linear Support Vector Machine. The objective is to find the best descriptor with Cuboid detector for future use in more realistic and challenging scenarios.

In the tests, the optical flow based descriptors (HOF, HOF-HOG) seem to be good descriptors for the space-time features that were detected using Cuboid detector. For the KTH dataset, the HOF-HOG descriptor achieved the best performance (92.12%) and the HOF descriptor took the second place (91.66%). The best performance on the Weizmann database (92.22%) has been achieved using the HOF descriptor and the HOG-HOF descriptor ranked the second (91.11%). The experiments also showed that the HOG descriptor reports the lowest accuracy for all tested datasets; however, the Gradient based descriptors (Gradient, HOG) are approximately 30 times faster than the optical flow based descriptors.

REFERENCES

[1] J. K. Aggarwal and M. S. Ryoo, "Human Activity Analysis: A Review," *Acm Comput. Surv.*, vol. 43, no. 3, pp. 1–43, 2011.

[2] D. Weinland, R. Ronfard, and E. Boyer, "A survey of vision-based methods for action representation, segmentation and recognition," *Computer Vision and Image Understanding*, vol. 115, no. 2. pp. 224–241, 2011.

[3] I. Laptev, "On Space-Time Interest Points," *International Journal of Computer Vision*, vol. 64, no. 2–3. pp. 107–123, 2005.

[4] P. Dollar, V. Rabaud, G. Cottrell, and S. Belongie, "Behavior recognition via sparse spatio-temporal features," *2005 IEEE Int. Work. Vis. Surveill. Perform. Eval. Track. Surveill.*, 2005.

[5] G. Willems, T. Tuytelaars, and L. Van Gool, "An efficient dense and scale-invariant spatio-temporal interest point detector," *Comput. Vision–ECCV 2008*, 2008.

[6] I. Laptev, M. Marszalek, C. Schmid, and B. Rozenfeld, "Learning realistic human actions from movies," *2008 IEEE Conf. Comput. Vis. Pattern Recognit.*, 2008.

[7] P. Scovanner, S. Ali, and M. Shah, "A 3-dimensional sift descriptor and its application to action recognition," in *15th international conference on Multimedia*, 2007, pp. 357–360.

[8] A. Kl, C. Schmid, and I. Grenoble, "A Spatio-Temporal Descriptor Based on 3D-Gradients," in *British Machine Vision Conference*, 2008.

[9] H. Wang, M. M. Ullah, A. Klaser, I. Laptev, and C. Schmid, "Evaluation of local spatio-temporal features for action recognition," *Procedings Br. Mach. Vis. Conf. 2009*, p. 11, 2009.

[10] L. Shao and R. Mattivi, "Feature detector and descriptor evaluation in human action recognition," in *Proceedings of the ACM International Conference on Image and Video Retrieval - CIVR '10*, 2010, p. 477.

[11] P. Bilinski and F. Bremond, "Evaluation of local descriptors for action recognition in videos," *Comput. Vis. Syst.*, 2011.

[12] I. Laptev, B. Caputo, C. Schüldt, and T. Lindeberg, "Local velocity-adapted motion events for spatio-temporal recognition," *Comput. Vis. Image Underst.*, vol. 108, no. 3, pp. 207–229, 2007.

[13] C. Schuldt, I. Laptev, and B. Caputo, "Recognizing human actions: a local SVM approach," *Proc. 17th Int. Conf. Pattern Recognition, 2004. ICPR 2004.*, vol. 3, 2004.

[14] C.-C. Chang and C.-J. Lin, "LIBSVM: a Library for Support Vector Machines (Version 2.31)," *Science*. pp. 1–22, 2001.

[15] L. Gorelick, M. Blank, E. Shechtman, M. Irani, and R. Basri, "Actions as space-time shapes.," *IEEE Trans. Pattern Anal. Mach. Intell.*, vol. 29, no. 12, pp. 2247–2253, 2007.

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Healthcare cost and access to care for viral hepatitis in Ethiopia

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ABSTRACT: *Introduction:* Viral hepatitis is an emerging threat. The economic impact of these infections is immense since liver cancer has a high fatality rate in Africa and usually affects economically productive age groups. However, little is known of the state of healthcare cost and access to care for such infections in the region (and especially in Ethiopia).
Objective and Study design: the present study investigated the current status of healthcare access in Ethiopia for patients with hepatitis B (HBV) and C (HCV) through expert surveys using a pre-defined questionnaire.
Principal findings: The survey results showed a heavy burden of HBV and HCV in Ethiopia, mostly affecting the economically productive age group in the middle and lower economic classes. Unfortunately, the diagnosis rates for both HBV and HCV cases are very low. Moreover, the treatment rates are also low due lack of access and affordability. There is no well-established health insurance system in Ethiopia. The cost of healthcare is mainly borne out-of-pocket by patients.
Conclusions: There is a need to increase hepatitis awareness among the general public and healthcare workers. Subsidies for diagnosis and treatment are also urgently needed. Vaccination needs to be extended to at-risk populations.

KEYWORDS: Hepatitis, Ethiopia, Cost of care, Health access, Awareness, HBV, HCV.

1 INTRODUCTION

Hepatitis is inflammation of the liver, generally caused by infection with five different types of hepatitis viruses: hepatitis A (HAV), hepatitis B (HBV), hepatitis C (HCV), hepatitis D (HDV), and hepatitis E (HEV). HAV and HEV are transmitted primarily through contaminated food and water, while, HBV and HCV are primarily transmitted via the muco-cutaneous route: infected blood transfusion, unprotected sex (although less common with HCV), and the use of non-sterilized needles and syringes (especially in injection drug use, tattooing, scarification, and nosocomial transmission). While most patients recover from acute hepatitis conditions, many progress to the chronic stage, in which liver damage becomes permanent and continuous. Chronic hepatitis if uncontrolled can often lead to life-threatening conditions such as cirrhosis, upper gastro-intestinal bleeding, hepatocellular carcinoma, hepato-renal syndrome, and bacterial peritonitis.

The World Health Organization (WHO) and the U.S. Centers for Disease Control (CDC) estimate that over 500 million people are currently living with chronic viral hepatitis. Nearly 1 million die every year of the consequences of hepatitis, especially cirrhosis and liver cancer. An estimated 57% of liver cirrhosis and 78% primary liver cancer cases are believed to result from HBV or HCV infections [1, 2]. In Africa, the burden of viral hepatitis is believed to be significantly high. The prevalence of HBV is estimated to be 8% in West Africa, and 5%–7% in Central, Eastern, and Southern Africa [2]. Approximately 70%–95% of the adult population in Africa show evidence of past exposure to HBV infection, with an

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estimated hepatitis B surface antigen (HBsAg) sero-prevalence of 6%–20% [3]. The WHO estimates the prevalence of HCV in the African continent at 5.3% [4], it is markedly higher in some areas, particularly Egypt (17.5%) [4].

Ethiopia is one of the fast growing economies in Africa with 50% of its population being under the age of 18, indicating the hidden potential of the country in terms of a future productive work force. However, the risk posed by viral hepatitis could greatly affect the future of this nation. In Kenya and Ethiopia it is estimated that more than 60% of chronic liver disease and up to 80% of hepatocellular cancers are due to chronic hepatitis B and C viral infections [5]. A press report published on March, 28, 2013, claimed that over 10 million Ethiopians are infected with HBV [6]. Yet the majority of the infected population is unaware of their disease status. This is most likely a result of a general lack of awareness. Transmission of these viruses in areas of endemicity is mainly horizontal during childhood, probably through saliva, traces of blood, unsterile needles, scarification, etc [7, 8]. Indeed, there is very limited knowledge on hepatitis prevalence in Ethiopia, which has resulted in minimal awareness of the disease as well as insufficient budgetary and organizational focus [9].

As one step toward better information on the burden of viral hepatitis in Ethiopia, the present study investigated the current status of healthcare access in Ethiopia for patients with HBV and HCV infection through expert surveys using a pre-defined questionnaire.

2 METHODS

In order to understand the burden of viral hepatitis and the on-ground situation regarding policy, awareness, and access to care, we conducted a structured expert survey with key national experts in Ethiopia. To begin with, a literature review was conducted of scientific articles on HBV and HCV specific to Ethiopia from indexed and non-indexed journals and reports. Several data gaps were discovered in the literature review. To address these data gaps, an expert survey was conducted with hepatitis clinical stakeholders. The survey was conducted with a standard questionnaire. The questionnaire was designed based on FSRC`s proprietary "CA^2RE" (Collaboration, Awareness, Access to health, Research and Epidemiology) methodology which is aimed at providing solutions to healthcare scenarios in emerging economies. FSRC's theoretical and in-field experience in these environments means "CA^2RE" has been desgned such that the majority of both the problems and solutions to healthcare and pharmaceutical market access scenarios of emerging economies can be "bucketed" into CA^2RE.

3 RESULTS

3.1 SOCIO-EPIDEMIOLOGY

The published literature on viral hepatitis in Ethiopia is very limited. Structured nation-wide surveillance studies on viral hepatitis in Ethiopia have not been conducted recently. The expert survey suggests that the prevalence of HBV in Ethiopia is approximately 10%–15% and that of HCV is approximately 2%–5% [10]. However, the incidence rates of HBV and HCV have not been studied, and hence there is no clarity on this.

The main modes of transmission in Ethiopia are similar for both HBV and HCV; apart from usual routes of transmission (like sexual, vertical, and reuse of needles and syringes), tattooing, scarification, nosocomial and horizontal transmission (only for HBV) also contribute to the spread [10]. As shown in Table 1, the prevalent genotype for HCV in Ethiopia is mainly genotype 4 (G-4; accounting for 40%–60% of HCV infections), followed by genotype 1 (G-1; accounting for 20%-30% of HCV infections) [10]. While HBV and HCV affect people from all socioeconomic strata, they are relatively more common in the middle and lower socioeconomic strata (Table 1). Both HBV and HCV are relatively more common among men than women, and in the economically productive age group of 18–60 years (Table 1).

3.2 DIAGNOSIS AND TREATMENT

Diagnosis of HBV and HCV cases is usually incidental, (e.g. on donating blood, antenatal visits (antenatal screening for HBV and HCV is not mandatory in the country, although many tertiary hospitals and private hospitals do screen pregnant women for viral hepatitis), pre-employment screening for emigration requirements, and at HIV clinics (Table 2) [10]). Although there are no clear data, available information on the diagnosis rate, treatment rate, and treatment completion rate do not seem to be encouraging (Table 2) [10]. Of those who initiate and complete treatment, nearly 60% of HCV cases attain sustained virological response, whereas hardly 10%-20% of HBV cases respond to treatment [10]. The choice of treatment for HCV infection is ribavirin with interferon, whereas that for HBV involves tenofovir, lamivudine, and interferon (Table 2).

3.3 COST OF MANAGEMENT

Since there is no public funding/subsidy for diagnosis and treatment of HBV and HCV infections in Ethiopia, payment is generally out-of-pocket by the individual (Tables 3 and 4). Some anti-retroviral drugs given for HIV act against HBV, because of which, government policy in Ethiopia restricts the use of these drugs for the treatment of HBV for fear of the emergence of drug resistance. Hence, for mono-infected cases of chronic HBV, the drugs (tenofovir, lamivudine) are not readily available either in the public or private sectors in Ethiopia. Interestingly, HIV–HBV co-infected patients receive free treatment at HIV clinics. However, HIV–HCV co-infected patients currently receive only anti-retroviral therapy and no anti-HCV therapy (Tables 3 and 4).

A majority of the infected are unaware of their disease status, most likely due to the general lack of awareness among the Ethiopian population. The expert survey findings suggest low public awareness of viral hepatitis in Ethiopia; patients generally do not even suspect their positive infection status until they are diagnosed [9]. Lack of awareness and the silent nature of hepatitis leads to late presentation, generally with severe complications [9]. The cost of treatment with repeated complications could be daunting to the average patient in Ethiopia, as shown in Table 4. Awareness among healthcare workers also seems to be lacking; hardly 20%–30% of physicians have clarity on the management of viral hepatitis cases [10].

To prevent the spread of hepatitis, the government of Ethiopia has taken up an initiative to immunize children against HBV as a part of its national Expanded Program on Immunization. The vaccination is provided at the expense of the state to all infants as early as 6 weeks. However, the national coverage of three doses of this vaccination in infants seems to be low (~50%–60%) [10]. Moreover, while the HBV vaccine has been made available free of cost to infants, no such options exist for adults and high-risk groups [9]. The cost of a complete HBV vaccination course at a private center can be as high as US$60 [10].

4 DISCUSSION

As stated earlier, data on viral hepatitis in Ethiopia is limited as no recent prevalence studies have been conducted to assess the disease burden. The one study conducted in the late 1980s [11] may not represent the true national burden, as the study was conducted in a limited number of subjects (n = 5270) and only in young males. Nevertheless, the experts' opinion on the burden of HBV and HCV is also in alignment with earlier published literature and projected estimates [11]. Studies have been conducted with limited scope and in specialized groups such as blood donors, pregnant women, HIV clinic attendees, and prison inmates, but such study results may not represent the true national burden of viral hepatitis.

Though Ethiopia is estimated to have a huge burden of viral hepatitis [6], most of the infected population are unaware of their disease status most likely as a consequence of a general lack of awareness concerning hepatitis. By contrast, awareness among the general public on issues related to HIV seems to be sufficient [9]. This is due to intense public awareness campaigns conducted by national and international organizations. Of course, awareness is key to the success of any venture. Thus, there is a need for hepatitis awareness campaigns similar to those for HIV.

Alongside raising awareness, there is a need to protect the rights of infected individuals through legislation. This would encourage patients to shed guilt and approach healthcare openly. Moreover, there is a need for continuous educational programs for healthcare workers from all sectors (doctors, nurses, ancillary staff, laboratory technicians, etc.). These activities would also enhance advocacy for the management and control of the disease.

The high cost of diagnosis is also another contributing factor to the poor diagnosis rate (Table 3) [9]. Current hepatitis diagnostics and medications are not affordable to the majority of the population [9]. Hence, there is a need to initiate policies to make them affordable or subsidize them. This would improve the diagnosis rate and also enable diagnosis at an early uncomplicated stage of hepatitis. Subsidizing diagnosis would encourage more patients to seek healthcare.

There is also a lack of access to medications for HBV treatment [10]. Since every patient has a natural right to treatment, there is a need to change national policy to make the anti-retroviral drugs freely available to patients. The drugs used for the treatment of HCV patients are beyond the reach of most of the population [10]. Considering the total population of Ethiopia (94.1 million) [12] and the current prevalence of chronic hepatitis (HBV and HCV combined) of 15%, the total patient population in need of effective medication is 14.1 million. From the point of view of economics treating such a huge population may seem to be a heavy burden on the state, especially when the GDP per capita of the country is around 1,300 USD [13]. However, not treating or facilitating access to treatment is an even greater risk, as the cost of treating the eventual complications of hepatitis would far exceed the cost of treatment. Furthermore, the country does not have an established public health insurance system. However, in view of new and more effective treatments becoming available at more

affordable rate it is wise to initiate steps towards public funding for treating hepatitis infections [14]. Hence, there is a necessity to develop strategies for public subsidy for the treatment of viral hepatitis.

HBV, HCV, and HIV share several epidemiological characteristics such as their at-risk populations and transmission routes, which puts HIV-positive individuals at high risk of co-infection with HBV and HCV. This is significant as HIV-hepatitis co-infected individuals show an accelerated course of liver disease, with faster progression to cirrhosis. This scenario is more relevant in Sub-Saharan Africa, which has two-thirds of all of the world's cases of HIV. Researchers who analyzed data on HIV and hepatitis from 20 Sub-Saharan African countries have found a mean prevalence for HBsAg of 15% among people living with HIV, while that of antibodies to HCV was 7% [15]. Hence, it would be prudent to integrate the viral hepatitis program with the existing HIV prevention/control programs and other related healthcare programs.

Furthermore, viral hepatitis patients are diagnosed at several points: in hospitals, HIV clinics, blood banks, antenatal clinics, etc. It would be advisable to integrate these diagnosis points and related health programs with the viral hepatitis program. This would ensure that the patients are not lost to follow-up. However, this sort of integration is complex and care needs to be taken to ensure that the existing programs are not hampered or overburdened.

There are no nationally endorsed guidelines for the management of viral hepatitis [9]. The lack of data on the burden of viral hepatitis in Ethiopia seems to have resulted in inaction at the policy level. Currently, there is no framed hepatitis policy from the Government of Ethiopia. Any strategy to combat viral hepatitis must be multi-pronged: including aspects such as universal vaccination against HBV, creating awareness among the public and healthcare workers, providing access to subsidized diagnosis and treatment, protection of the rights of infected individuals, and mandatory screening of high-risk individuals. To initiate these activities, there is a need for a well-defined national strategy and plan with clearly demarcated goals. As of now, there seems to be only three major programs currently operating that might have an influence on combating the spread of viral hepatitis: screening of blood and blood products (for infectious diseases such as HIV, syphilis, HBV, and HCV is mandatory as per National Blood Transfusion Services guidelines), vaccination program for infants (part of the Expanded Program on Immunization), and injection safety practices in healthcare settings (disposable/auto-disable needles and syringes are recommended) [9]. However, vaccination of high-risk groups such as healthcare workers, community social workers, men who have sex with men, prison inmates, and the armed forces is not yet mandatory [9]. Since HBV can infect any person at any age, state-funded vaccination needs to be made available and accessible to every person.

The Ethiopian Ministry of Health (MoH) has a well-established healthcare delivery system and is the principal authority that regulates and delivers healthcare in the country. Thus, the implementation and penetration of viral hepatitis programs depends exclusively on the MoH's network. Of course, there are several national and international players also operating in the health sector in Ethiopia. For viral hepatitis programs, these existing players provide the simplest avenues for partnership.

Table 1: Socio-epidemiological data of HBV and HCV in Ethiopia

Parameter	HBV	HCV
Prevalence	10%–15%	2%–5%
Transmission	sexual, vertical, blood transfusion, reuse of needles and syringes, tattooing, scarification, nosocomial and horizontal	sexual, vertical, blood transfusion, reuse of needles and syringes, tattooing, scarification, and nosocomial
Genotype prevalence	NA	G-1: 20%–30%; G-2: 5%–20%; G-3: 5%–10%; G-4: 40%–60%; G-5: 1%–5%; G-6: 1%–5%
Male: Female ratio	60:40	
Age distribution		
<18 y	10%–20%	
18-60 y	60%–80%	
>60 y	10%–30%	
Socioeconomic distribution		
Upper	5%–30%	
Middle	30%–80%	
Lower	15%–70%	

Table 2: Diagnosis and treatment parameters for hepatitis patients in Ethiopia

Parameter	HBV	HCV
Diagnosis rate	10%-15%	5%-10%
First time diagnosis	Blood donation, antenatal clinic, dialysis center, medical check-up for emigration	
Treatment rate	<5%	~5%
Treatment completion rate	~50%	~60%
Treatment response rate	10%–20%	~60%
Treatment options/preference	tenofovir, lamivudine, interferon	ribavirin, interferon

Table 3: Cost of diagnosis and treatment for hepatitis infections in Ethiopia

Parameter	HBV (in US$)	HCV (in US$)
ELISA	10–15 per test	10–15 per test
PCR	200–300 per test	250–350 per test
Rapid test	5–10 per test	5–10 per test
Other tests	10–30 for other routine tests	30–60 for other routine tests
Ribavirin	NA	Not available in open market
Tenofovir	Not available in open market	NA
Interferon	14 400 for full course of treatment	14 400 for full course of treatment
Lamivudine	Not available in open market	NA

Table 4: Consolidated cost of treatment of HBV and HCV infections, and cost of management of complications in Ethiopia

Consolidated cost of management	HBV (in US$)	HCV (in US$)
Chronic infection	10 000–20 000	15 000–18 000
Compensated liver cirrhosis	15 000–18 000	
Decompensated liver cirrhosis	1100–3200	
Hepatocellular carcinoma	1300–5500	
Ascites	1000–2700	
Spontaneous bacterial peritonitis	1200–3000	
Variceal bleeding	2000	
Hepatic encephalopathy	600	

5 CONCLUSIONS

The data on viral hepatitis in Ethiopia is limited. There is a need to conduct systematic studies in this regard. There is lack of awareness among public and healthcare professionals on the current burden of hepatitis in the country. Hence there is a need for educational campaigns. High cost of diagnosis and lack of access to HBV medications have resulted in poor access to care. Hence the diagnostics and medications need to be subsidized to improve access. There is a need to integrate different health services to combat viral hepatitis as the patients are diagnosed at different departments within a hospital. There is need to develop indigenous guidelines to diagnose and treat hepatitis.

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REFERENCES

[1] Center for Disease Control. *World Hepatitis day-July 28th*. [Online] Available: http://www.cdc.gov/features/dshepatitisawareness/index.html#References (August 21, 2014)

[2] World Health Organization. *Prevention & Control of Viral Hepatitis Infection: Framework for global action*. [Online] Available: http://www.who.int/csr/disease/hepatitis/GHP_framework.pdf (August 21, 2014)

[3] Elizabeth W and Hwang RC, "Global Epidemiology of Hepatitis B Virus (HBV) Infection," *North American Journal of Medicine and Science,* vol. 4, no. 1, pp. 7-13, 2011.

[4] Karoney MJ and Siika AM, "Hepatitis C virus (HCV) infection in Africa: a review," *Pan Afr Med J,* vol. 14, pp. 44, 2013.

[5] Mast EE, Alter MJ, and Margolis HS, "Strategies to prevent and control hepatitis B and C virus infections: a global perspective," *Vaccine,* vol. 17, pp. 1730-1733, 1999.

[6] Ethiopian Radio and Television Agency. *Ethiopia undertaking hepatitis vaccination program.* [Online] Available: http://www.ertagov.com/news/index.php/component/k2/item/258-ethiopia-undertaking-hepatitis-vaccination-program (August 21, 2014)

[7] Kiire CF, "The epidemiology and prophylaxis of hepatitis B in sub-Saharan Africa: a view from tropical and subtropical Africa," *Gut,* vol. 38, suppl. 2, pp. S5-12, 1996.

[8] Chang MH, "Hepatitis B virus infection," *Semin Fetal Neonatal Med,* vol. 12, no. 3, pp. 160-167, 2007.

[9] Authors discussions with expert participants 2014.

[10] Expert survey findings 2014.

[11] Kefene H et al, "Ethiopian National Hepatitis B Study," *J Med Virol,* vol. 24, no. 1, pp. 75-84, 1988.

[12] World Bank. *Total population.* [Online] Available: http://data.worldbank.org/indicator/SP.POP.TOTL (August 21, 2014)

[13] CIA. *The World Factbook: Ethiopia*. [Online] Available: https://www.cia.gov/library/publications/the-world-factbook/geos/et.html (August 21, 2014)

[14] Business Standard. *Drug makers sign pact with Gilead for cheaper Hepatitis-C drug*. [Online] Available: http://www.business-standard.com/article/companies/drug-makers-sign-pact-with-gilead-for-cheaper-hepatitis-c-drug-114091501087_1.html (August 21, 2014)

[15] World Health Organization. *Global policy report on the prevention and control of viral hepatitis in WHO member states.* [Online] Available: http://apps.who.int/iris/bitstream/10665/85397/1/9789241564632_eng.pdf (August 21, 2014)

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Etude de préfaisabilité du dessalement d'eau de mer couplé aux Energies renouvelables à des fins d'irrigation

[Feasibility study of water desalination coupled to renewable energies for the purpose of irrigation]

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ABSTRACT: The problem of water in the agricultural sector and the country's poverty level of fossil energy sources (import 97%) lead to the most appropriate solution is the coupling of renewable energy in water desalination. In this article an economic approach has been established at the price per kilowatt hour, which aims to explain and demonstrate the feasibility of this solution in the action area.

KEYWORDS: water desalination; solar radiation; wind energy; fossil energy.

RESUME: La problématique de l'eau dans le secteur agricole et la pauvreté du pays au niveau des sources énergétiques fossiles (importation 97 %), conduisent vers la solution la plus adéquate qui est le couplage les énergies renouvelables au dessalement d'eau. Dans cet article une approche économique a été établir au niveau des prix du kilowattheure dont l'objectif est expliquer et montrer la faisabilité de cette solution dans la zone d'action.

MOTS-CLES: Dessalement d'eau, Gisement solaire, Energie éolienne, Energie fossile.

1 INTRODUCTION

L'énergie et l'eau en agriculture sont deux domaines au cœur de l'actualité et dont les préoccupations se rejoignent dans l'opinion et dans les politiques de développement de la présente zone d'étude. Elle est considérée comme le premier producteur et fournisseur des produits agricultures au pays, ce qui nécessite sur la grande mobilisation des ressources en eau.

Cet article aborde la problématique et le besoin de l'eau pour fin d'irrigation, ensuit nous traiterons la question de l'énergie de dessalement d'eau comme solution de ce problème, à partir d'une comparaison entre les prix du kilowattheure d'origine fossile et ceux d'origines renouvelables, notamment de l'énergie photovoltaïque et éolienne.

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2 PROBLÉMATIQUE

2.1 SITUATION GÉOGRAPHIQUE

La zone d'études couvre les quatre principaux bassins suivants :

- Le bassin de l'Oued Souss (16 200 km2) ;
- Le bassin de Massa (6280 km^2) ;
- Les bassins côtiers des Oueds Tamraght et Tamri (2 600 km^2) ;
- Le bassin de Tiznit-Ifni (2 800 km2)

Elle situés entre l'Océan Atlantique et les montagnes du Haut-Atlas et l'Anti-Atlas, ces bassins ont des superficies s'étendant approximativement sur 25% de zones de plaine et 75% de zones de montagne. Les principales plaines sont celle du Souss (4 500 km^2), celle des Chtouka (1260 km^2) et celle de Tiznit (1 200 km^2). [1]

2.2 CONTEXTE CLIMATIQUE

Le climat de la région est à prédominance aride, mais il varie du type humide à hiver froid sur les sommets du Haut-Atlas Occidental à prè-saharien, à hiver frais en plaine.

2.2.1 TEMPÉRATURES

Les températures moyennes annuelles varient de 14°C sur le Haut-Atlas au Nord à 20°C sur l'Anti-Atlas au Sud. La température maximale journalière atteint 49°C et la température minimale descend jusqu'à 3°C au dessous de zéro.

2.2.2 PRÉCIPITATIONS

Les précipitations, sur la région d'étude, présentent une grande variabilité spatiale et temporelle.

Les précipitations moyennes correspond les différents bassins:

- 280 mm sur le bassin du Souss ;
- 265 mm sur le bassin du Massa ;
- 390 mm sur le bassin du Tamrhart
- 180 mm sur la plaine de Tiznit.

3 ETAT DES RESSOURCES EN EAU

3.1 EAUX SUPERFICIELLE

L'hydrographie du bassin du Souss-Massa s'articule autour de 4 grandes unités hydrologiques comme il est indiqué dans la figure 1:

- Bassin du Souss ;
- Bassins côtiers atlantiques (Tamri – Tamraght) ;
- Bassin de Massa ;
- Bassins de Tiznit-Sidi Ifni.

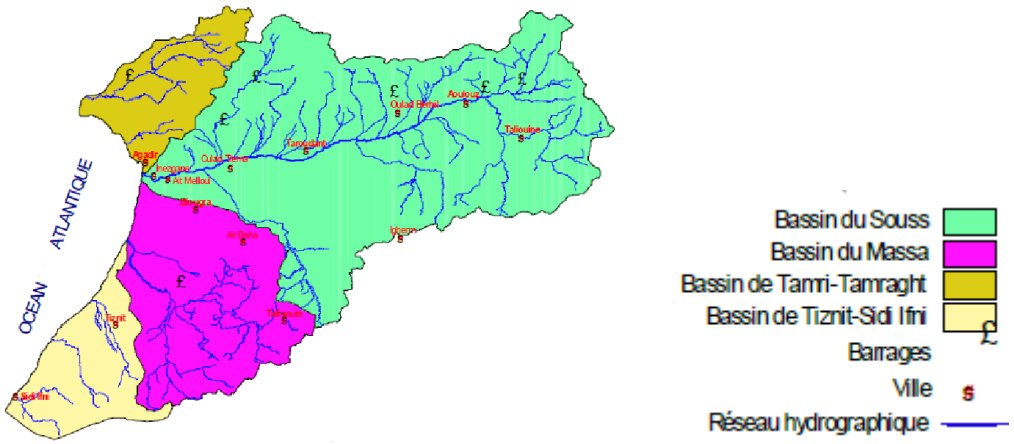

Fig 1 : Découpage hydrologique du bassin Souss Massa

Les apports annuels moyens dans la zone de l'étude, répartis par bassin et sous bassin, sont présentés dans la figure 2.

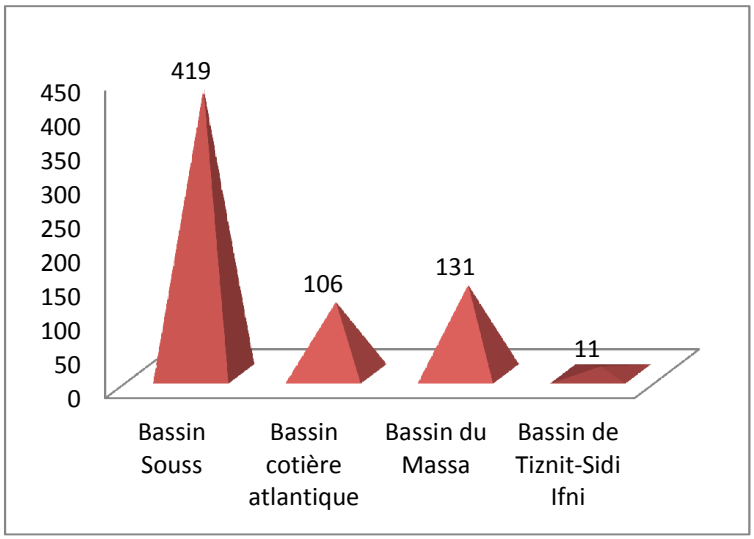

Fig 2 : Apports moyens annuels du bassin hydraulique du Souss Massa

L'intégration de l'ensemble des sous bassins a permis d'établir l'apport moyen du bassin du Souss Massa à environ 668 Mm^3/an.

3.2 EAUX SOUTERRAINES

La région comprend trois principales unités hydrogéologiques : la nappe du Souss, la nappe des Chtouka et celle de Tiznit, dont la localisation est donnée dans la figure 3.

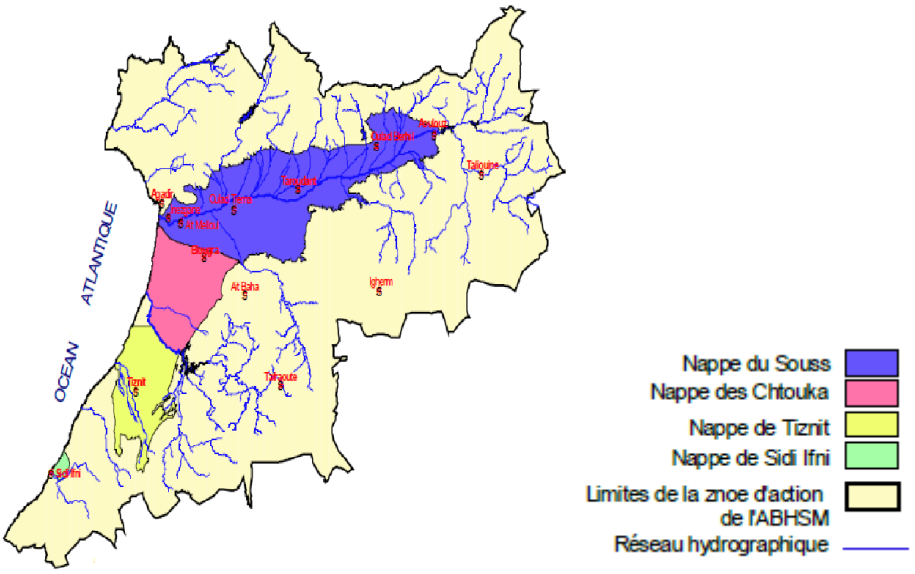

Fig 3 : Principales nappes de la zone d'étude

Le tableau 1 expose l'allure caractéristique correspond les nappes d'eau souterraine dans les années 2003 et 2012.

Tableau 1 : Apports moyens annuels des eaux souterraines de la zone d'étude en Mm^3/an

	2003		2012	
Nappe	Entrée	Sortie	Entrée	Sortie
Chtouka	35	93	33	90
Tiznit	24,9	25,4	21,5	23
Souss	323	551	268	551

4 UTILISATION ACTUELLE DE L'EAU EN IRRIGATION

La superficie totale irriguée en 2012, dans les bassins de Souss Massa, est estimée par 120 680 ha selon l'ORMVASM. [2]

La figure, ci-après, dresse une estimation de l'utilisation agricole des ressources en eau, par bassin, pour l'année 2012.

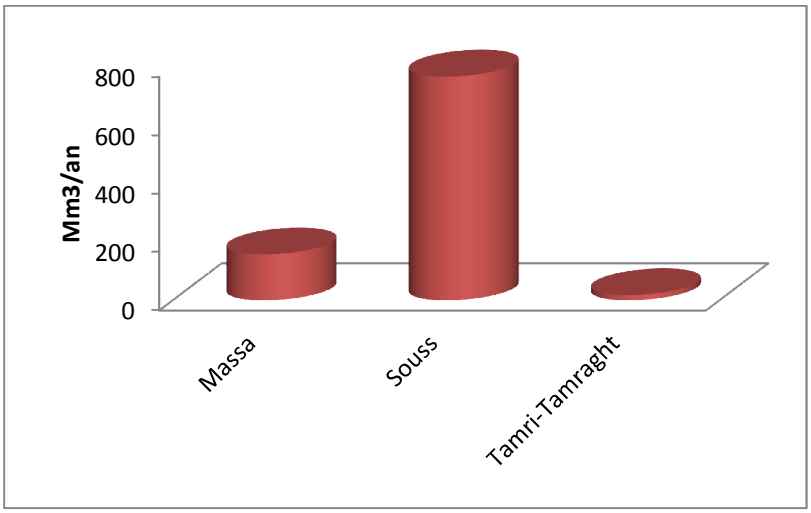

Fig 4 : Utilisation d'eau d'irrigation en Mm^3/an.

L'irrigation utilise ainsi actuellement un volume brut (comprenant toutes les pertes dues au transport, stockage etc..) d'environ 942 Mm^3/an d'eau, dont 616 Mm^3 d'eau souterraine et 326 Mm^3 d'eau de surface.

5 EVALUATION DE LA DEMANDE EN EAU D'IRRIGATION

Les résultats, présentés dans ce chapitre, sont ceux de l'étude de révision du PDAIRE des bassins de Souss Massa, notamment la mission relative à l'étude de la demande en eau agricole, où il a été procédé à l'actualisation, en étroite collaboration avec les services de l'ORMVASM, des éléments permettant l'évaluation des besoins en eau d'irrigation.

Tableau 2 : Demande d'eau agricole future

Bassin	demande d'eau en Mm^3		Superficie irriguée
	2020	2030	
Massa	145	145	27235
Souss	595	588	101935

Globalement, la demande en eau d'irrigation, au niveau des bassins de Souss Massa, telle qu'elle ressort de l'étude de révision du PDAIRE, passerait de 808 Mm^3 en 2012, à 768 Mm^3 en 2020 et à 750 Mm^3 en 2030 selon l'ORMVASM. [4]

6 IDENTIFICATION DES BESOINS EN EAU DE DESSALEMENT

Le tableau suivant récapitule les bilans globaux Besoins / Ressources totales, du bassin du Souss Massa ressources, après mise en œuvre des options de développement contenues dans l'étude de révision du PDAIRE. [4]

Tableau 3 : Bilans globaux Besoins / Ressources du bassin du Souss Massa en 2012

Zone	Superficie irriguée en ha	Besoins (Mm^3)	Ressources (Mm^3)	Bilan (Mm^3)
Massa	27235	145	134	-11
Souss	101935	645	634	-11

La zone d'action entrer dan un déficit hydraulique a cause de la croissance de la demande en eau d'irrigation, ce qui impose la solution de dessalement d'eau pour couvrir et satisfaire ces demandes**.**

7 POTENTIEL DES ÉNERGIES RENOUVELABLES DE LA ZONE D'ACTION

7.1 ENERGIE SOLAIRE

Le solaire est certainement la source d'énergie renouvelable occupe une place importante dans la stratégie énergétique du Maroc. Avec plus de 3000 h/an d'ensoleillement comme il est indiqué sur la figure 4, soit une irradiation de 5 $kWh/m^2/j$ [5] .Cette source d'énergie constitue un potentiel particulièrement important surtout dans les régions mal desservies en capacités de production électrique.

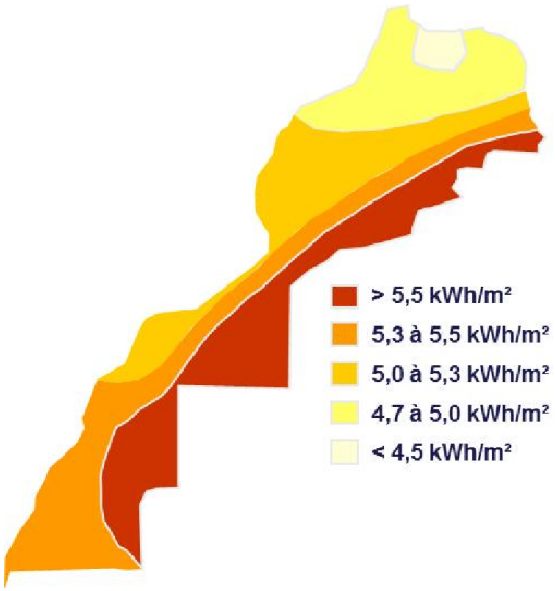

Fig 4 : Carte du gisement solaire du Maroc

Pour la zone d'étude, le potentiel solaire est exposé dans la figure 5, qui montre que le site a un rayonnement solaire journalier moyen environ de 5,27 kWh/m^2/j. [6]

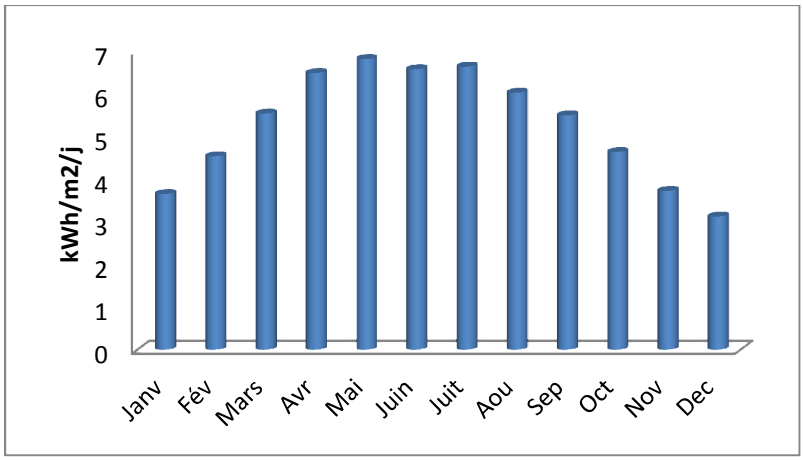

Fig 5 : Irradiation globale moyenne journalière du site en kWh/m^2/j

8 POTENTIEL EOLIEN

Dans l'éolien, le Maroc jouit d'un potentiel très important plus particulièrement le long de ses côtes avec des vitesses de vent supérieur à 6.5 m/s et allant jusqu'à 10m/s. Toutefois ce potentiel est limité principalement par la capacité d'intégration au réseau électrique au moins à moyen terme, soit d'ici 2020

Le potentiel théorique illustré dans la figure 6 est très important au Maroc car il compte sur des gisements de vents dans plusieurs régions. [7]

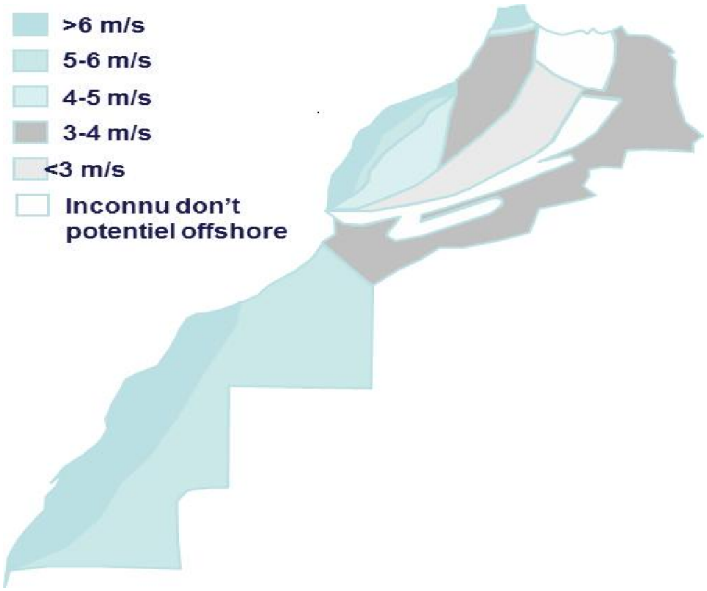

Fig 6 : Potentiel éolien du Maroc

Notre site est caractérisé par une vitesse de vent moyenne estimée par 4 m/s, la figure 7 expose le profile de la vitesse moyenne du vent au cours de l'année selon les données météorologies de l'ADEREE.

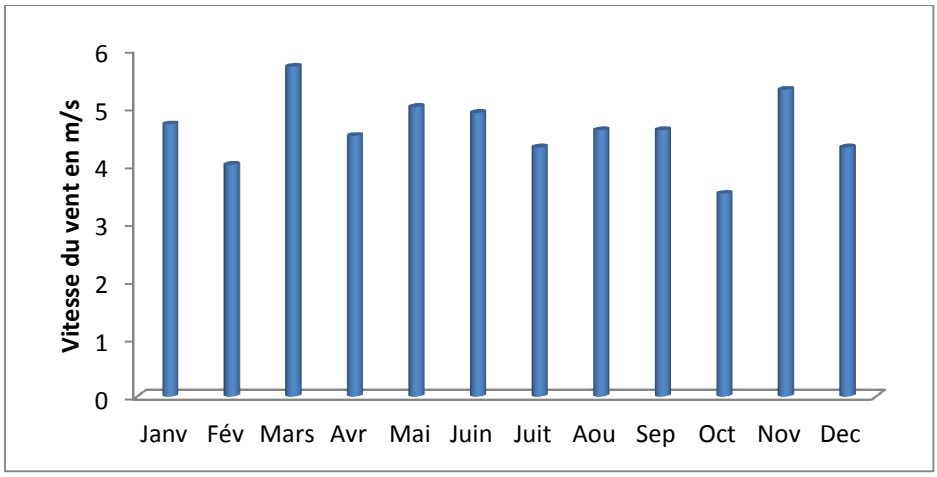

Fig 7 : Profile de vitesse moyenne du vent à 9 mètre au sol en m/s [8]

9 MARCHÉ ENERGÉTIQUE

Le Maroc est un pays importateur d'énergie, tel que le taux de dépendance énergétique qui mesure le degré de la dépendance énergétique du pays par rapport à l'étranger, il est donné par la relation (1) ci après. La figure 8 montre l'évolution de cet indicateur entre 2004 et 2012 au Maroc. [9]

$$IDE=1-\frac{\text{Production totale de l'énergie}}{\text{Consommation intérieur brute}} \quad (1)$$

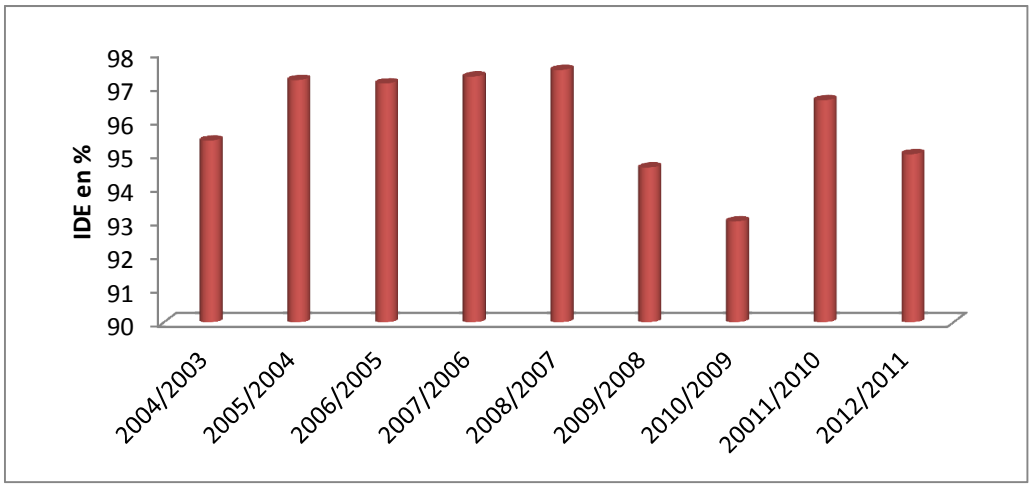

Fig 8 : Evolution d'IDE au Maroc

L'objectif de cette partie, est de montrer la croissance du prix de l'électricité qui vienne du réseau électrique au Maroc, et par conséquent l'augmentation du prix du kWh ce qui conduit vers les énergies renouvelables.

9.1 EVOLUTION DU PRIX KWH DU RÉSEAU ELECTRIQUE

Le coût de l'énergie au Maroc connait depuis les années quatre-vingt une augmentation, ce qui provoque un système tarifaire. Dans cet article on s'intéresse sur l'évolution du prix du kWh en haute tension. La figure 9 montre la croissance du prix du kilowattheure au Maroc.

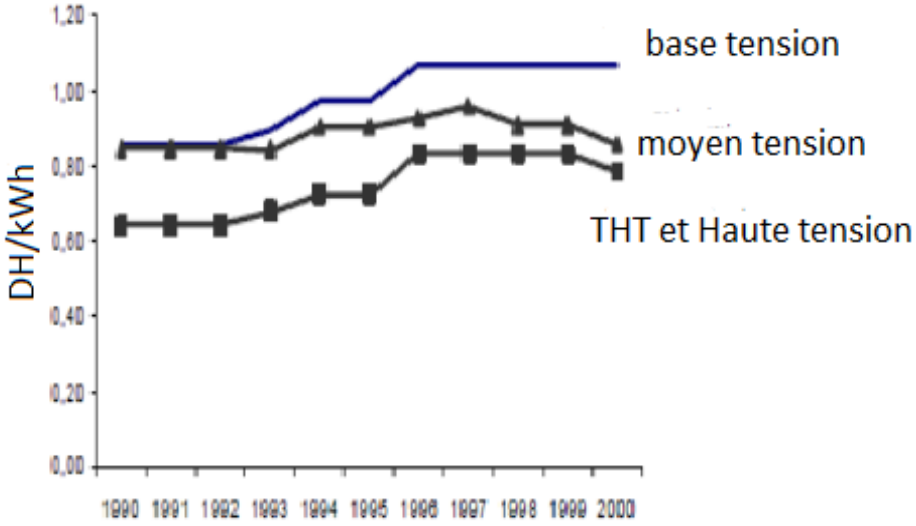

Fig 9 : Evolution des tarifs de l'électricité par niveau de tension entre 1990 et 2000

Les tarifs de l'électricité (haute tension) connaissent une croissance de 2% chaque année [10], la figure 10 montre l'évolution présente et future du prix du kilowattheure.

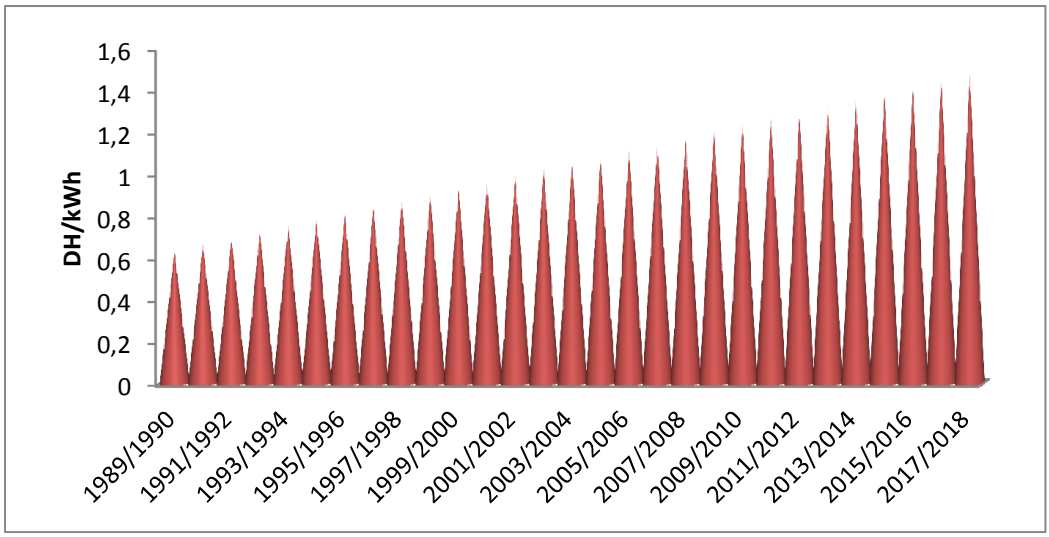

Fig 10 : Evolution du prix du kWh HT en DH/kWh

9.2 EVOLUTION DU PRIX DU KWH PHOTOVOLTAÏQUE

Généralement, le cout du kWh vient de l'énergie photovoltaïque dépend de plusieurs paramètres, tel que le rayonnement solaire du site et d'autres comme il est indique dans le tableau 3.

Tableau 3 : Détermination du rendement moyen de la PV pour la région du Souss-Massa

Zone	Production PV en [kWh/kWc]
Agadir-Inzgane	1849
Massa(Chtoukat)	1821
Tiznit	1726

Le prix par Wc d'un système photovoltaïque est actuellement en Europe d'environ 2,5-3 €/Wc. Au Maroc, selon un expert de Temasol, le prix est similaire. Le calcule dans cet article se base sur un prix de 3 €/Wc pour l'année 2010. Pour une projection des prix des systèmes, on se base sur une baisse annuelle moyenne de 7,5% pour la période jusqu'à 2020, et de 4% jusqu'en 2030. [11]

En effet, le calcule du prix du kWh photovoltaïque dépend de plusieurs paramètres, comme il est indiqué sur la figure ci après. [12]

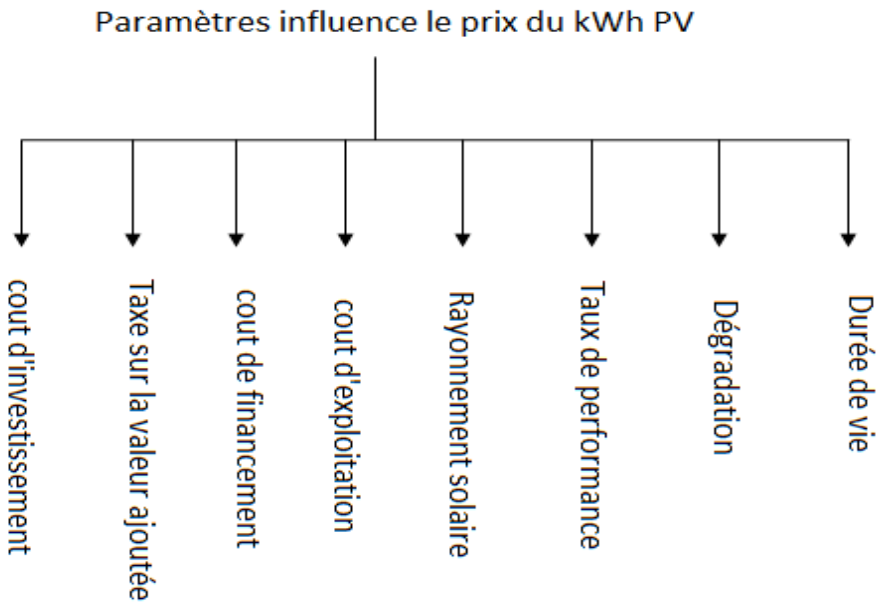

Fig 11 : Paramètres influence le prix du kWh photovoltaïque

Les coûts de production de l'électricité varient légèrement en fonction des différences régionales de rayonnement solaire.

9.3 ENERGIE EOLIENNE

Energie éolienne pourrait cependant offrir une solution durables à la croissance des besoins énergétique du pays, les ressources éoliennes sont moyenne au niveau de la zone d'action.

On se base dans cette partie sur les tarifs de l'ONEE pour ses clients qui sont alimenté par les parcs éoliens. Il existe deux tarifs, l'une concernant l'abonnement normale qui un tarif de 0,465 DH/kWh et l'abonnement super pointe, le tarif est 0,311 DH/kWh. [13]

Enfaite, ces prix inclus incluent quelques paramètres telle que :

- Remise client
- Timbre de transport
- Pertes

10 RÉSULTATS ET DISCUSSION

D'un côté, les résultats montrent que la situation du périmètre privé et publique du Massa a un déficit hydraulique enregistré de 11 Mm^3 en 2012 (tableau 3) et qui puisé en grande partie dans les réserves non renouvelables des nappes (Tableau 1). En effet, le déficit calculé à un volume équivalent de 30 Mm^3 (périmètre privé), et environ de 40 Mm^3 au périmètre publique (la baisse des volumes régularisés du barrage YOUSSEF BENTACHFINE), à l'horizon de 2030 selon PDAIRE, alors le volume globale nécessaire est 70Mm^3/an en terme de mobilisation des eaux de mer dessalées.

D'autre côté, l'indépendance énergétique au Maroc est 97%, ce qui explique l'augmentation du prix du kilowattheure d'origine fossile qui connait une croissance annuelle de 2% à 3% (figure 9), par contre le kilowattheure d'origine renouvelable qui est environ 0,88 DH/kWh et baisse jusqu'à 0,4 DH/kWh pour le photovoltaïque (figure 12) et 0,63 DH/kWh pour l'éolien, est devient plus prometteuse pour les grandes installations, c'est-à-dire les hautes tensions, au contraire le prix du kilowattheure d'origine fossile (réseau électrique national HT) qui est autour de 1 DH/kWh et quelques. (Figure 10). [10][11]

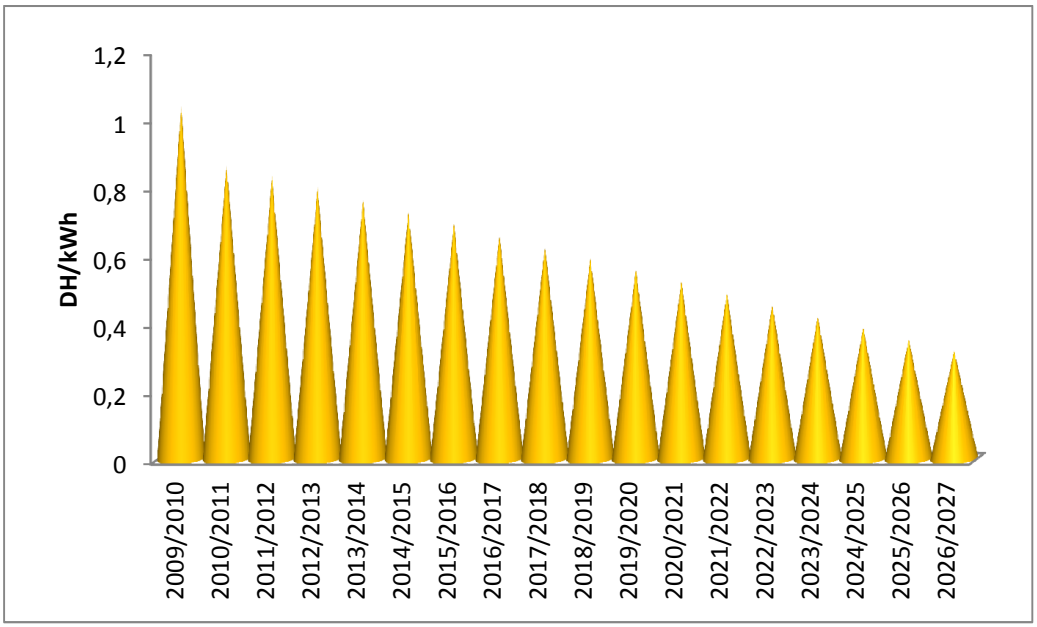

Fig 12 : Evolution future du prix du kWh photovoltaïque au cite d'action

Les comparaisons qu'on fait ici, a pour objectif de montrer que le secteur des énergies renouvelables est devient très prometteuses pour la future.

11 CONCLUSION

Cette Etude de préfaisabilité montre que le dessalement couplé aux énergies renouvelables est sans doute un des axes de recherche prometteuse pour cette région de Souss-Massa et au Maroc, non seulement par sa nature multidisciplinaire mais aussi par les nombreuses questions qu'il soulève et qui méritent d'être appréhendées. Aussi le développement législative, institutionnelles, technologique et l'option de l'ouverture de la politique des énergies renouvelables, permettant d'optimiser et de choisir un mixte énergétique qui sont présentés aujourd'hui les grandes lignes dans le plan énergétique de l'état.

NOMENCLATURES

ADEREE	Agence de développement des Energies renouvelables et Efficacité Energétique du Maroc
DH	Dirham marocain
IDE	Indicateur de Dépendance Energétique
KWc	Kilowatt crête
Mm^3	Million mètre cube
ORMVASM	Office Régional de Mise en Valeur Agricole de Souss-Massa
ONEE	Office National de l'Eau et l'Electricité
PDAIRE	Plans Directeurs D'aménagements et de gestion Intégrée des Ressources en Eau

REFERENCES

[1] Ecole Hassania des Travaux Publics « Changements climatiques: causes et conséquences sur le climat et les ressources en Eau ; Centre d'Etudes et de Recherches sur les Ressources en Eau (CERHYDREAU) ».Casablanca. Maroc 2005.

[2] Bougis J. (2001) Etude de faisabilité de dessalement d'eau de mer pour l'alimentation en eau potable du Grand Agadir : prise d'eau et émissaire de rejet, Rapport RET.01.234.01.01 du 15-02-2001.

[3] ABHSM (2008) Termes de référence ; Agence du Bassin du Souss-Massa-Daraa ; rapport d'ORMVA du Souss-Massa-2007.

[4] Bougis J. (2009) Etude stratégique sur le dessalement de l'eau de mer au Maroc.
Rapport RET.08.478.02.01 du 30-03-2009 « Etude de la stratégie de dessalement de l'eau de mer pour l'irrigation dans le bassin du Souss Massa » ; Agence du bassin hydraulique d'Agadir 2010 ;[Online] Avalable: http://www.abhsmd.ma/spip.php?rubrique87

[5] Judith Jäger, Géo-éologue « ''Étude du potentiel de développement de l'énergie photovoltaïque dans les régions de Meknès-Tafilalet, Oriental et Souss-Massa-Drâa'' » ; la Coopération maroco-allemande Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) ; p.63, 99, 112.

[6] Agence de développement des Energies renouvelables et Efficacité Energétique du Maroc ; ressources du vent au Maroc ; atlas Eolien p.66 ;[Online] avalable : http://www.aderee.ma

[7] Potentiel Maroc 2014.[Online] avalable: http://www.siem.ma/index.php/fr/potentiel-maroc

[8] Mm. M. ENZILI ; Mm .F. AFFANI ; Mm. A. NAYSSA ; Mmes .A. KABOUS ; Mmes. N. ALHDADCHA ; Mmes .K. QACIR ; Les Ressources Eoliennes Du Maroc « Analyse Des Données Du Vent Relevées Au Niveau Des Appareils De Mesure Installés »; Juillet 2007.

[9] Naima Elouali ; Département de l'Economie, des Finances et de la Privatisation « Approche économique du secteur énergétique » ; Février 2009, document de travail N°73.

[10] Rapport d'activité-ONE 2004 et ONEE-2012 ; [Online] avalable : http://www.one.org.ma/.

[11] Fraunhofer-Institut für Solare Energiesysteme ISE, Février 2010, p. 11.

[12] Rapport d'activité Ministère de l'Economie et des Finances, 2009. Uh, 20.11.2008, p. 4.

[13] Said GUEMRA ; Énergie éolienne & Initiative Nationale Pour le Développement Humain: INDH ; [Online] available : http://energiemines.ma/?p=215

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Enterobacteriaceae: At the verge of treatment

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ABSTRACT: Antibiotics have a history of more than 70 years, during which they have saved the lives of millions of individuals. However, the golden era of so called miracle bullets is over now-antibiotic resistance to almost every class of antibiotics particularly in Gram negative microbes has rippled the fear that we may enter to pre-antibiotic era. The situation is gruesome as eventually diarrhea would be difficult to treat because it has already developed resistance to treatment of last resort and in enterobacteriaceae, which comprises of diarrheal pathogens-the multi-drug resistance genes are present on plasmids associated with integrons and transposons that aid in dissemination of resistance genes to unrelated species. It is imperative to reverse the resistance mechanism by overwhelming those microbial enzymes that degrade the antibiotics, by increasing the uptake of antibiotics by bacterial cells, by blocking drug efflux, by discovering new natural products having antimicrobial potential and most importantly through development of nano-antibiotics.

KEYWORDS: Enterobacteraceae, Nano antibiotics, Extended Spectrum Beta Lactamases, New Delhi Metallo beta lactamases-1, Multi drug resistance, Efflux pumps.

1 INTRODUCTION

Almost a decade back, resistance in Gram positive microbes was considered to be reaching at critical level. However, with the implementation of control policies and through the development of new medicines, it is considered to be under good control now [1]. However, though the situation against Gram positive microbes has improved the same against Gram negative has exacerbated to an extent that clinical microbiologists reach agreement that multi drug resistant Gram-negative bacteria are the existent threat to public health. There are many whys and wherefores that can be attributed to this menace.

Enterobacteriaceae is a large family comprising of more than 70 genera and all microbes belonging to this family are Gram negative bacilli. It along with other microbes constitutes normal flora of GIT. Clinically significant pathogens belonging to this family are *Escherichia coli (E.coli)*, *Klebsiella* species, *Salmonella, shigella* and *Enterobacter* species [2]. As its name indicates Enterobacteriaceae family are mostly the etiological agents of gastrointestinal infection like diarrhea, though few extra abdominal infections are also caused by them [3]-[4]. Enteric infections so caused by them generally exhibit very good spontaneous recovery, where fluid and electrolyte replacement therapy is appropriate to get rid of diarrhea and subsequent dehydration so caused. Scarcely antimicrobial chemotherapy is required [2] with which the cure rate always remained very high. Enterobacteriaceae spread effortlessly between humans by various means like by hand carriage besides contaminated food and water. It has genetic plasticity that reveal tendency to acquire genetic material through horizontal gene transfer, mediated mostly by plasmids and transposons. This combination is why emerging multidrug resistance in Enterobacteriaceae is of the utmost importance for clinical therapy [3].

It was considered to be causative agent of easily curable ailments however; past several decades have observed the spread of Enterobacteriaceae with resistance to broad-spectrum antimicrobials. Especially, the emergence of Carbapenem-resistant Enterobacteriaceae (CRE) has invalidated almost all the available therapies. It has created the havoc that once easily treatable infections like diarrhea may become untreatable or very difficult to be managed. KPC (*Klebsiella pneumoniae*

carbapenemase) and NDM (New Delhi Metallo-beta-lactamase) are the recently discovered types of CRE. KPC and NDM are the enzymes that break down carbapenems and make them ineffective [5]-[6].

It's evident that Enterobacteriaceae has developed resistance against Carbapenem, which is considered to be the drug of last resort. Second reason why resistance in Enterobacteriacece is considered to be more notorious is that the rate of spread of resistance; being very fast in Gram negative than the same in Gram-positive bacteria, the resistance genes in Enterobacteriacece are found on mobile genetic elements that can readily disseminate resistance through horizontal gene transfer to unrelated bacterial populations [7]. Moreover, unprecedented human air travel is also considered to be a cause of dissemination of resistance between countries and continents. Thirdly, there is currently no new antibiotic in the developmental pipeline that can specifically target Gram negative microbes though many against Gram positive are in the way [8].

2 DISSEMINATION OF RESISTANCE IN ENTEROBACTERIACECE

The mixing of susceptible to resistant microbes is an important cause of spread of resistance genes. Thus the most important reservoir is the gut of men and animals where all type of microbes get the opportunity to interact with each other. Particularly, in all those individuals who frequently take antibiotics courses and may have developed resistance to multiple antibiotics. In Enterobacteriaceae genetic plasticity allows acquisition and simultaneous dissemination of resistance genes to takes place very actively [7].

Acquisition of resistance genes may takes place by consumption of contaminated crops irrigated by polluted water, livestock fed on antibiotics containing feed, consumption of fish that has been fed on unwholesome ingredients, as our oceans and rivers are polluted with industrial waste and likewise, water that we consume is also not clean and pure. There are numerous studies that indicate potable water being contaminated with highly resistant pathogens. As these microbes interact with each other they exchange their genetic material so cross resistance takes place and it is much more prominent in Enterobacteriaceae [7].

Not only the gut of humans and animals is the reservoir for exchange of genetic materials but infact, the large-scale mixing of environmental bacteria with microbes from anthropogenic sources such as farm drainage and waste processing provides the ideal selective and ecological conditions for new resistant strains to arise; thus, soil, water, and other nutrient-enriched habitats can act as hotspots for horizontal gene transfer [9]. Many antibiotics particularly, some synthetic antibiotics are not easily biodegradable and can persist in soils for many years and microbes residing there develop resistance to them [7].

In enterobacteriaceae resistance genes are usually associated with mobile genetic elements such as transposons and integrons on large plasmids therefore they easily acquire and spread resistance phenotypes [10]. Likewise they accumulate resistance genes by other species making them multidrug resistant then these multiple genes of resistance persists for years.

3 TREATMENT MODULES FOR ENTERIC INFECTIONS:

Semi-synthetic penicillins in combination with beta-lactamase inhibitors were successfully used to treat enteric infections. However, the emergence of plasmid-encoded beta-lactamases (particularly TEM) put a pressure on the use of aminoglycosides, third generation cephalosporins and quinolones. Just after few years of application, resistance against aminoglycosides invalidated its use and put the pressure on third-generation cephalosporins and quinolones. However, early in this century extended-spectrum beta-lactamases (ESBLs) has created turbulence. An ESBL confer resistance to third and fourth generation cephalosporins called oxyimino-cephalosporins [7].

The carbapenems (e.g. imipenem, meropenem) are regarded as the drug of choice against ESBL-producing organisms since they are uniformly active *in vitro* and *in vivo* against these strains. Carbapenems can easily penetrate outer membrane barrier of Gram Negatives microbes due to its zwitterionic structure and is also stable to ESBL hydrolytic activity [11].

Although it is understandable from a clinical perspective to use then carbapenems, it is equally worrisome that this practice leads to the rapid selection of carbapenem-resistant Ent. As a result, only a few antimicrobial agents (e.g., colistin, fosfomycin, tigecycline) with an uncertain in vivo efficacy and/or reported toxicity are usually left to treat infections due to multidrug-resistant Ent (MDR-Ent) [4].

4 RESISTANCE MECHANISMS IN ENTEROBACTERIACEAE

In order to understand the mechanism of resistance in Enterobacteriaceae, it is very crucial to understand their structure. As Enterobacteriaceae consists of all Gram-negative (G-ve) bacteria and these Gram-negative microbes exhibit a rather more complex outer envelope consisting of an outer (OM) and an inner (IM) membrane that demarcate a periplasmic space [12] (Fig. 1).Bacterial lipopolysaccharides (LPS) are also unique to Gram negative (G-ve) microbes. LPS gives a negative charge to the cell and makes it impermeable to certain molecules particularly, hydrophilic one and the one that bear negative charge while promote the attachment of positively charged molecules. Diverse protein channels are present in outer membranes that are involve in transportation of materials, nutrients, drugs and chemicals from both inside and outside the cell

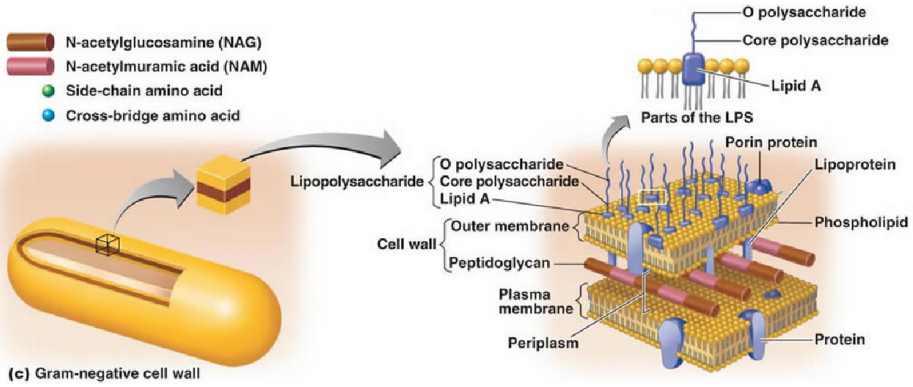

Fig. 1. Structure of Gram negative outer envelop

4.1 PORINS MODIFICATIONS

Though there are various channels but, porins and efflux transporters maintain a balance of intracellular drug accumulation and the quantity to be extruded. Hydrophobic compounds can permeate through the OM bilayer easily in a concentration dependent manner. However, hydrophilic molecules can only traverse via porins as LPS is offering a permeability barrier to them. Consequently, LPS alterations and porin modifications are a significant resistance mechanism adopted by various Gram negative microbes [12]. Mutatios in porins also reduce the ability of many beta-lactam antiobiotic (hydrophilic antibiotic) to cross the outer membrane of G-ve bacteria to bind at penicillin binding protein (PBP). Pertinent to mention here is that this resistance mechanism is specific for G-ve microbes only.

4.2 OVER-EXPRESSION OF EFFLUX PUMPS

The over-expression of efflux pumps is another effective way of resistance in enterobacteriaceae [13]-[14] (Fig. 2). In Gram negative microbes, down regulation of porins along with over-expression of efflux pump establish the first line of defense against antibiotics, biocides (disinfectants, antiseptics, preservatives), bacteriocins, detergents, surfactants, defensins, bile salts and also dyes and other chemicals.

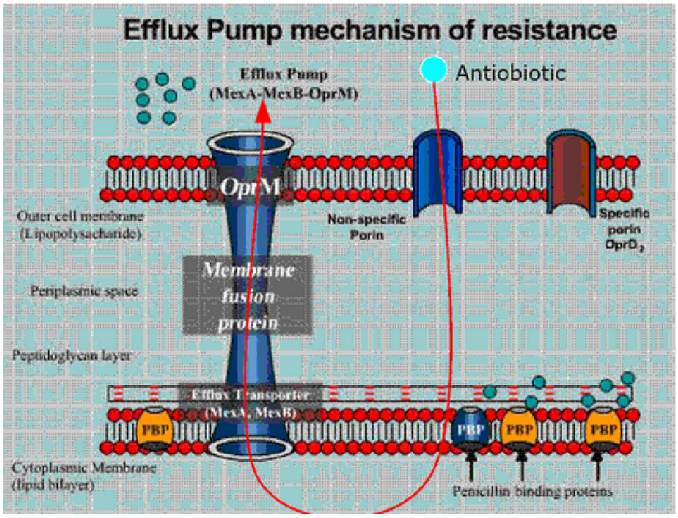

Fig. 2. Over expression of efflux pump

4.3 MODIFICATION OF ANTIBIOTIC TARGET SITES

Another mechanism of resistance in G –ve microbes are modification of target site. Penicillin-binding proteins (PBPs) forms crosslinking between peptidoglycan unit and β-lactam antibiotics have high affinity for binding with them because of structural similarity. As β-lactam antibiotics occupy PBPs, further cell wall synthesis stops because it will no longer be employed by cell wall synthesis machinery. Alteration in target site i.e., PBP will end up in losing the β-lactam to bind with PBPs.

4.4 Β-LACTAMASE PRODUCTION

In Gram-negative pathogens, most significant mechanism of resistance is the production of certain enzymes that degrade β-lactam ring of β-lactam antibiotics by hydrolysis and make them ineffective (Fig.3). These enzymes termed as β-lactamase. There are different types of β-lactamases for instance penicillinases, cephalosporinases, Extended Spectrum Beta Lactamases (ESBL), carbenicillinases, oxacillinases, carbapenemases etc., that are classified according to two schemes of classifications *viz.,* Bush-Jacoby-Medeiros classification system and Ambler classification [15] [16].

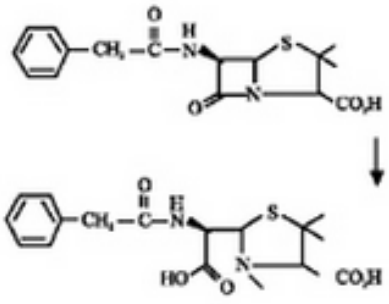

Fig. 3. Hydrolysis of β-lactam ring

4.4.1 BETA LACTAM ANTIBIOTICS:

All antibiotics included in this category contains beta lactam ring and antibiotics included in this category named as Penicillins (Ampicillin, Amoxicillin, Piperacillin), Cephalosporins (1st gen: cephalothin, 2nd gen (cephamycins): cefoxitin, cefotetan, 3rd gen: ceftazidime, cefotaxime, ceftriaxone and 4th gen: cefepime), Monobactam: aztreonam and Carbapenems:Imipenem, Meropenem and Ertapenem.

4.4.2 CLASSIFICATION SCHEMES FOR B-LACTAMASES

MOLECULAR OR AMBLER CLASSIFICATION (AND NUMBERING) SCHEME

In this scheme of classification, β-lactamases enzymes are classified based upon amino acid sequence similarity. Ambler et al., distributed β-lactamases into four classes (A, B, C and D), based on conserved and distinguishing amino acid motifs. Enzymes included in Class A, C, and D hydrolyze their substrates through an active site serine, whereas class B β-lactamases are metalloenzymes that utilize at least one active-site zinc ion to facilitate β-lactam hydrolysis [16].

FUNCTIONAL OR BUSH'S CLASSIFICATION SCHEME

Another way to classify β-lactamases is proposed by Karen Bush. According to this scheme of classification β-lactamases are divided into various classes according to the substrate profile, inhibitor profiles, and physical characteristics such as molecular weight and isoelectric point. For the most part, b-lactamases of a particular molecular class correlate with a specific group in the Bush classification system [11] Table 1.

Table.1: Classification scheme of β-lactamases

Bush's Group	Ambler Group	Enzymes	Inhibited by		Substrate	examples
			CA/TZB[1]	EDTA[2]		
1	Class C	cephalosporinases	No	No	cephalosporin	AmpC
2a	A	penicillinases	yes	No	Penicillin, cephalosporin,	
2b	A	Penicillinases+ cephalosporinases	yes	No	Penicillin, early cephalosporin	TEM-1, TEM-2, SHV-1
2be (ESBL)	A		yes	No	Inactivating 3rd-generation cephalosporins and monobactams (aztreonam)	TEM-3, SHV-2, CTX-M-15.
2br (inhibitor resistant)	A		No	No	Penicillin	TEM-30, SHV-10,
2ber	A		no	No	3rd and 4th generation cephalosporins, monobactams	TEM-50
2c	A	Carbenicillinase	Yes	No	Carbenicillins	
2ce	A		Yes	No	Carbenicillins and cefipime	
2d	D	Oxacillinase	variable	No	Cloxacillin or oxacillin	OXA-1, OXA-10
2de	D		do	No	3rd and 4th generation cephalosporins+cloxacillin or oxacillin	OXA-11, OXA-15
2df	D		do	No	Cloxacillin or oxacillin+carbapenems	OXA-23, OXA-48,
2e	A	Cephalosporinase	Yes	No	Cephalosporins(extended spectrum)+manobactams	CepA
2f	A	Carbapenemase	variable	No	Carbapenems, 3rd and 4th generation cephalosporins and cephamycins	KPC-2, SME-1
3a	B	MBL	No	Yes	Carbapenem but not monobactams+penicillns+cephalosporins.	IMP-1, VIM-1
3b	B	MBL	No	Yes	Carbapenems	

1: Clavulonic Acid/ Tazobactam
2: Ethylene diammine tetra acetic acid

4.4.3 EXTENDED SPECTRUM BETA-LACTAMASES (ESBLS)

Most imperative type of β-lactamases in current practice is extended-spectrum β-lactamases (ESBLs). These extended spectrum beta-lactamases (ESBLs) are emerging as a foremost threat for patients in the patient care centers and in community.

All those enzymes that have the capacity to hydrolyze penicillins (ampicillin and piperacillin), third and fourth generation cephalosporins and monobactams (aztreonam), are termed ESBL. Cephamycins (i.e. cefoxitin and cefotetan) and carbapenems (i.e. imipenem, meropenem, doripenem and ertapenem) are susceptible to their action. ESBL enzymes are readily inhibited by lactamase inhibitors such as clavulanic acid, sulbactam and tazobactam.

As ESBLs are inhibited by beta lactamase inhibitors so this unique property serves as an important phenotypic test that is conveniently exploited to identify ESBLs in bacteria [17].

The majority of ESBLs belongs to the class A (TEM, SHV, CTX-M) and D (OXA type ESBLs) in Ambler classification and from groups 2be (TEM, SHV, CTX-M) and 2d (OXA type ESBLs) in Bush's classification [18]. Pertinent to mention is that OXA type ESBLs have been found mainly in Pseudomonas aeruginosa and only rarely in Enterobacteriaceae [3].

ESBL genes (blaESBL) are mostly encoded by large plasmids (up to 100 kb and even more) that are transferable from strain to strain and between different bacterial species through conjugation; these are not chromosomally mediated [11]. Thus, ESBL genes can be transmitted between different gram-negative bacteria. In addition, their association with mobile genetic elements (e.g, integrons and transposons) facilitate dissemination of resistance pattern many folds. This is not the only resistance gene present on plasmid rather the situation is more gruesome because of the very fact that ESBL -producing bacteria show cross resistance to other classes of antibiotics such as aminoglycosides, fluoroquinolones, cotrimoxazole, and tetracycline [18]. There are more than 700 types of ESBLs that have been detected all over the world [19].

TYPES OF ESBLS

TEM, SHV, CTX-M and OXA β-lactamases are the types of ESBLs. More than 140 variants of TEM β-lactamases have been discovered so far, while greater than 60 for SHV β-lactamases. *E. coli* producing CTX-M- β-lactamases are the most frequently reported etiological agent for urinary tract infections (UTIs). Currently, these enzymes are the most prevalent type of ESBL found in most areas of the world [20]. Particularly, CTX-M-15 is the most widely distributed and most commonly recorded type in the world, having reached endemic prevalence in much of Asia, southern Europe, and South America. The widespread and increasing prevalence of CTX-M is causing a shift in prescribing away from third generation cephalosporins to carbapenem. Of grave concern at present is the rise in carbapenemase genes. This rise was because of the high incidence of CTX-M ESBLs, which resulted in heavy use of carbapenem antibiotics to treat patients infected with these bacteria. The resistance genes emerging in India include NDM-1 [7].

ESBLs together with the chromosomally encoded class C cephalosporinases (AmpC) constitute today's predominant resistance mechanism of gram-negative bacteria.

4.4.4 RESISTANCE TO CARBAPENEMS:

Carbapenemases are β-lactamases able to hydrolize β-lactam antibiotics, including carbapenems and cephamycins which are not hydrolyzed by ESBL. However, they cannot catalyze the hydrolysis of Aztreonam. These are termed metallo β-lactamases because metal ion is necessary for their activity. They are inhibited by metal chelators for instance, EDTA but not by beta lactamase inhibitors.

Pertinent to mention here is that carbapenems (imipenem, ertapenem, meropenem, and doripenem) are the latest developed molecules that possess the broadest spectrum of activity and are considered to be as last resort therapy. CRE has become notorious and deadly with a death toll up to 50%.

TYPES OF CARBAPENEMASES

Class A carbapenemases (Ambler Group and 2f from Bush's grouping) can be chromosomally encoded (SME) or plasmid-encoded (KPC). The KPC-types are the most clinically common carbapenemases found in Ent and are responsible for hospital outbreaks. Class B carbapenemases (Ambler Group and 3a from Bush's grouping) are called as metallo-β-lactamases (MBLs). They are usually of VIM and IMP types but the recently emerged NDM-types [21] are becoming the most threatening carbapenemases and have spread rapidly among Ent in all continents [22]. In Ent, class D carbapenemases (Ambler Group 2df from Bush's grouping) are mainly represented by the OXA-48-like enzymes (e.g., OXA-48, -162, and -181). These genes are extensively reported among *E. coli* and *K. pneumoniae* isolates in the European and African Mediterranean countries. However, very recently, OXA-48 producers have been reported in North America [10].

Carbapenem Resistant Enterobacteriaceae (CRE) develops a form of infection that is hard-to-treat and it is displaying an escalating trend amongst patients in medical facilities. CRE have become resistant to nearly all the antibiotics. Particularly, CRE with NDM-1 carbapenemase are a particular intimidation, as the blaNDM-1 gene is highly promiscuous and is readily transmitted between species and genera [23], with concomitant transfer of up to 14 antibiotic resistance genes. There is much evidence that CPE with NDM-1 carbapenemase are widespread in the population of the Indian subcontinent [23]-[24].

This poses a significant challenge to effective antimicrobial therapy of patients in this region and there is a clear danger of global dissemination of NDM-1 via international travel [25].

NDM-1 has been disseminated in different countries and is being reported globally. Because of its association with Indian sub-continent, a number of studies have included samples from Pakistan and India to evaluate the prevalence and spread of this enzyme. A study conducted on stool samples from patients at Military hospitals in Pakistan revealed an overall prevalence of 18.5% NDM-1 positive Enterobacteriaceae with 27.1% from inpatients while 13.8% were from out patients [26]. Out of 356 clinical isolates, 160 showed carbapenem resistance. Of these 160 isolates, 131 displayed MBLs production as accessed by combined disk method. In MBLs producing organisms, PCR amplification confirmed 31 (23.6%) isolates harboring blaNDM-1 gene, 33 (25.1%) isolates having blaVIM gene and 2 (1.5%) isolates displaying blaIMP gene. Plasmid profile analysis of NDM-1 positive organisms showed variable number of plasmids which were stable during serial passages in antibiotic free media. The prevalence of ESBL producing organisms was recorded to be 87.5% [27].

TREATMENT OF CRE

Treatment of carbapenemase resistant Enterobacteriaceae (CRE) now includes combination regimens of carbapenems, colistin, aminoglycosides, aztreonam, and tigecycline, as well as prolonged infusions of carbapenems [24].

5 COUNTER STRATEGIES TO COMBAT RESISTANCE

5.1 OVERCOMING BETA-LACTAMASES

β-lactamases constitute the main mechanism of resistance in enterobacteriaceae and it can be overcome by adopting two strategies, firstly by finding it's inhibitor or by discovering new antibiotics that are not target for β-lactamases. Right now, three beta-lactamase inhibitors are available: clavulanic acid, sulbactam, and tazobactam, these inhibitors because of their structural similarity with that of beta-lactam are targeted by β-lactamases and they spare actual drug moiety [15].

5.2 INCREASING THE ANTIBIOTIC INFLUX

Second most significant resistance mechanism in Gram negative microbes is the inability of hydrophilic drugs to cross the outer membrane barrier due to alteration in porins. On the other hand hydrophobic drugs cannot trespass barrier due to modifications in LPS.

To combat resistance in Gram negative microbes because of limited entry there is a need to facilitate the diffusion of antibiotics through the bacterial envelope in order to increase their intracellular concentration. Certain chemical facilitators and chemosensitizers, such as detergents, surfactants, chaotropic agents, polymyxines, and antimicrobial peptides can be employed for this purpose.

5.3 DESTABILIZATION OF LPS BARRIER

Another way to circumvent the membrane barrier is to destabilize the LPS layer by using chaotropic agents or detergents that consequently facilitate the diffusion of hydrophilic compounds through the membrane lipid bilayer. Treatment by Tris/EDTA leads to massive release of LPS in the medium, and it is believed that the reduced amount of LPS in the OM leaflet is compensated by glycerophospholipids, essentially creating patches of phospholipid bilayer, which are much more permeable to lipophilic compounds

5.4 BLOCKING THE EFFLUX

Many of the antibiotics if traverse the outer membrane barrier extruded out by efflux pumps. Efflux pumps inhibitors in combination with conventional antibiotic therapy are now considered as an attractive target for the development of a combinational therapy [13]. At the moment, efflux pump activity blockers are the main group that are described and tested on Gram-negative bacteria from both, natural and synthetic sources [28]-[29].

5.5 NATURAL ANTIBIOTICS

Natural products and their analogs continue to play a prominent role in medicine, accounting for two-thirds of new antibacterial therapies approved from 1980 to 2010 as well as several antibacterials currently in clinical trials. In the past 80

years numerous classes of natural product antibacterials have been discovered. The efficacy of natural products as antibacterial agents likely stems from the fact that they have been honed by evolutionary processes to be bioactive, thereby giving the producing organisms a selective advantage in the environment. Discovery and development of new antibacterial agents is undergoing a renaissance brought on by the confluence of diverse fields and expertise; and once again natural products are coming to the forefront [5].

5.6 NANOANTIBIOTICS

One of the recent struggles in addressing the challenge of resistance lies in exploring antimicrobial nanomaterials, to which microbial pathogens may not be able to develop resistance, and novel nanosized platforms for efficient antibiotics delivery [30].

All those nanomaterials, which possess their intrinsic antimicrobial activity or augment the overall efficacy and safety of enclosed or adsorbed antibiotics are termed “nano-antibiotics. This definition includes nano-carriers as well. Nano-carriers are drug vectors which retain and transport drug; deliver it within or in the vicinity of target. In general, nano-carriers may protect a drug from degradation, enhance drug absorption, modify pharmacokinetic and pharmacodynamics and improve intracellular penetration [31].

Bio-based nano-carrier systems (including liposomes, chitosan etc.,) [32] as drug delivery vehicle are replacing metallic NPs because of various advantages rendered by them being biodegradable, biocompatible, economical, easy to manufacture with minimal or no side effects [33].

Nanoparticles (NPs) can aid in overcoming existing drug resistance mechanisms, including decreased uptake and increased efflux of drug from the microbial cell, biofilm formation, and intracellular bacteria. In addition, NPs can target antimicrobial agents to the site of infection, so that higher doses of drug are given at the infected site, thereby overcoming resistance (Fig. 4).

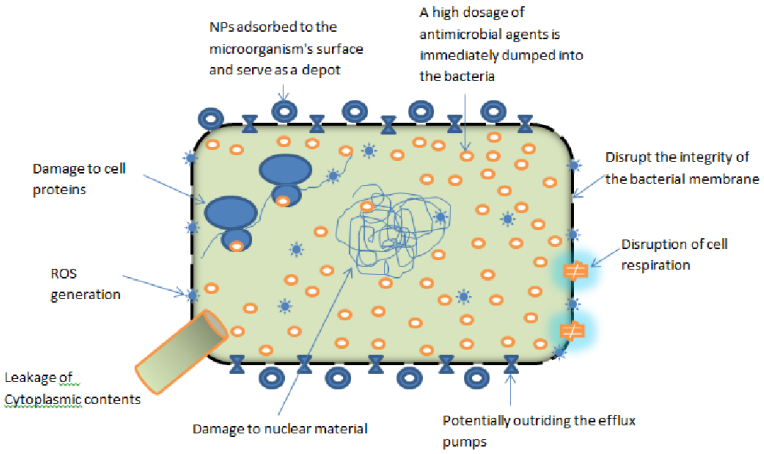

Fig. 4. Possible mechanism of action of nano antibiotics

Nanoparticles use multiple mechanisms of action simultaneously to combat microbes resulting in decreasing the likelihood of developing resistance to these NPs [34]-[35].

6 CONCLUSION

The recent emergence and spread of a novel carbapenemase, New Delhi Metallo β-lactamase (NDM) producing organisms are an example of that situation where available antibiotics are ineffective. This novel enzyme along with other antibiotic resistance factors is carried by mobile genetic elements such as plasmids or transposons. Horizontal gene transfer (HGT) is one of the most common mechanisms by which antibiotic resistance traits are transferred from one organism to another. It is imperative to find out quick method for the diagnosis of these MDR microbes. In particular, blaCTX-M, blaTEM, blaSHV, blaCMY, blaKPC, blaNDM, blaOXA-48, the 16S rRNA methylases genes and mutations in gyrA and parC are the most important targets that should be always tested for Ent [4].

In enterobacteriaceae, resistance is mainly caused by impaired intake of antibiotics by the microbial cells or by active efflux of these drugs by efflux pumps and by the activity of beta lactamases. Nonetheless, it can be overcome by reversing these resistance mechanisms. Consequently, in order to bypass the membrane barrier, we need to develop various strategies to increase the diffusion of antibiotics through bacterial membranes (target the influx), and we have to circumvent the pump mechanism to preserve a high intracellular concentration of antibiotics (target the efflux). Nano technology is a promising field that has lot of potential in many areas including medical field. Nano antibiotics could be an attractive alternative to conventional antibiotics in combating many resistance mechanisms. Likewise, the potential of natural products could be further explored to bulwark resistance menace.

One good thing for CRE infections is that normal healthy people cannot get it. It is usually associated with hospitals and other healthcare settings, where many type of resistance mechanisms prevail under one roof and CRE has the propensity to acquire these resistance mechanisms actively. Strict measurement should be taken to contain CRE and to avoid its spread to community.

REFERENCES

[1] K. K. Kumarasamy, M. A. Toleman, T. R Walsh, J. Bagaria, F. Butt, R. Balakrishnan, U. Chaudhary, M. Doumith, C. G. Giske, S. Irfan, P. Krishnan, A. V. Kumar, S. Maharjan, S. Mushtaq, T. Noorie, D. L. Paterson, A. Pearson, C. Perry, R. Pike, B. Rao, U. Ray, J. B. Sarma, M. Sharma, E. Sheridan, M. A. Thirunarayan, J. Turton, S. Upadhyay, M. Warner, W. Welfare, D. M. Livermore, N. Woodford, "Emergence of a new antibiotic resistance mechanism in India, Pakistan, and the UK: a molecular, biological, and epidemiological study", *Lancet Infect Dis*, vol. 10, pp. 597-602, 2010.

[2] L. K. Pickering, "Antimicrobial resistance among enteric pathogens", *Seminars in Pediatric Infectious Diseases,* vol, 15, pp. 71-77, 2004.

[3] D. L. Paterson, "Resistance in gram-negative bacteria: Enterobacteriaceae", *American journal of infection control*, vol, 34, S20-8; discussion S64-73, 2006.

[4] A. Lupo, K. M. Papp-Wallace, P. Sendi, R. A. Bonomo, A. Endimiani, "Non-phenotypic tests to detect and characterize antibiotic resistance mechanisms in Enterobacteriaceae" *Diagnostic microbiology and infectious disease,* vol. 77, pp 179-94, 2013.

[5] C. G. Bologa, O. Ursu, T. I. Oprea, C. E. Melancon, G. P. Tegos, "Emerging trends in the discovery of natural product antibacterials", *Current opinion in pharmacology,* vol. 13, pp. 678-87, 2013.

[6] P. K. Talukdar, M. Rahman, A. Nabi, Z. Islam, M. M. Hoque et al., "Antimicrobial resistance, virulence factors and genetic diversity of Escherichia coli isolates from household water supply in Dhaka, Bangladesh", *PloS one*, vol. 8 , e61090, 2013.

[7] E. M. H. Wellington, A. B. A. Boxall, P. Cross, E. J. Feil, W. H. Gaze, P. M. Hawkey, et al., "The role of the natural environment in the emergence of antibiotic resistance in Gram-negative bacteria", *The Lancet Infectious Diseases*, vol. 13, pp. 155-65, 2013.

[8] M. S. Butler, M. A. Blaskovich and M. A. Cooper, "Antibiotics in the clinical pipeline in 2013", *The Journal of Antibiotics*, vol. 66, pp. 571-591, 2013.

[9] R. Laxminarayan, A. Duse, C. Wattal, A. K. M. Zaidi, H. F. L. Wertheim, N. Sumpradit, E. Vlieghe, G. L. Hara, I. M. Gould, H. Goossens, C. Greko, A. D. So, M. Bigdeli, G. Tomson, W. Woodhouse, E. Ombaka, A. Q. Peralta, F. N. Qamar, F. Mir, S. Kariuki, Z. A. Bhutta, A. Coates, R. Bergstrom, G. D. Wright, E. D. Brown, O. Cars, "Antibiotic resistance—the need for global solutions", *Lancet Infect Dis,* vol. 13, pp. 1057–98, 2013.

[10] P. Nordmann, L. Dortet, L. Poirel, "Carbapenem resistance in Enterobacteriaceae: here is the storm", *Trends in molecular medicine*, vol. 18, pp. 263-72, 2012.

[11] E. Stürenburg and D. Mack, "Extended-spectrum β-lactamases: implications for the clinical microbiology laboratory, therapy, and infection control", *Journal of Infection*, vol. 47, pp. 273-95, 2003.

[12] J. M. Bolla, S. Alibert-Franco, J. Handzlik, J. Chevalier, A. Mahamoud, G. Boyer, et al., "Strategies for bypassing the membrane barrier in multidrug resistant Gram-negative bacteria", *FEBS letters*, vol. 585, pp. 1682-90, 2011.

[13] J. M. Pages and L. Amaral, "Mechanisms of drug efflux and strategies to combat them: challenging the efflux pump of Gram-negative bacteria", *Biochim Biophys Acta*, vol. 1794, pp. 826-833, 2009.

[14] B. Marquez, "Bacterial efflux systems and efflux pumps inhibitors", *Biochimie*, vol. 87, pp. 1137-1147, 2005.

[15] M. Babic, A. M. Hujer and R. A. Bonomo, "What's new in antibiotic resistance? Focus on beta-lactamases", *Drug resistance updates : reviews and commentaries in antimicrobial and anticancer chemotherapy*, vol. 9, pp. 142-56, 2006.

[16] K. Bush and G. A. Jacoby, "Updated functional classification of beta-lactamases", *Antimicrobial agents and chemotherapy*, vol. 54, pp. 969-76, 2010.

[17] F. Perez, A. Endimiani, K. M. Hujer, and R. A. Bonomo, "The continuing challenge of ESBLs", *Curr Opin Pharmacol*, vol. 7, no. 5, pp. 459–469, 2007.
[18] J. D. D Pitout and K. B. Laupland, "Extended-spectrum β-lactamase-producing Enterobacteriaceae: an emerging public-health concern", *The Lancet Infectious Diseases*, vol. 8, pp 159-66, 2008.
[19] B. Al-Assil, M. Mahfoud and A. R. Hamzeh, "Resistance trends and risk factors of extended spectrum beta-lactamases in Escherichia coli infections in Aleppo, Syria", *American journal of infection control*, vol. 41, pp. 597-600, 2013.
[20] G. Peirano and J. D. D. Pitout, "Molecular epidemiology of Escherichia coli producing CTX-M _-lactamases: the worldwide emergence of clone ST131 O25:H4", *International Journal of Antimicrobial Agents*, vol. 35, pp. 316–321, 2010.
[21] L. J. V. Piddock, "The crisis of no new antibiotics—what is the way forward?", *Lancet Infect Dis*, vol. 12, pp. 249-53, 2012.
[22] D. Jabes D, "The antibiotic R&D pipeline: an update", *Current opinion in microbiology*, vol. 14, pp. 564-9, 2011.
[23] K. K. Kumarasamy, M. A. Toleman, T. R. Walsh, J. Bagaria, F. Butt, R. Balakrishnan , U. Chaudhary, M. Doumith, C. G. Giske, S. Irfan, P. Krishnan, A. V. Kumar, S. Maharjan, S. Mushtaq, T. Noorie, D. L. Paterson, A. Pearson, C. Perry, R. Pike, B. Rao, U. Ray, J. B. Sarma , M. Sharma, E. Sheridan, M. A. Thirunarayan, J. Turton, S. Upadhyay, M. Warner, W. Welfare , D. M. Livermore and N. Woodford, "Emergence of a new antibiotic resistance mechanism in India, Pakistan, and the UK: a molecular, biological, and epidemiological study", *Lancet Infect Dis*, vol. 10, no. 9, pp. 597-602, 2010.
[24] G. Bushnell, F. Mitrani-Gold and L. M. Mundy, "Emergence of New Delhi metallo-b-lactamase type 1-producing Enterobacteriaceae and non-Enterobacteriaceae: global case detection and bacterial surveillance", *International Journal of Infectious Diseases*, vol. 17 pp. e325–e333, 2013.
[25] K. M. Day, S. Ali, I. A. Mirza, H. E. Sidjabat, A. Silvey, V. C. Lanyon, S. P. Cummings, S. A. Abbasi, M. W. Raza, D. L. Paterson, et al., "Prevalence and molecular characterization of Enterobacteriaceae producing NDM-1 carbapenemase at a military hospital in Pakistan and evaluation of two chromogenic media", *Diagnostic Microbiology and Infectious Disease*, vol. 75, no. 2, pp. 187-191, 2013.
[26] J. D. Perry, S. H. Naqvi, I. A. Mirza, S. A. Alizai, A. Hussain, S. Ghirardi, S. Orenga , K. Wilkinson, N. Woodford, J. Zhang, D. M. Livermore, S. A. Abbasi and M. W. Raza, "Prevalence of faecal carriage of Enterobacteriaceae with NDM-1 carbapenemase at military hospitals in Pakistan, and evaluation of two chromogenic media", *J Antimicrob Chemother*, vol. 66, no. 10, pp. 2288-94, 2011.
[27] F. Nahid, A. A. Khan, S. Rehman and R. Zahra, "Prevalence of metallo-beta-lactamase NDM-1-producing multi-drug resistant bacteria at two Pakistani hospitals and implications for public health", *Journal of infection and public health*, vol. 6, pp. 487-93, 2013.
[28] M. Martins, S. G. Dastidar, S. Fanning, J. E. Kristiansen, J. Molnar, J. M. Pages, Z. Schelz , G. Spengler, M. Viveiros and L. Amaral L, "Potential role of non-antibiotics (helper compounds) in the treatment of multidrug-resistant Gram-negative infections: mechanisms for their direct and indirect activities", *Int J Antimicrob Agents*, vol. 31, pp. 198-208, 2008.
[29] C. Kourtesi, A. R. Ball, Y. Y. Huang, S. M. Jachak, D. M. Vera, P. Khondkar, S. Gibbons , M. R. Hamblin and G. P. Tegos, "Microbial efflux systems and inhibitors: approaches to drug discovery and the challenge of clinical implementation, *Open Microbiol J*, vol. 7, pp. 34-52, 2013.
[30] R. Y. Pelgrift and A. J. Friedman, "Nanotechnology as a therapeutic tool to combat microbial resistance", *Advanced Drug Delivery Reviews*, vol. 65, pp. 1803-1815, 2013.
[31] A. J. Thorley and T. D. Tetley, "New perspectives in nanomedicine", *Pharmacol Ther*, vol. 140, no. 2, pp. 176-185, 2013.
[32] A. Muñoz-Bonilla, M. Fernández-García, "Polymeric materials with antimicrobial activity", *Progress in Polymer Science*, vol. 37, pp. 281-339, 2012.
[33] A. Kumari, S. K. Yadav and S. C. Yadav, "Biodegradable polymeric nanoparticles based drug delivery systems", *Colloids Surf B Biointerfaces*, vol. 75, pp. 1-18, 2010.
[34] A. J. Huh and Y. J. Kwon, "Nanoantibiotics: A new paradigm for treating infectious diseases using nanomaterials in the antibiotics resistant era", *Journal of Controlled Release*, vol. 156, pp. 128-145, 2011.
[35] M. J. Hajipour, K. M. Fromm, A. Ashkarran, J. Aberasturi D, I. R. Larramendi, T. Rojo, V. Serpooshan, W. J. Parak and M. Mahmoudi, "Antibacterial properties of nanoparticles", *Trends in Biotechnology*, vol. 30, pp. 499-511, 2012.

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A Natural Language Retrieval System, Natural Language Interface to Data Warehouse (NLI to DWH)

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ABSTRACT: The Data Warehouse is the advanced form of the database which is used for decision-making by the executives. There are several front-end tools for data warehouse available to support decision making. These tools come under the categories such as OLAP, Data Mining and Enterprise Information System etc. The common thing in using these tools is to have knowledge about the schema. The users of decision-making systems are top management or executives who are normally non-technical having less knowledge of the data warehouse schema and about writing database technical queries. Therefore, Natural Language (NL) interface can facilitate the executives in their decision-making process. The users prefer to have an easy querying tool that free them from technicalities of back-end processes and let them focus on desired results.
This motivated us to develop a natural language retrieval system (Natural Language Interface to Data Warehouse) that supports users especially in the ad-hoc query development. Using this system, non-technical users can easily write any ad-hoc information need in their native language. Users without having the knowledge about back-end query processing and schema can retrieve any information they want that is available in Data Warehouse. As a result, the complexity and time is reduced as well as dependency is removed.

KEYWORDS: Business Intelligence, Decision Making, Retrieval, Query, Schema.

1 INTRODUCTION

A data warehouse is a subject oriented, non volatile, integrated and time variant collection of data used in support of management's decision making process and business intelligence [1]. It is the collection of different heterogeneous data bases. A multidimensional model will be very helpful for Executives, Business Analysts and Managers to know all dimensions for good and effective decision making. Top management may not be technically expert in order to assist top management for effective and better decision making there is a need of natural language interface to data warehouse. There are several front-end tools for data warehouse available to support decision making. The common issue in using all front-end tools is that user must have knowledge about schema and technical queries. Where the process of decision making is performed by managers, business analyst or executives and all these have little technical knowledge. The users prefer to have an easy querying tool that free them from technicalities of back-end processes and let them focus on desired results.

Considering the above scenario our intention in this work is to build a natural language interface to support non-technical users unlike other Business Intelligence (BI) tools that mostly focus on expert users so that we develop and design a system name as Natural Language Interface to Data Warehouse (NLI to DWH) which has some goals to achieve. The main goal is to assist Top Management by providing a natural language interface for data warehouse for easy and efficient querying as well as effective decision making. There are some other goals of developing the system and these are

- A system which can be used with minor domain knowledge
- Support in ad-hoc query with simplicity
- Provide broad scope of analysis
- Reduce dependence of I.T staff

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2 LITERATURE REVIEW

Data Warehouse provides an effective way for analysis and statistic to the mass data, and helps to do the decision-making. Data Warehouse integrates several types of operational or external sources to provide multidimensional analysis of data. For decision purposes, multidimensional model plays a key role in data warehousing. Better understanding of multidimensional data of an organization could be very beneficial for a businessman or executives. It is also good for an organization that their executives, business analyst and managers to know about all dimensions of enterprise to take effective, good and fast decisions.

The Natural Language Interfaces to Databases (NLIDB) [2] facilitate users to write their request in natural language rather than technical database query language. Several NLIDBs have been developed. There are very few Natural Language Interfaces has been develop till know. One of them was developed with XML database [3]. Some interfaces are question answer based [4], [5] and some of the Natural Language Interfaces are domain specific that are made especially for that domain [6], [7], [8]. Multidimensional models from an implemented data warehouse can be generated by reverse engineering process [9]. The experiments proved that the approach has been successfully reverse engineered the data warehouse.

3 DEMONSTRATION OF THE SYSTEM (NLI TO DWH)

The system is design and develop provide a Natural Language Interface to Data Warehouse. This interface helps the users to query in natural language. A user query in natural language and the results display after searching for relevant context from data warehouse. When user query at run time it will break the query into parts and each part is checked against schema objects.

To develop Natural language Interface to Data Warehouse system the C#.Net and Crystal Reports used with SQL Server 2008 database. General architecture of the system is given below. System architecture is shown in Figure 1.

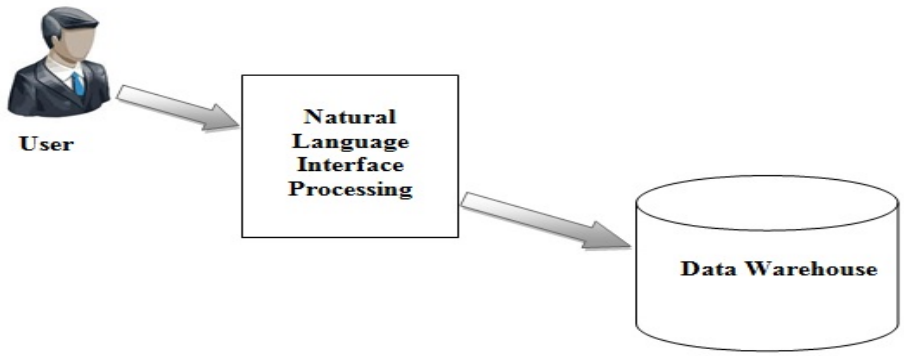

Fig. 1. System Architecture

The system provides ability to choose from two search techniques (search online or search offline) to its users. When a user has selected an option the progress bar shows the current state of system. Synonyms generated for all objects which will help for mapping the query [10], because user is free to query in natural language and can use any synonyms of any word. User can generate the synonyms of objects in both searching techniques (search offline and search online). Front end of Natural Language Interface to Data Warehouse is shown in Figure 2.

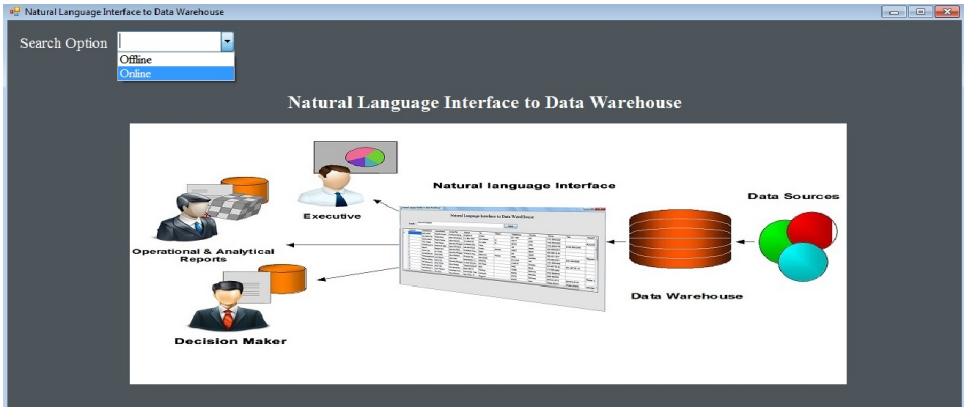

Fig. 2. Natural Language Interface to Data Warehouse

3.1 SEARCH OPTION

This system provides the ability to the users to choose any search option from online search or offline search. After choosing any of the above option users is provided an easy interface to make selection of searching.

3.1.1 OFFLINE SEARCH OPTION

The offline search option provides the ability to search results from XML file. In Offline Search system will map user's natural language query with the XML file objects and find out the results. User can generate the XML file of a database on clicking "Generate XML file" button in offline search. A message will be shown to user when XML file generated successfully. Offline Search Option is shown in Figure 3.

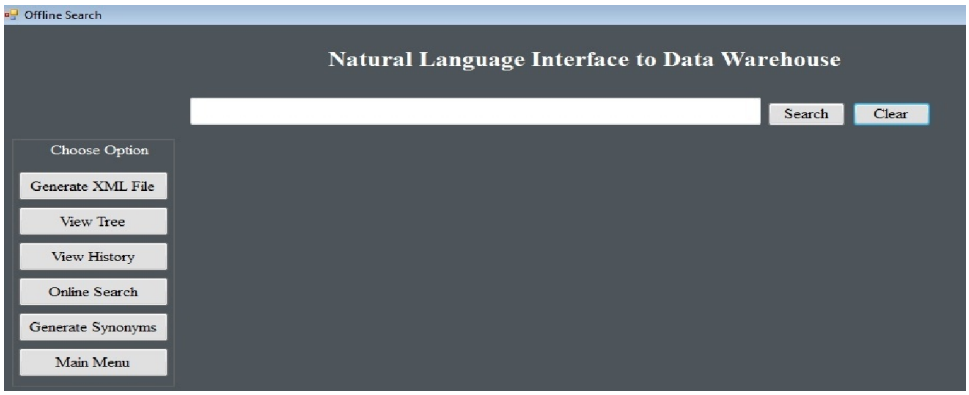

Fig. 3. Offline Search Option

Search offline will have the above dash board for user with features of

- Generate XML file
- View Tree
- View History
- Redirect to Online Search
- Generate Synonyms
- Redirect to main View

3.1.2 ONLINE SEARCH OPTION

The online search option provides the ability to search desired results from Database. In Online Search system will map user's natural language query with the Database schema objects and find out the results. User can generate the schema tree

of a database on clicking “View Tree” button in online search. Schema tree will be shown to user. Online Search Option is shown in Figure 4.

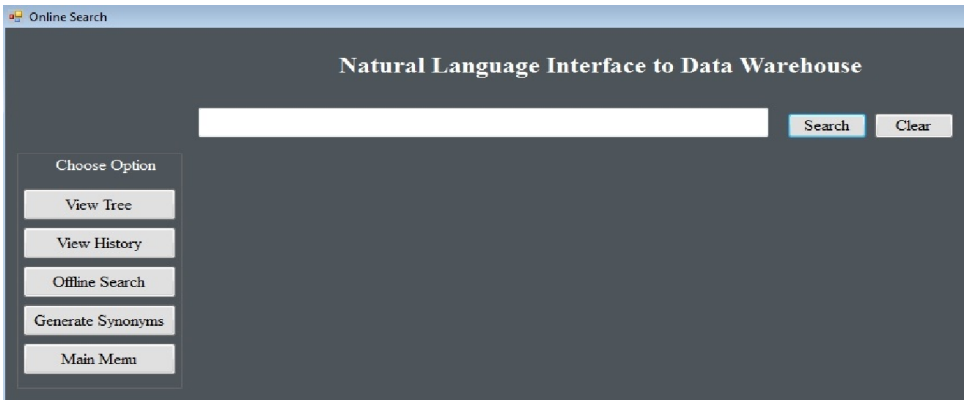

Fig. 4. Online Search Option

Search online will have the above dash board for user with features of

- View Tree
- View History
- Redirect to Offline Search
- Generate Synonyms
- Redirect to main View

3.2 NATURAL LANGUAGE INTERFACE FOR SEARCHING

User will write any query in natural language (without any syntax) and system will show the desired results e.g. “show me details about categories”.

User can also write any query in native language whether user wants to search selected results or any other results. User can query anything from available data according to need e.g. “Show me details about categoryid=1 from products”. NLI searching window is shown in Figure 5.

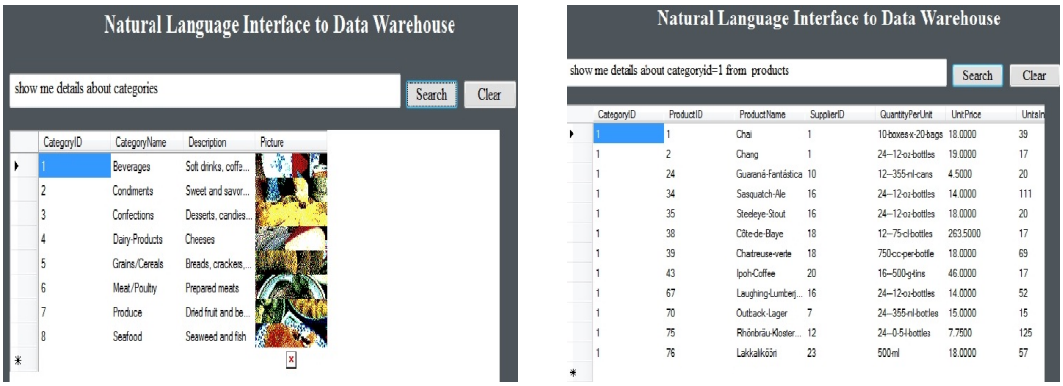

Fig. 5. NLI for Searching

3.3 GENERATE SYNONYMS OF DATABASE OBJECTS

Synonyms generated for all database objects which will help for mapping the query to Database, because user is free to query in natural language and can use any synonyms. Synonyms will be generated and stored in dictionary. Mapping of query to Database objects. User can generate the synonyms of objects in both searching techniques (search offline and search online). Synonyms generated for all objects which will help for mapping the query, because user is free to query in natural language and can use any synonyms of any word. Generate Synonyms window is shown in Figure 6.

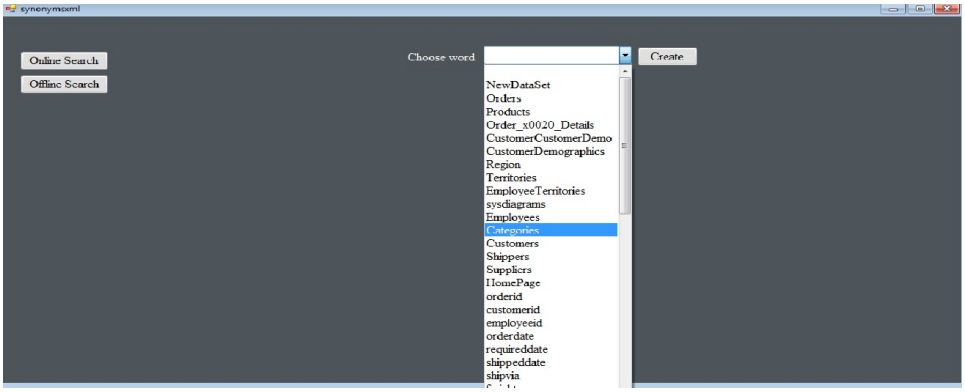

Fig. 6. Generate Synonyms

3.4 INTELLISENSE OPTION (SUGGESTIONS)

When user writes any word into query box system will show all the suggestions matching with that word existing in the form of objects in available data so that user can easily and accurately write the query and also helps in saving time. System's IntelliSense menu (suggestions pop-up) also focuses on retrieving the desired results for users with providing the time saving facility. IntelliSense Option (suggestion) window is shown in Figure 7.

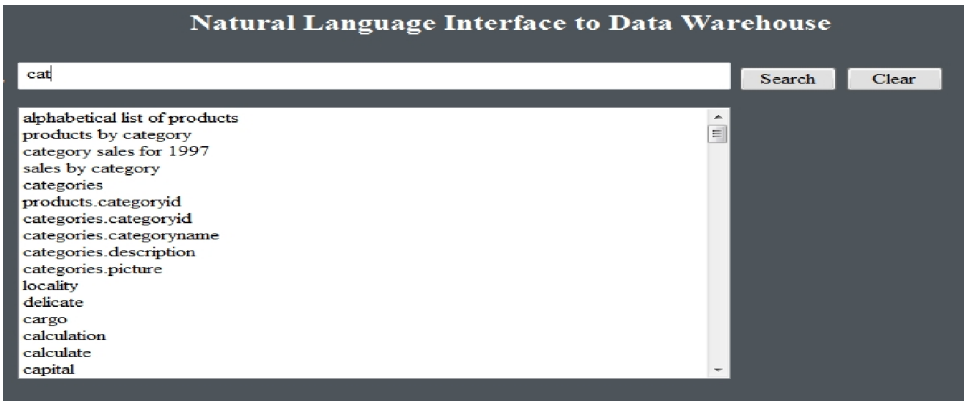

Fig. 7. Suggestions

3.5 RANKING MULTIPLE INTERPRETATIONS

When user searches for the data by writing a natural language query that exist in more than one tables system will automatically map all the existing results for user query and allowing the user to choose their desired results e.g. User searches "show me details of productid=1" if this information exists in 2 different tables system will show all the available options that contain this data so that user can view desired results. Ranking Multiple Interpretations shown in Figure 8.

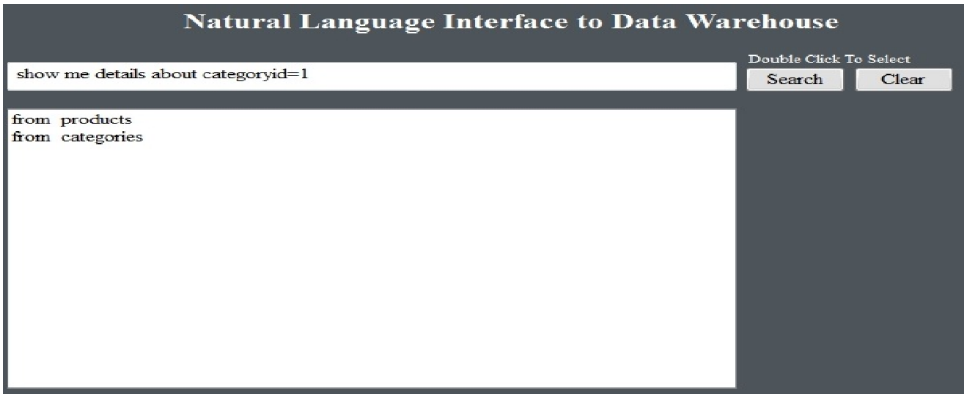

Fig. 8. Ranking Multiple Interpretations

3.6 GROUP BY FUNCTION

System facilitates the user by helping them in setting parameters of query for more efficient search e.g. user viewing the results of total units in stock system will give them facility of viewing this result against all parameters of (productid, product name etc). The system also shows results to user for the query in a well formatted structure that is easily understandable to user. Group by Function is shown in Figure 9.

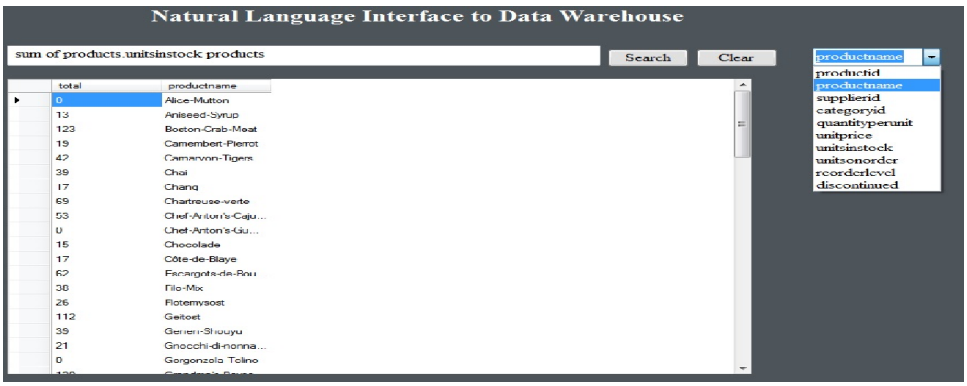

Fig. 9. Group by Function

3.7 DECISION SUPPORT SYSTEM

System is a dully decision support system e.g. user in a situation wants to see the details of products who are not available in stock user can simply write “show details about products having unitsinstock=0”. Decision Support System window is shown in Figure 10.

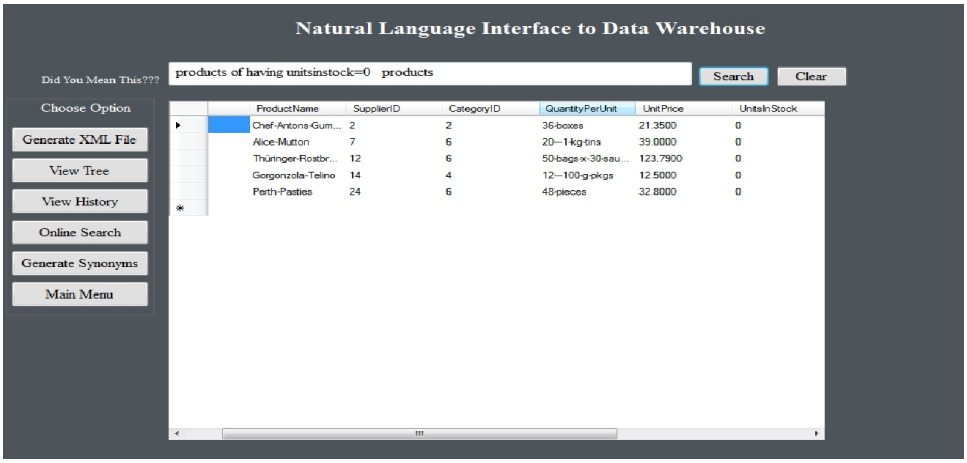

Fig. 10. Decision Support System

4 LIMITATIONS

The system has some limitations and these limitations can be addressed in future to enhance our Natural Language Interface to Data warehouse system. The limitations are

- Search is pop-up based suggestion list
- System Interface shows resultant data only in tabular format
- Dashboard menu has limited facilities for end user
- To attach another data warehouse change in connection string is necessary and to remove the spaces between data value
- Results against the user searched query is populated in grid view only

5 CONCLUSION

The expected output from the system was providing a Natural Language Interface to Data Warehouse (NLI to DWH) so that users with little technical knowledge can easily retrieve desired results and the system achieved the expected output efficiently and conveniently. By using this system User will query to data warehouse through a natural language interface. User can retrieve any desired results he/she want to know about data. User can query to data warehouse whether he/she is not awarded of schema. Decision makers (non-technical users) can easily write any ad-hoc information need in their native language.

REFERENCES

[1] W.H. Inmon "Building the Data Warehouse. 1st Edition." Wiley and Sons, 1992.

[2] Umair Shafique and Haseeb Qaiser, "A Comprehensive Study on Natural Language Processing and Natural Language Interface to Databases," International Journal of Innovation and Scientific Research, vol. 9, no. 2, pp. 297–306, September 2014.

[3] Li, Y., Yang, H., Jagadish, H.V. "Nalix: an interactive natural language interface for querying xml", SIGMOD '05: Proceedings of the 2005 ACM SIGMOD international conference on Management of data, 2005.

[4] Woods, W., Kaplan, R. and Webber, B. "The Lunar Sciences Natural Language Information System" Bolt Beranek and Newman Inc., Cambridge, Massachusetts Final Report. B. B. N. Report No 2378, 1972.

[5] R.J.H., Scha, "Philips Question Answering System PHILIQA1", In SIGART Newsletter, no.61. ACM, New York, February 1977.

[6] Hendrix, G., Sacrdoti, E., Sagalowicz, D. and Slocum, J. "Developing a natural language interface to complex data". ACM Transactions on Database Systems, Volume 3, No. 2, USA, Pages 105 – 147, 1978.

[7] David L. Waltz, "An English Language Question Answering System for a Large Relational Database", Communications of The ACM, Volume 21, July 1978.

[8] Ana-maria Popescu , Alex Armanasu , Oren Etzioni , David Ko and Alexander Yates, "Modern natural language interfaces to databases: Composing statistical parsing with semantic tractability", COLING '04 Proceedings of the 20th international conference on Computational Linguistics Article No. 141, 2004.

[9] Hausi A. Müller, Jens H. Jahnke, Dennis B. Smith, Margaret-Anne Storey, Scott R. Tilley and Kenny Wong, "Reverse Engineering: A Roadmap" ICSE '00 Proceedings of the Conference on The Future of Software Engineering Pages 47-60 ACM New York, NY, USA, 2000.

[10] Renée J. Miller, Laura M. Haas and Mauricio A. Hernández "Schema Mapping as Query Discovery", VLDB '00 Proceedings of the 26th International Conference on Very Large Data Bases, Morgan Kaufmann Publishers Inc. San Francisco, CA, USA, Pages 77-88, 2000.

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Etude Comparative des Instruments Juridiques de la RD Congo, du Cameroun et du Congo-Brazza sur la Production des Emballages Non-Biodégradables

[Comparative study of legal instruments of Democratic Republic of Congo, Cameroon and Congo Republic into the production of non-biodegradable package]

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ABSTRACT: This study is related to a cross reading of the legislation governing the waste processing in the Democratic republic of the Congo (DRC), the Cameroon and in Congo-Brazza. It is important to note that one concise inventory of the legal texts reveal that there is an innovation in the taking into account of the question related to the non biodegradable packing in these countries.

Thus, notwithstanding the relevant provisions relating to environmental protection envisaged in the legal and regulatory texts, the African cities in fact the megalopolis of Kinshasa in Congo and that of Yaoundé in Cameroon remain unhealthy. Moreover, the effective application of these texts remains a challenge for our controlling authorities whose means are limited. Thus, to attenuate the attacks against the environment, a mesologic education is required to be used as a tool in order to contribute to the cleansing of the environment in both countries under examination and in Africa in general.

KEYWORDS: legal text, production, package, no biodegradable, environment and dangerous waste.

RESUME: Au seuil de cette étude portant sur une lecture croisée de la législation régissant le traitement des déchets en République Démocratique du Congo (RDC), au Cameroun, il sied de noter qu'un inventaire lapidaire des textes légaux y afférents dénote d'une nouveauté dans la prise en compte de la question liée aux emballages non- biodégradables dans ces pays.

Ainsi, nonobstant les dispositions pertinentes relatives à la protection de l'environnement prévues dans les textes légaux et règlementaires, les villes africaines en l'occurrence la mégapole de Kinshasa au Congo, la Yaoundé au Cameroun et celle de Brazzaville demeurent insalubres. En outre, l'application effective de ces textes reste un défi pour nos gouvernants dont les moyens sont limités. Ainsi, pour atténuer les atteintes portées à l'environnement, il y a nécessité d'une éducation mésologique pour servir de creuset en vue de contribuer à l'assainissement de l'environnement dans les trois pays sous examen et en Afrique en général.

MOTS-CLEFS: Texte juridique, production, emballage, non biodégradable, environnement et déchets dangereux.

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1 INTRODUCTION

D'aucuns n'ignorent qu'au jour d'aujourd'hui, si l'Afrique est libérée du joug du colonialisme, la pauvreté et ses effets deviennent le lot quotidien qui asservissent les Africains. Cela va sans dire qu'une dégradation continue de l'environnement les plongera davantage dans cette pauvreté. Il nous est loisible de rappeler toutefois que la Conférence des Nations Unies, tenue à Stockholm, du 05 au 16 juin 1972 sur l'Environnement Humain, constitua une étape importante dans l'évolution du droit international de l'environnement tant elle donna lieu à l'instauration de plusieurs ministères chargés de la question de l'environnement en Afrique [1].

En effet, l'insalubrité constitue un des sérieux problèmes environnementaux auxquels sont confrontés les africains. La gestion des déchets aussi bien solides, liquides que gazeux, et particulièrement celle des emballages non- biodégradables constituent un sujet d'actualité. Cette catégorie des déchets a été inventoriée parmi les sources potentielles de gaz à effet de serre qui préoccupe les pouvoirs publics dans presque tous les Etats du monde et, singulièrement, dans les pays en développement où leur gestion demeure une préoccupation essentielle [2] [3]. A titre exemplatif, le protocole de Montréal, signé le 16 septembre 1987, qui vise à stopper les dégâts causés à la couche d'ozone, notamment, en interdisant l'usage des chlorofluorocarbures et d'autres gaz nocifs pour la couche d'ozone [4]. Depuis 1989, le commerce des déchets est réglementé par la convention de Bâle, qui interdit l'exportation des déchets des pays développés vers les pays en voie de développement pour échapper aux réglementations locales [5]. Le dernier sommet mondial important a été le sommet de Copenhague en décembre 2009, dont le bilan est mitigé mais qui avait entamé la préparation de l'après-Kyoto, et essayé de lui donner un nouveau souffle en décidant des engagements chiffrés en matière de réduction des émissions de gaz à effet de serre [6].

S'agissant de la RDC, du Cameroun et du Congo Brazza, ils n'échappent pas à cette triste réalité étant donné qu'ils sont dépourvus des vrais programmes d'assainissement adaptés au développement industriel et à l'assainissement du moment. Malgré quelques efforts consentis à travers leurs ministères de l'environnement au travers certains programmes, ces pays n'arrivent pas à gérer correctement les déchets générés faute d'une organisation adéquate et d'une mise en œuvre des textes légaux.

Le but de cette étude est d'inventorier les textes sur le droit de l'environnement dans les pays sous examen et d'en mesurer le degré de leur d'application. Plusieurs lois en vigueur ont été répertoriées dans ces pays en vue d'une vulgarisation beaucoup plus importante de manière à permettre aux populations de connaître leurs droits et devoirs dans le domaine du droit de l'environnement.

Il sied de relever que la Déclaration de Stockholm sur l'environnement a énoncé un certain nombre de principes dont le premier consacre le droit de l'homme à un environnement de qualité et en contrepartie impose, le devoir solennel de protéger et d'améliorer l'environnement.

Pour mener à bon port cette étude nous allons devoir effectuer une analyse comparative des textes en matière de protection de l'environnement entre la RDCongo, le Cameroun et le Congo Brazza pour déceler ceux qui traitent de la question des emballages non- biodégradables. Pour cela, nous structurons cette étude autour de deux principes axes de considération. Au premier, nous circonscrivons les contours du concept emballage non biodégradable. Au deuxième, nous présentons notre milieu d'enquête, le matériel ainsi que les méthodes. Il va de soi que commencée par cette brève introduction, nous clôturerons cette réflexion par une conclusion.

2 CLARIFICATION DU CONCEPT EMBALLAGE NON BIODEGRADABLE ET SES PROPRIETES PHYSICO-MECANIQUES [7]

2.1 ASPECT DEFINITIONNEL

L'homme, de par ses habitudes quotidiennes de consommation, use de produits ou d'objets dont la composition est faite parfois de matières non-dégradables. En effet, celles-ci sont des polymères qui sortent des unités de fabrication généralement inutilisables tels quels. Tous contiennent des impuretés qui proviennent de leur synthèse (traces de produits n'ayant pas réagi, catalyseurs, solvants). Ces corps peuvent à la longue, subir des dégradations sous l'influence de l'oxygène, des eaux souterraines, des acides, etc., et conduire à une détérioration du polymère. Il est indispensable d'incorporer à la résine un certain nombre de produits tels que : des **lubrifiants** (savons, cires, etc. destinés à faciliter les opérations de moulage ou extrusion) ; des **stabilisants** (sels organiques de métaux, comme le plomb, le baryum, l'étain, le cadmium, le sodium, le cobalt, etc. dont le rôle est d'empêcher les dégradations chimiques de la matière plastique ; des **plastifiants** (qui sont souvent des substances visqueuses, dont l'insertion entre les chaînes macromoléculaires assure entre elles « un certain jeu », donc une certaine souplesse) ; enfin des **charges** (faites de matériaux très divers, comme des fibres de verre coupées,

de la farine de bois, du talc, de l'amiante, des tissus hachés, etc. Ces charges qui peuvent représenter 50% de la masse, sont destinées principalement aux résines thermodurcissables afin d'en améliorer les propriétés mécaniques.

2.2 GRANDES FAMILLES DE PLASTIQUES

L'utilisation des matières plastiques pour la fabrication de certains objets ont été rendu possible qu'au terme d'études systématiques mettant à l'épreuve leurs propriétés thermoplastiques et thermodurcissables. Ainsi, on peut citer :

2.2.1 THERMOPLASTIQUES

- **Polyoléfines**

Ces polymères, obtenus par polymérisation de certains alcènes ou oléfines, sont utilisés comme : [**emballages** : sacs, films, corps creux (flacons, bouteille, biberons, bonbonnes, citernes), capsules, bacs de manutention et casiers à bouteilles ; **articles divers** : cuvettes, seaux, brocs, jouets ; **isolation de câbles** ; **filaments pour cordages, non tissés, papier**].

- **Vinyliques**

Ce sont des polymères du genre [**bouteilles** : (eau minérale, vin, huile, vinaigre, etc.) ; **tuyaux rigides :** irrigation, drainage et évacuation des eaux, souples (arrosage) ; **bâtiment** : fenêtres, huisseries, plinthes, rampes d'escalier, gouttières ; **revêtements de sols** (dalles, tapis) et de murs (papiers et tissus enduits) ; **peintures** ; **isolation électrique** ; **similicuir** (sacs et valises, chaussures, ameublement, sellerie d'automobile) ; **semelles, bottes et sandales** ; **jouets gonflables** ; **disques**].

- **Styréniques**

Il s'agit de : [**automobiles : (**tableaux de bord, poignées, entourages de vitres, accoudoirs, grilles de conditionnement d'air); **électroménager :** (corps d'aspirateurs, cuves et portes de réfrigérateurs, cartes de mixers, **équipement de bureau** ; **télévision et radio** : (boîtiers de transistors et de T.V., grilles de haut-parleur) ; **boîtes et coffrets isothermes**]

- **Polyuréthanes**

On peut citer : [**mousses pour sièges et literie, garnitures d'automobile** ; **pare-chocs** ; **semelle expansée et chaussures de ski**; **peintures**].

- **Acryliques**

Ces polymères sont : [**vitrage**, **verres de lunettes** ; **fibres synthétiques** ; **peintures**].

- **Polyamides**

On peut citer : [**textiles artificiels** ; **pièces mécaniques** : (engrenages, soupapes, joints, etc.) ; **pièces pour l'industrie électrique** : (isolants moulés, contacteurs, fiches, etc.) ; **articles de bureau** : tabletterie, boîtes].

- **Cellulosiques**

On peut citer : [**accessoires d'ameublement** : (poignées, boutons, etc.); **brosserie et coutellerie** : (manches); **lunetterie**; **films photographiques**].

2.2.2 THERMODURCISSABLES

- **Aminoplastes**

Colles pour contre-plaqué et panneaux de particules, stratifiés décoratifs, peintures.

- **Phénoplastes**

Isolation, queues de casse-roles, etc.

- **Polyesters**

Ce sont des polymères comme [**fibres textiles; boutons; vernis pour meubles; tiroirs**]. Avec **fibre en verre** : [**bateaux ; perches de saut ; cannes à pêche ; citernes routières et camions isothermes ; éléments de carrosserie**].

- **Epoxydes**

  Colles pour tous usages, revêtements

2.3 EFFETS SUR L'ENVIRONNEMENT

Les matières inventoriées ci-haut deviennent à leur tour des déchets, et ont des conséquences sur l'environnement, notamment :

- les matières non-dégradables en verre et en métaux portent le risque de blessure pour l'Homme (tessons de bouteilles, aiguilles, boîtes de conserves) ;
- les matières plastiques enfouis empêchent les racines des plantes de jouer pleinement leur rôle et par conséquent assurent la dégénérescence de celles-ci ;
- le plomb contenu dans le carburant pour vélomoteur, voiture et avion provoque des maladies respiratoires aux citadins ou se dépose sur les plantes (légumes, par exemple) que consomment les habitants de grandes agglomérations.

2.4 DECHETS DANGEREUX, QUID ? [8]

Pour être considéré comme **« déchet dangereux »**, le matériel (objet) doit d'abord être un déchet. Le déchet se définit comme quelque chose qui ne peut plus être utilisé selon ses intentions premières ou quelque chose qui est rejetée définitivement. Beaucoup d'industries génèrent des déchets toxiques ou dangereux, et ont les caractéristiques suivantes : de l'inflammabilité, de la corrosivité, de la réactivité et de la toxicité. En effet, en 1994, l'Union Européenne procéda à une reclassification des déchets dangereux, en vue d'une approche plus complète. L'U.E considère notamment comme pouvant présenter des risques (immédiats ou différés) tout déchet à caractère explosif, inflammable, irritant, nocif, toxique, cancérigène, corrosif, infectieux, tératogène ou mutagène. Voici les catégories de déchets classés par l'U.E comme « dangereux », définis par rapport à leur nature, à l'activité qui les a générés ou encore aux propriétés qui les rendent dangereux : certains déchets hospitaliers et cliniques ; les résines, latex, plastifiants, colles et adhésifs ; les résidus de l'incinération de déchets ménagers ; les résidus d'opérations d'élimination de déchets industriels ; les composés organophalogènes en générale, les déchets de traitement de surface de métaux ou de matières plastiques, etc.

3 MILIEU D'ETUDE, MATERIEL ET METHODES

3.1 PRESENTATION DU MILIEU D'ETUDE : LA REPUBLIQUE DEMOCRATIQUE DU CONGO, LE CAMEROUN ET LE CONGO BRAZZA

La République démocratique du Congo est un pays d'Afrique centrale. Sa capitale est Kinshasa. Le Congo est borné par la République du Congo à l'ouest, la République centrafricaine et le Soudan au nord, l'Ouganda, le Rwanda, le Burundi, la Tanzanie à l'est, la Zambie et l'Angola au sud.

Sa population est estimée à 68.008.922 habitants (2008) avec une densité globale moyenne de 30 habitants au Km^2. Les foyers de peuplements sont concentrés dans la région minière du Shaba et dans le Bas-Congo. Moins d'un tiers de la population vit dans les zones urbaines. En 2008, la natalité s'élevait à 42,50 % et celui de mortalité infantile à 64 %, l'espérance de vie atteignant 57, 6 ans [9].

Le Cameroun est aussi un pays d'Afrique centrale ouvert sur l'océan Atlantique. Sa capitale est Yaoundé. Pays membre du Commonwealth, le Cameroun est limité à l'ouest par le Nigeria, au nord-est par le Tchad, à l'est par la République centrafricaine, au sud par le Congo, le Gabon et la Guinée équatoriale.

En 2008, la population camerounaise était estimée à 18,5 millions d'habitants. Le taux de croissance annuel de la population atteint 2,22 %. En 2008, l'indice de fécondité demeure élevé (4,4 enfants par femme) tandis que le taux de mortalité infantile est de 65 % et l'espérance de vie à la naissance est de 53 ans [10].

La République du Congo, souvent connue sous l'appellation Congo-Brazzaville, est un pays d'Afrique centrale situé de part et d'autre de l'équateur et couvrant une superficie de 342.000 km^2, pour une population d'environ 4 millions d'habitants. Les pays limitrophes sont la République Centrafricaine et la République du Cameroun au nord, la République Démocratique du Congo au sud et à l'est, la République d'Angola (enclave du Cabinda) au sud, et la République du Gabon à l'ouest. La République du Congo possède une façade maritime de 170 km sur la côte atlantique [11].

3.2 MATERIEL ET METHODES

Notre réflexion portera sur ces trois pays. Le choix de ces derniers a été motivé par le fait qu'ils sont dans une situation similaire, la problématique du traitement des emballages non-biodégradables. Nous avons décortiqué les textes légaux qui cadrent avec la protection de l'environnement et la production des emballages non-biodégradables de ces trois pays. Des textes juridiques ont constitué dans ce contexte notre objet d'étude mais aussi notre matériel. La technique documentaire a consisté à parcourir la littérature consacrée aux questions de droit de l'environnement et cela nous a grandement aidé à inventorier les lois, les décrets, les articles relatifs à la gestion des déchets et, plus précisément, aux emballages non biodégradables. Ainsi, la méthode comparée est au centre de notre approche, celle-ci a permis de scruter à fond les instruments juridiques et de dégager une certaine analogie entre ceux de la R D Congo, ceux du Cameroun et ceux du Congo Brazza. En plus, au travers de l'approche diachronique, nous avons fait recours à l'évolution historique des textes juridiques sur la protection de l'environnement, et plus particulièrement aux emballages non-biodégradables. C'est pourquoi, ils sont listés des plus anciens aux récents.

4 RESULTATS

A travers ce point, nous présentons l'inventaire des textes pour les trois pays (RD Congo, Cameroun et Congo Brazza) en essayant de poser un diagnostic sérieux par rapport aux réalités environnementales des pays sous examen, lesquels sont suivis d'une comparaison en vue de dégager à la fois leurs convergences et leurs divergences.

4.1 TEXTES JURIDIQUES EN MATIERE DE PRODUCTION ET GESTION DES DECHETS AU CAMEROUN, EN RDCONGO ET AU CONGO BRAZZA

Par textes juridiques, nous entendons l'ensemble de règles de conduite qui, dans une société organisée, gouvernent les rapports des hommes entre eux et s'imposent à eux au besoin par le moyen de la contrainte sociale [12].Ces règles de droit sont essentiellement écrites et consignées dans les documents (journaux officiels, codes et d'autres instruments juridiques). De là, leur nom de "textes juridiques". Ces textes revêtent diverses appellations, à savoir : constitution, loi, ordonnance, arrêté, etc [2].

4.2 INVENTAIRE DES TEXTES JURIDIQUES

Ainsi que le relève Mavungu, parmi les textes juridiques les plus importants, en RDC, sur les déchets nous avons inventorié les principaux qui se présentent ainsi sous cet ordre :

1. Ordonnance du 24 avril 1899, créant commission d'hygiène dans chaque chef-lieu de district ;
2. Ordonnance n°127/6, du 15 juin 1913, relative au règlement général sur les constructions dans les circonscriptions urbaines ;
3. Ordonnance du 1er juillet 1914, relative à la pollution et à la contamination des sources, lacs, cours d'eau ;
4. Ordonnance du 10 mai 1929, créant dans chaque chef-lieu de province une direction technique des travaux d'hygiène ;
5. Décret du 06 mai 1952, concernant les servitudes relatives aux eaux souterraines, aux eaux des lacs et des cours d'eau ainsi qu'à leur usage ;
6. Ordonnance n°41/48, du 12 février 1953, relative aux établissements dangereux, insalubres et incommodes ;
7. Ordonnance n°62/181, du 25 avril 1958, fixant les conditions techniques auxquelles doivent répondre les véhicules affectées au transport des personnes ;
8. Ordonnance n°75/231, du 22 juillet 1975, fixant les attributions du département de l'Environnement, Conservation de la nature et Tourisme ;
9. Loi n°78-002, du 30 août 1978, portant nouveau code de route ;
10. Arrêté départemental n°014/DCNT/CCE/81, du 17 février 1981, portant création du Service National d'Assainissement ;
11. Ordonnance n°82/027 du 19 mars 1982 fixant le cadre organique des services publics de l'Etat en matière d'assainissement du milieu ;
12. Ordonnance n°87/331, du 16 septembre 1987, portant création de l'Office des Voiries et Drainages ;
13. Convention de Bâle sur le contrôle des mouvements transfrontaliers de déchets dangereux et leur élimination, Suisse (Bâle), 1989 ;
14. Arrêté n°SC/0034/BGV/COJU/CM/98, du 17 février 1998, portant application des mesures d'assainissement du milieu et de protection de la salubrité publique dans la ville de Kinshasa.
15. Convention-cadre sur le changement climatique, New-York, 1992 ;

16. Convention sur la protection et l'utilisation des cours d'eau transfrontaliers et des lacs internationaux, Finlande (Helsinki), 1992 ;
17. Ordonnance n°74/345, du 28 juin 19…relative à l'hygiène publique dans les agglomérations ;
18. Loi n°11/009, du 09 juillet 2011, portant principes fondamentaux relatifs à la protection de l'environnement.

Au regard du DECRET n°2012/2808/PM et n°2012/2809, du 26 septembre 2012 et de l'Arrêté conjoint n°005/MINEPDED/MINCOMMERCE, du 24 octobre 2012, les textes juridiques sur les déchets en vigueur au **Cameroun** sont nombreux et les plus importants sont:

1. Loi n°89/027, du décembre 1989, portant sur les déchets toxiques et dangereux ;
2. Loi n°94/01, du 20 janvier 1994, portant régime des forêts, de la faune et de la pêche ;
3. Loi n°96/03, du 04 janvier 1996, portant loi cadre dans le domaine de la santé ;
4. Loi n°96/12, du 5 août 1996, portant loi-cadre relative à la gestion de l'environnement ;
5. Loi n°96/117, du 05 août 1996, relative à la normalisation ;
6. Loi n°98/005, du 14 avril 1998, portant régime de l'eau ;
7. Loi n°98/015, du 14 juillet 1998, relative aux établissements classés dangereux, insalubres ou incommodes ;
8. Loi n°99/013, du 22 décembre 1999, portant code pétrolier ;
9. Loi n°001, du 16 avril 2001, portant code minier ;
10. Loi n°2001/015, du 23 juillet 2001, régissant l'activité du transporteur routier et d'auxiliaire de transport routier ;
11. Loi n°2002/013, du 30 décembre 2002, portant code gazier ;
12. Loi n°2003/003, du 21 avril 2003, portant protection phytosanitaire ;
13. Loi n°2003/006, du 21 avril 2003, portant régime de sécurité en matière de biotechnologie moderne au Cameroun ;
14. Loi n°2004/018, du 22 juillet 2004, fixant les règles applicables aux communes ;
15. Loi-cadre n°2011/012, du 06 mai 2011, portant protection du consommateur au Cameroun ;
16. Décret n°2011/2581/PM, du 23 août 2011, portant règlementation des substances chimiques nocives et/ou dangereuses.

Vu la demande introduite par la délégation générale des grands travaux en date du 18 mai 2009 ; A l'issue, de l'autorisation provisoire n°084/MTE/CAB/DGE du 22 mai 2009 portant réalisation du projet d'aménagement et de bitumage de la route Ketta-Sembé-Souanké-Ntam-Frontière du Cameroun, le Ministre du Tourisme et de l'Environnement du Congo Brazza fait mention sur les instruments juridiques, il s'agit de :

1. Arrêté n° 3772, du 12 août 1972, fixant les périodes dû chasse en République du Congo;
2. Arrêté n° 0103, du 30 janvier 1984, fixant les dispositions relatives à l'exportation des produits de la faune et la flore sauvages;
3. Arrêté n° 3863, du 18 mai 1984, déterminant les animaux intégralement et partiellement protégés prévus par la loi n° 48/83, du 21 avril 1983, définissant les conditions de conservation et de l'exploitation de la faune sauvage;
4. Décret n° 85/879, du 6 juillet 1985, portant application de la loi n° 48/83 du 21 avril 1983 définissant les conditions de conservation et d'exploitation de la faune sauvage;
5. Décret n° 86/775, du 7 juin 1986, rendant obligatoire les études d'impact sur l'environnement;
6. Loi n° 003/91, du 23 avril 1991, sur la protection de l'environnement;
7. Arrêté n° 3282 MEFPE-DFF, du 18 novembre 1991, portant protection absolue de l'éléphant sur toute l'étendue du territoire de la République du Congo;
8. Décret n° 98-148, du 12 mai 1998, portant organisation et fonctionnement de la direction générale de l'environnement;
9. Décret n° 99-149, du 22 août 1999, portant organisation et fonctionnement du fonds pour la protection de l'environnement;
10. Arrêté n° 835/MIME/DGE, du 6 septembre 1999, fixant les conditions d'agrément pour la réalisation des études ou des évaluations d'impact sur l'environnement;
11. Décret n° 2007-615, du 30 décembre 2007, portant nomination des membres du gouvernement;
12. Décret n° 2008-306, du 5 août 2008, portant organisation et attributions du ministère du tourisme et de l'environnement;
13. Décret n" 2008-307, du 5 août 2008, portant attributions et organisation de l'inspection générale du tourisme, de l'hôtellerie et de l'environnement;
14. Loi n° 37/2008, du 28 novembre 2008, sur la faune et les aires protégées;

A la lumière de la comparaison de ces inventaires de textes juridiques sur l'environnement des pays précités, il se dégage que les pouvoirs publics ne prennent pas encore en compte la question relative aux emballages non biodégradables.

Outre, les manquements afférents aux textes ci-haut listés, ils demeurent quand même d'application dans le contexte de chaque pays pour la protection et la gestion de l'environnement. Ceux de la R.D.Congo paraissent trop anciens par rapport à ceux du Cameroun. Et, jusqu'ici, le législateur congolais (RDCongo) a essayé d'actualiser ces derniers à travers la Loi n°11/009, du 09 juillet 2011, portant principes fondamentaux relatifs à la protection de l'environnement. A savoir, le chapitre six de cette présente loi traite de la prévention des risques et la lutte contre les pollutions et nuisances. Il contient aussi six sections dont la troisième concerne la gestion des produits chimiques et la quatrième traite de la gestion des déchets, mais, nulle part ce chapitre traite des emballages non- biodégradables.

A l'issue de ce constat, il convient de noter la prise de conscience, depuis 2012, par nos Etats de cette question des emballages non biodégradables.

4.3 EVOLUTION JURIDIQUE DE LA QUESTION RELATIVE AUX EMBALLAGES NON- BIODEGRADABLES AU CAMEROUN ET EN RDCONGO ET BREVE HISTORIQUE SUR LES POLYMERES

Le ministre camerounais de l'Environnement, Pierre Hélé, a rendu public le mercredi 13 février 2013, un communiqué interdisant «formellement sur l'étendue du territoire national la fabrication, la détention, la commercialisation ou la distribution à titre gratuit des emballages plastiques non biodégradables à basse densité, ainsi que les granulés servant à leur fabrication » [13].

Ce communiqué rappelle par ailleurs que les opérations de tri, collecte, de transport et de stockage des déchets sont soumises à la délivrance d'une autorisation du ministre de l'Environnement, de même que la fabrication, l'importation, la commercialisation et la distribution des emballages non- biodégradables et des équipements électriques et électroniques.

En réalité, c'est depuis la signature d'un Arrêté daté du 24 octobre 2012 relatif à la réglementation de la fabrication, de l'importation et de la commercialisation des emballages non biodégradables que cette mesure d'interdiction a été prise. La récente sortie du ministre Pierre Hélé, vise maintenant à la mettre en pratique.

Tandis que du côté, de la RDCONGO, c'est plutôt, le ministre de l'industrie, petites et moyennes entreprises qui vient de retirer l'autorisation de fonctionnement à trois entreprises qui continuent à commercialiser les emballages non biodégradables. C'était à l'issue d'une séance d'échange et de démonstration sur les méfaits des sachets dans notre environnement. Au cours de cette séance avec les opérateurs œuvrent dans ce secteur, Remy Musungayi a annoncé que des bouclages auront lieu dans les tous prochains jours en vue de faire respecter la loi en cette matière [14], cette adresse est soutenue par l'ARRETE INETRMINISTERIEL N°001/CAB/MINIPME/2012 et N°003 CAB/MIN/ECO&COM/2012 portant interdiction de fabrication, d'importation et de commercialisation des emballages non biodégradables.

Du côté de Congo-Brazza, une campagne de sensibilisation via internet et au Congo Brazzaville, a été menée par l'Association Développer Autrement le Congo, en sigle DAC de Jean-Claude BERI, sur les conséquences environnementales de l'utilisation des sacs plastiques, le Gouvernement congolais avait pris en conseil des ministres, le 1er juin 2011, la décision d'interdire la production, l'importation et la commercialisation des sacs en plastique en République du Congo. Cette mesure a été effective le 20 janvier 2012. Et, une campagne a été lancée par le ministère du commerce, pour sensibiliser la population sur l'entrée en vigueur à la date fixée, de cette mesure gouvernementale. De ce fait, le Directeur de Cabinet de la Ministre MUNARI, Monsieur KAMBA, invité du journal magazine de la télévision nationale congolaise ce 15 janvier 2012, promet à cette date butoir, des sanctions exemplaires, à toute personne qui serait prise en flagrant délit de commercialisation des sacs en plastique, sur toute l'étendue du territoire national. Donc, avec l'entrée en vigueur de cette décision gouvernementale, se pose la question de la revalorisation des déchets plastiques au Congo Brazzaville [15].

A la lumière de ces adresses ministérielles, nous constatons une certaine volonté politique dans le chef de nos autorités politique qui visent à règlementer ce secteur par des textes qui cherchent à faire souffler dans ces trois pays un vent nouveau. Toutefois, ceux-ci devraient être accompagnés de l'exécution et des actions concrètes sur le terrain afin de pouvoir assainir nos villes, nos provinces, en somme, nos pays. Malheureusement, malgré toutes ces bonnes intentions politiques, nos populations ne bénéficient pas encore du cadre de vie assainit. Ne dit-on pas qu'il vaut mieux l'absence d'une loi qu'une loi imparfaitement appliquée ?

En effet, l'idée de fabriquer des biomatériaux plastiques à partir de ressources végétales date des années 1930 mais le développement de ces biomatériaux a été mis en sommeil car les polymères d'origine fossile (issue de la pétrochimie), moins onéreux, se sont développés. Dès 1950, ces matières plastiques de synthèse ont commencé à se développer fortement et, au début du XXI^{e} siècle, la consommation de matériaux plastiques ne cesse de progresser; c'est ainsi que durant les 25 dernières années, la croissance a été de l'ordre de 7 %. Ces matériaux sont maintenant incontournables dans la vie quotidienne. Cependant, ces matériaux de synthèse constituent un problème pour l'environnement, sachant que leur durée de vie est

supérieure à 400 ans. Par ailleurs, la baisse des réserves en énergie fossile, le renchérissement consécutif de la baisse des réserves en pétrole, les difficultés à recycler nos déchets et la nécessité de valoriser les sous-produits agricoles donnent un intérêt fort au marché des polymères biodégradables. Ceux-ci ne cessent de se développer, que ce soit ceux issus des ressources végétales ou ceux issus des ressources fossiles [16].

4.4 EMBALLAGES NON BIODEGRADABLES, UNE MALADIE HONTEUSE POUR L'AFRIQUE [17] [18]

Le problème de l'Afrique en matières des déchets reste le même à tous égards. Il ressort de cette affirmation le témoignage de Georges Lannafankpotin sur le niveau alarmant d'insalubrité à Cotonou. Celle-ci fut considérée comme une ville coquette avec ses 600.000 habitants. Actuellement, on rencontre partout des matières qui ont servi non seulement pour manger mais aussi de récipient à la défécation qu'on vient déposer sur les voies publiques

Mais nul n'a apparemment conscience que Cotonou seul produit annuellement environ 117.000 tonnes de déchets, soit plus de 307.000 m^3, dont une grande partie non biodégradables est constituée de caoutchouc et des matières plastiques (0,6% du total). A ce rythme, il n'est pas exclu qu'au bout de quelques années, ils finiront par être asphyxiés puisqu'ils vivent sur un tas d'ordures qui dégagent des gaz de toutes sortes.

En somme, l'Afrique noire souffre de mêmes maux partout, mais surtout en cette matière de gestion des déchets (emballages non-biodégradables). Il se fait qu'il se trouve qu'il n'existe pas encore une bonne politique africaine en cette matière ainsi qu'en témoignent des investisseurs qui coopèrent bien au Nord mais qui, au Sud, font du chantage à nos Gouvernants. Cette façon de voir les choses mérite une réflexion, MUSIBONO de l'Université de Kinshasa/Faculté des sciences/Département d'Environnement, dans son entretien du 22 juin 2013 lors d'un séminaire d'écotoxicologie et santé des écosystèmes avec ses apprenants en DEA-ENV., commentaire sur les réflexions de son ouvrage [19].

4.5 PROGRAMMES PILOTES D'ASSAINISSEMENT

Voici quelques illustrations de certains programmes qui donnent l'espoir dans le cadre d'assainir nos villes. Certes, il reste encore beaucoup à faire.

Le programme d'assainissement urbain de Kinshasa (PAUK) est né dans la suite des interventions de remise en état de la voirie de la ville du second programme d'appui à la réhabilitation (PARII). En effet, les efforts de réhabilitation de voirie se sont butés à la problématique de gestion d'assainissement. La Commission européenne en accord avec la République démocratique du Congo a décidé, dans le cadre du programme indicatif national, de financer des travaux d'assainissement du milieu urbain. Cette décision a été concrétisée par la signature le 13 novembre 2007de la Convention de financement n° 9792/ZR d'un montant de 22 000 000 euros. Compte tenu des ressources financières disponibles, la zone d'intervention du projet a été circonscrite par les deux bassins versants de la Bitshakutshaku et du fleuve Congo, couvrant la totalité des territoires des communes de Barumbu et Kinshasa et une grande partie de celui de la Gombe. Sa superficie est de 1 130 hectares dans laquelle sont recensés 350 000 habitants.

Au 31 décembre 2010, le taux de réalisation de globale de travaux est autour de 96% contre la cible de 85%. 42 676 mètre linéaire du réseau de drainage de deux bassins versants ont été réhabilité et rendu opérationnel. Lors de cette opération, le projet a évacué dans ce réseau plus de 455 000 m^3 de déchets.

Les 10 décharges sauvages identifiées (points noirs) à travers la zone d'intervention de PAUK ont été toutes nettoyées. 24 stations de transfert ont été construites et la quantité de déchets collectés en fin décembre 2010 a été évaluée à 1 102 015 m^3. A chaque station de transfert correspond une équipe opérationnelles d'entretien des stations de transfert augmentent au fur en mesure que les stations sont mises en service [20].

Tandis qu'à Brazzaville, une initiative timide a depuis vu le jour, pour mettre fin à cette situation. Elle est l'œuvre de l'Association Partenaires 381. Cette Association œuvre dans la collecte des déchets plastiques, qu'elle transforme en pavés. La production journalière de cette Association n'est pas connue. Cependant, elle reste faible et ne peut suffire pour revaloriser les 80.000 tonnes de déchets plastiques que le Congo Brazzaville produit ou importe chaque année. A Mopti au Mali, une solution similaire à celle de Partenaires 381 existe depuis plus de 5 ans et aide à transformer les déchets plastiques en pavés urbains. Depuis, les rues boueuses de cette ville encerclée par les eaux dite la Venise du Mali, ne voient plus ses habitants pataugés dans les eaux comme naguère [15].

En effet, nos pays ont accumulés au long des années, des tonnes importantes des matières plastique qui font désormais partie de notre environnement. Partout dans nos villes et campagnes, la présence de ces déchets, a fini par rentrer dans le décor du paysage. Aujourd'hui, il faut trouver une solution durable pour débarrasser nos cités, des restes d'emballages qui

ont dégradé considérablement leur visage. D'où l'urgence, de réfléchir sur une stratégie africaine de revalorisation des déchets plastiques. Ceci pour débarrasser de nos pays, définitivement, des décharges à ciel ouvert remplies par ces poisons.

5 CONCLUSION

Cette étude vient de démontrer le parfait lien qui existe entre le droit, l'homme et l'environnement à travers les textes juridiques. En effet, la déclaration de Stockholm sur l'environnement a énoncé un certain nombre de principes dont le premier consacre le droit de l'homme à un environnement de qualité et en contrepartie, le devoir solennel de celui-ci de protéger et d'améliorer l'environnement.

En effet, la plupart des activités humaines dont la production des déchets (emballages non biodégradables) ont des répercussions sur l'homme lui-même en tant que producteur de ces rebuts et sur l'environnement en tant que (cadre de vie, réservoir des ressources et réceptacle des déchets avait confirmé le professeur **BINZANGI**).

Grosso modo nous nous sommes assigné la tâche d'inventorier, analyser et comparer les textes juridiques de la R D Congo, du Cameroun et ceux du CONGO-Brazza. Le constat qui s'en dégage reste que les textes de la R D Congo paraissent anciens par rapport à ceux du Cameroun et du Congo-Brazza. Ainsi, la RD Congo a essayé de se rattraper à travers la Loi n°11/009, du 09 juillet 2011, portant principes fondamentaux relatifs à la protection de l'environnement où elle a actualisé ces instruments juridiques en matière des déchets. En revanche, elle est tombée dans la même erreur que le Cameroun à savoir celle de négliger, une fois de plus, la question relative aux emballages non biodégradables. Cela est d'autant plus vrai qu'aujourd'hui encore, aucun article de cette loi ne traite de la question.

Il a fallu attendre l'année 2012 pour que les trois Etats prennent conscience de la question relative aux emballages non biodégradables en s'engageant dans la voie qui conduit à leur éradication et en essayant de matérialiser leurs bonnes intentions politiques à travers la mise sur pied des textes juridiques. Par conséquent, beaucoup reste encore à faire dans ce domaine parce que bon nombre de ces textes sont restés enfermer dans des tiroirs. Ce que démontre suffisamment l'état dégradant de nos villes, provinces et pays qui pataugent encore dans un niveau d'insalubrité criant faute, entre autres de la mise en application de ces textes juridiques. Dans un contexte comme celui-ci que nous déplorons, une éducation mésologique peut, dans cette perspective, constituer un réel creuset au plus grand profit des pays étudiés et de l'Afrique en général. En somme, les autorités gouvernementales africaines, devraient s'inspirer des exemples des uns des autres, en s'appuyant sur les démarches réussies, et mettre en œuvre une vraie politique de recyclage de ses déchets. Cela passe, par la mise sur pied d'un organe chargé du recyclage de ceux-ci, et devra avoir entre autres missions de :

1. Associer, organiser et sensibiliser les populations, et surtout la jeunesse africaine selon le modèle.
2. Mettre en œuvre des unités industrielles de transformation de déchets plastiques, etc.
3. Encourager la mise sur pied des centres d'enfouissement des déchets, et transformer les produits finis (lixiviats et le CO_2) en biogaz.

De cette façon, les décisions gouvernementales auront un sens, en ce qu'elles contribueront à l'assainissement de nos pays, car l'interdiction seule à la production, importation et commercialisation des emballages en plastique ne suffit pas.

REFERENCES

[1] RAPPORT (1996). Rapport provisoire sur l'identification des problèmes liés à l'assainissement urbain et leurs conséquences sur l'environnement au Zaïre, volet urbain, Premier Séminaire National sur le Plan d'Action Environnemental (PNAE), Kinshasa, du 15 au 18 juillet, 35pages.

[2] Texte du protocole de Montréal, complété depuis par différents amendements [archive], www.unep.org/ozone/pdfs/Montréal-Protocol2000.pdf

[3] VERSTRAETE W.et al (1999). Actes du I^{er} colloque sur la problématique des déchets à Kinshasa, 12-15 août, Gent-Bxl, Belgique, 347pages.

[4] MAVUNGU M.(1999). Les textes juridiques et la jurisprudence en matière de production et de gestion de déchets in Actes du I^{er} colloque sur la problématique des déchets à Kinshasa, 12-15 août 1998, Gent-Bxl, Belgique, 197- 208pages.

[5] PNUE (2005). L'Avenir de l'Environnement en Afrique / Notre Région-Notre Vie, Nairobi, Kenya.

[6] VUNUNU G. (2006). La planète est menacée à cause de notre mauvais comportement, in Le Gardien vert-bleu n°001, p.22

[7] FONTAINE G. & MAGNA J.Y. (1982). Sciences physiques, Editions d'Hachette, Paris

[8] KIYOMBO M. (2010). Gestion de l'environnement : notions d'hygiène et d'économie de l'environnement, Cours de Master professionnel en économie de la santé, Faculté de médecine/Ecole de santé de l'Université de Kinshasa

[9] "CONGO, République démocratique du." Microsoft®Encarta®2009[DVD]. Microsoft Corporation, 2008.
[10] CAMEROUN." Microsoft®Encarta®2009[DVD]. Microsoft Corporation, 2008.
[11] EMWA (2013). La législation pétrolière en République du Congo: www.cabemery.org/fr/2013/10/14/la-legislation-petroliere-en-republique-du-congo/#.VDKU6dkdpdg, consulté le 5 octobre 2014 à 14 h14'
[12] WELL A. (1973). Droit civil : Introduction générale,3è édition, Dalloz, Paris.
[13] AGENCE ECOFIN (2013). Le ministre camerounais de l'environnement rendu public, éditorial camerounais
[14] RADIO RTGA (2013). Le Gouvernement de la RDC interdit les emballages non biodégradables : le Ministre de l'Industrie au micro de Dominique DINANGA, Kinshasa à 13h25'
[15] Google (2014). 20 janvier 2012 fin des sacs en plastique, comment les revaloriser? www.mampouya.com/article-les-sacs-en-plastique-la-purge-debaptiser-nos-rues-97251971.html, consulté le 06 octobre 2014 à 14h 35'
[16] WYART D. (2007). Les polymères biodégradables, vol. AM4, n°AM3579 : www.cat.inist.fr/?aModele=afficheN&cpsidt=21791318, consulté le 20 / 12 /2013
[17] CENTRE WANAD (1995). Actes du Séminaire des journalistes en environnement, p.43
[18] WANGA B.M. & al. (2014). Étude comparative des instruments juridiques de la RDCongo et du Cameroun sur la production des emballages non-biodegradables, in Mouvements et Enjeux Sociaux, n°86 du septembre-octobre.
[19] MUSIBONO D. E. (2006). Du marasme d'un Etat-squelette aux défis du développement durable, éd. CHAIRE UNESCO, UNIKIN
[20] RAPPORT FINAL (2010). Rapport final de suivi des indicateurs de performance du PAUK, entre Janvier 2008 – décembre 2010, Projet 18667 financé par le Fond Européen pour le Développement, Kinshasa/RDCongo
[21] CAMEROUN, DECRET n°2012/2808/PMdu 26 septembre 2012
[22] CAMEROUN, DECRET n°2012/2809/ du 26 septembre 2012
[23] CAMEROUN, ARRETE conjoint n°005/MINEPDED/MINCOMMERCE du 24 octobre 2012
[24] CONGO BRAZZA, Lettre N°0453/MTE/CAB du 25 mai 2009
[25] CONGO BRAZZA, Autorisation provisoire N°084/MTE/CAB/DGE du 22 mai 2009
[26] RDCONGO, ARTICLE 2 de la loi fondamentale du 19 mai 1960
[27] RDCONGO, JOUNAL OFFICIEL-Numéro Spécial- 16 juillet 2011, 31pages

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La combinaison d'engrais minéraux et de l'herbicide sur un Ferralsol est-elle une alternative pour accroitre le rendement du haricot commun (*Phaseolus vulgaris* L.) par une gestion des mauvaises herbes à Lubumbashi R.D. Congo ?

[The combination of mineral fertilizer and herbicide on Ferralsol is it an alternative to increase the yield of common bean (*Phaseolus vulgaris* L.) by weed management in Lubumbashi, DR Congo?]

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ABSTRACT: In sub-Saharan Africa, the relationship between modes of weed management by chemical molecules and soil quality, resulting remains little known or poorly farmers. This study highlights the influence of mineral fertilizer and herbicide on increasing grain yield of common bean in Lubumbashi by the maintenance of the weed population to a tolerable level. The experiment was installed on a device in a ferralsol split splot with 3 repetitions. The main plots consisted of three types of fertilizer: NPK1 (10-20-10); NPK2 (17-17-17) and NPK3 (14-18-18) at the rate of 200kg / ha and secondary plots of 3 doses of the herbicide glyphosate D1 (1.5l / ha); D2 (3 l / ha) and D3 (4.5 l / ha). Observations were made on growth parameters, yield and weed infestation rate on the plots. The results obtained showed that the highest yield was observed on plots with an average of NPK1avec 2,1t / ha, no dose of herbicide has influenced performance. However, the herbicide was ineffective with weeds; high levels of infestation plots by weeds were observed in plots receiving NPK3 and NPK2. The combination of mineral fertilizer and herbicide was ineffective and would be a solution to weeding a ferralsol if we added organic matter and providing a second application based on a selective molecule to complement the action of first applied near weeds.

KEYWORDS: Lubumbashi, common bean, ferralsol, weeding, lifting pressure, organic manure.

RESUME: En Afrique subsaharienne, la relation entre les modes de gestion des mauvaises herbes par les molécules chimiques et la qualité du sol, qui en résultent, reste très peu ou mal connue des agriculteurs. Cette étude met en évidence l'influence de la fertilisation minérale et l'herbicide sur l'accroissement du rendement en grain du haricot commun à Lubumbashi par le maintient de la population adventice à un seuil tolérable. L'essai a été installé sur un ferrasol suivant un dispositif en split splot comprenant 3 répétitions. Les parcelles principales étaient constituées de 3 types d'engrais : NPK1 (10-20-10) ; NPK2 (17-17-17) et NPK3 (14-18-18) à raison de 200kg/ha et les parcelles secondaires de 3 doses de l'herbicide glyphosate D1 (1,5l/ha) ; D2 (3l/ha)et D3 (4,5l/ha).Les observations ont porté sur les paramètres de croissance, de rendement et sur les taux d'enherbement dans les parcelles. Les résultats obtenus ont montré que le rendement le plus élevé a été observé sur les parcelles ayant reçu NPK1avec une moyenne de 2,1t/ha, aucune dose d'herbicide n'a influencé le rendement. Cependant, l'herbicide s'est révélé inefficace face aux mauvaises herbes, les degrés élevés d'infestation des parcelles par les mauvaises herbes étaient observés dans les parcelles ayant reçu NPK3 et NPK2. La combinaison de l'herbicide et engrais minéraux s'est révélée inefficace et serait une solution de désherbage sur un ferralsol si on y ajoutait la matière organique et prévoir un

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second épandage à base d'une molécule sélective en vue de compléter l'action du premier appliqué en prés levée des mauvaises herbes.

MOTS-CLES: Lubumbashi, haricot commun, ferralsol, désherbage, prés- levée, matière organique.

1 INTRODUCTION

En RDCONGO le haricot occupe la deuxième place parmi les aliments de base des populations ; il vient immédiatement après le manioc, la patate douce ou la pomme de terre qui se substituent les uns aux autres suivant les échelons d'altitude. Le haricot assure la majeure partie des apports de protéines dans l'alimentation [1]. Le haricot est un aliment important car il constitue une grande source de protéines pour les plus pauvres de la population chez qui les protéines d'origine animale sont rarement disponibles [2].

Au Katanga, le haricot cultivé représente 10% dans toute les entités administratives, il occupe la deuxième place du point de vue de la production moyenne de légumineuses, après l'arachide Moba est l'entité la plus productrice et détient à peu-prés la production provinciale[3] dans les conditions des producteurs du Sud-Katanga le meilleur rendement oscille autour de 800 et 1000 kg/ha et jusqu'à 2500 kg/ha avec les variétés améliorées[4].

L'agriculture africaine est confrontée à des nombreux défis dont le climat caractérisés par une irrégularité des pluies, la pauvreté des sols en éléments nutritifs et une acidité élevée que ceux des régions tempérées. De plus les ennemis des plantes n'y sont pas moins dommageables [5]. La perte de fertilité s'exprime à son tour par une diminution brusque ou graduelle de rendement selon le type de sol. L'utilisation des amendements minéraux et organiques est une option possible pour renverser cette tendance de perte de rendement et donc pour améliorer la sécurité alimentaire [6] complétée par [7] montre aussi que les apports au sol en minéraux stimulent la croissance et le développement du haricot qui à son tour va priver par son couvert végétal la lumière aux mauvaises herbes et limitant leur prolifération. Les mauvaises via les compétitions infligées aux plantes cultivées entraînent de grandes pertes de rendement allant de 24% à99% globalement, avant la récolte elles sont de l'ordre de 20 à40% [8]. Cependant beaucoup de paysans dans les pays en développement ignorent plusieurs aspects de l'interférence des mauvaises herbes et le moment pour éliminer les mauvaises herbes [9].

Par ailleurs [10] Estiment que dans l'agriculture moderne, l'utilisation du désherbage chimique s'inscrit dans un itinéraire technique comme une opération indispensable à l'accroissement des rendements

Les herbicides contrôlent les adventices lors des premiers stades de développement de la culture, au moment où les paysans ont peu de temps disponible pour le sarclage. Vue l'intérêt que revêt cette étude dans notre milieu de l'accroissement du rendement sur un sol fortement altéré par l'approche gestion intégrée des mauvaises herbes. Ainsi les hypothèses suivantes ont été émises (i) Quel type d'engrais pourrait favoriser la croissance et le développement de la culture (ii) quel est la dose de glyphosate qui assurerait une bonne gestion des adventices (iii) la combinaison de l'engrais et doses de glyphosate pourrait influencer considérablement touts les paramètres.

2 MILIEU MATERIEL ET METHODE

2.1 MILIEU

Les expérimentations ont été réalisées à la ferme Kassapa, une station de recherche de la Faculté des Sciences Agronomiques de l'Université de Lubumbashi (UNILU). Le site est situé à 1243m d'altitude, 11° 39' de latitude sud et 27°28' de longitude Est [11]. Au cours de la période expérimentale , les plus grandes quantités de pluie ont été enregistrées au mois de Février soit 331,6mm et les petites quantités des pluies ont été observées au mois d'Avril soit 113,5mm et quant aux températures, la valeur la plus élevée était observée au mois de Janvier32^0 C et la pus faible soit 29,1^{0}C au mois d'Avril et enfin le taux d'humidité le plus élevé a été observé au mois de Février soit 88% et le plus faible taux soit 81% a été observé au mois d'Avril. Seuls au mois de Février où les pluies se sont reparties sur 22jours contrairement au mois d'avril où il n'a plu que pendant 8 jours. Les conditions climatiques ayant prévalues au cours de notre expérimentation sont données par (**tableau1).**

Tableau 1. Données climatiques de la période expérimentale de Janvier 2014 à Avril 2014.

Mois	Température (°C)			Précipitations		Humidité (%)
	Moyenne	Maximum	Minimum	Quantité pluie (mm)	jours/pluies	
Janvier 2014	21,3	32,0	15,6	277,5	18	87
Février 2014	21,9	29,8	14,8	331,6	22	88
Mars 2014	21,4	30,5	16,0	157,8	13	85
Avril 2014	20,8	29,1	14,8	113,5	8	81

Source : *Agence nationale de météorologie et de télédétection par satellite (METTELSAT)/Station de la Luano*

Les sols de Lubumbashi et ses environs sont dominés, par les sols ferralitiques jaune, ocre-jaune et rouge suivant la position topographique et le drainage [12] complétée par La référence [13] qui donne certaines caractéristiques pour les ferralsols la teneur en argile se situe entre 10 et 15%, le rapport limon/argile d'une valeur de 0,08 indique un matériau fortement altéré. La capacité d'échange est très faible et le degré de saturation du complexe adsorbant est de l'ordre de 30 à 40 %, avec un pH présentant des valeurs situées entre 5,0-5,6. Avant l'expérimentation, des échantillons de sols ont été prélevés et analysés au Centre de Recherches Agro-Alimentaire(CRAA) en vue de déterminer les teneurs en azote, phosphore, carbone, potassium et le pH **(tableau2**).

Tableau 2. Composition chimique de l'échantillon du sol du site expérimental avant l'épandage d'herbicides

Eléments	pH (eau)	N en %	P en %	C en %	K en %
Teneur dans le sol	5,7	0,6916	Trace	9	0,0026

Source *: Centre de Recherche Agro-Alimentaire (CRAA, 2014)*

La flore et les groupes des végétaux de Lubumbashi et ses environs sont les résultats d'une longues évolution conditionnée par l'action de l'homme, les bioéléments et sols de temps passé et présent, la végétation est constituée par trois types des formations végétales : la savane, la steppe, et la forêt. Cette dernière représente plus de 80% et se présente sous trois aspects : forêts dense sèche, forêts claire et savane steppique [14]. La végétation de notre champ expérimental était constituée par la savane herbeuse et les espèces végétales suivantes ont été trouvées sur le site expérimental avant son ouverture : *Cynodon dactylon, Panicum maximum, Seteria pumila, Imperata cylindrica, Hyparrhenia sp, Pennisetum purpureum, Tithonia diversifolia, Bidens oligoflora, Hephorbia hirta, Cyperus sp, Aspilia kocthii, Celosia trygina, Eleusine indica, Spermacoce pusila, Acanthospernum hispidum*

2.2 MATERIEL ET METHODE

2.2.1 MATERIEL BIOLOGIQUE ET CHIMIQUE

Nous avons utilisé la variété semi volubile Prelon diffusée par la station de recherche de l'Institut National d'Etude et de la Recherche Agronomique (INERA, Station de Kipopo) avec comme caractéristiques variétales : Rendement potentiel 2-2,5 t/ha, poids 100 graines 23 g, hauteur 35à 40cm. Comme herbicide utilisé le glyphosate en pré-levée SL 480g/L sel d'isopropyl amine de glyphosate équivalent à 360g/L, pour le contrôle des herbes annuelles, pour le fabricant il est recommandé d'utiliser 2,0 à 3,0l/ha et les engrais utilisés pour notre expérimentation sont des engrais composés dont voici les formules : NPK1 10-20-10 ; NPK2 17-17-17 et NPK3 14-18-18 de la firme OMNIA.

2.2.2 CONDUITE DE L'ESSAI

L'essai a été conduit selon le dispositif split-plot avec trois blocs randomisés, trois répétitions et trois sous- parcelles par bloc. La grande parcelle correspondant au facteur secondaire NPK dont : NPK1 (10-20-10) ; NPK2 (17-17-17) et NPK3 (14-18-18) épandus à raison de 200kg/ha. C'est dans chaque grande parcelle où l'on trouve trois sous-parcelles correspondant chacune à un niveau du facteur doses herbicide glyphosate pour lequel on a choisi trois niveaux ou modalités à savoir : D1 (1,5l/ha) ; D2 (3l/ha) et D3(4,5l/ha). La dimension de chaque parcelle principale était de 5 m x12, 60 m, tandis que celle de chaque sous-parcelle était de 5m x 2,4m avec une superficie utile de 336m^2. Le terrain avait été ouvert à l'aide d'une machette et les plantes coupées étaient déportées hors du champ, vient ensuite le labour manuel à plat à la houe à une

profondeur de 25cm. Suivi de l'épandage de l'herbicide à l'aide d'un pulvérisateur portatif à dos de 20l en respectant les différentes doses retenues pour chaque sous-parcelle. Pour prévenir toute dérive du produit par le vent violant et des fortes pluies , l'épandage était effectué le soir sous une atmosphère calme et le semis était effectué 10 jours après épandage soit le 25/01/2015 aux écartements de 20cmx 40cm à raison de deux graines par poquet avec apport immédiat de l'engrais minéral en fonction de l'affectation selon chaque grande parcelle ceci pour pallier aux problèmes de pauvreté des sols tropicaux en éléments majeurs à la croissance et le développement des plantes pour prévenir les attaques de la mouche du haricot (*Ophiomyia spencerella*) un buttage des plants était effectué 15 jours après semis La cotation des mauvaises herbes était faite 35 jours après le semis, car aucune opération de sarclage n'était effectué , la cotation était faite suivant l'échelle de1 à 5 de Braun-blanquet qui traduit l'abondance-dominance attribuée à chaque espèce présente. D'ou l'aspect général de l'enherbement a été apprécié quantitativement.

2.2.3 PARAMETRES OBSERVES ET TRAITEMENT DES DONNEES

En cours de culture les observations ont porté sur les paramètres suivants : Le taux de germination déterminé en fonction du nombre de plantes qui ont levé × 100/ la densité parcellaire, le nombre des feuilles par plants 35jours après semis, le nombre des gousses par plant et nombre des graines par gousse. A la récolte nous avons déterminé le poids de 100graines, et le rendement partant de 20 plants situés sur deux lignes centrales dans chaque sous- sous parcelle. Par ailleurs au 35^{ième} jour après semis un inventaire floristique avait été fait dans chaque sous-parcelle pour déterminer le recouvrement selon la méthode semi quantitative de Braun-blanquet en vue d'évaluer l'impact de l'herbicide sur la flore car le produit était appliqué avant la levée. Pour y arriver 2 quadrats de 1m², placés aléatoirement dans chaque sous-parcelle. L'analyse de la variance nous a permis de ressortir les interactions des deux facteurs et L'analyse de la variance (ANOVA) et la séparation des moyennes par le test de TUKEY ont été utilisées pour déterminer les différences entre les doses de l'herbicide d'une part et de l'autre entre les types d'engrais. Les données non paramétriques relatives aux recouvrements des mauvaises herbes ont été analysées par le Test de Kruskal-wallis en vue de déterminer les effets des doses de glyphosate et de l'engrais. Pour y parvenir dans les deux cas, nous avons fait recours au logiciel R.i386 2.15.0.

3 RESULTATS

Il ressort des résultats de l'analyses de la variance que le facteur doses herbicide et types engrais ne génèrent aucune interaction sur touts les paramètres étudiés étant donné que (P>0,05). Cependant, seul le facteur types engrais a induit des effets significatifs sur le taux de germination avec (P=0,0419), il en est de même pour le nombre des gousses par plant car (P=0,030) et enfin des effets très significatifs sur le rendement. Par ailleurs, la comparaison des moyennes par le test de Tukey HSD pour le nombre des gousses par plant nous montre que : le nombre élevé en gousse soit (18±1,56) a été observé dans les parcelles fertilisées par le NPK3 par contre le plus faible soit (14±2,39) gousses par plant obtenu dans les parcelles fertilisées avec le NPK2 et ce couple s'est montré différent des autres couples car (P=0,013). Quant au taux de germination, le test de Tukey HSD nous montre que le taux de germination le plus élevé des graines soit (82,11%±9,54) est observé dans les parcelles ayant été fertilisées par le NPK1 contre le faible taux de germination soit (71,66%±7,96) observé dans les parcelles traitées au NPK2. De ce fait, il convient de dire que seul les moyennes de NPK2 et NPK1 sont différents car (P=0,0305) contrairement aux moyennes des couples NPK3-NPK1et NPK3-NPK2 qui sont identiques car P>0,05. La comparaison des moyennes pour le rendement révèle que les rendements le plus élevé soit (2,1t/ha±0,1) a été observé dans les parcelles fertilisées avec NPK1et les plus faibles soit (1,7t/ha±0,4) dans les parcelles ayant reçu NPK3et par conséquent seul ce couple NPK1-NPK3 s'est révélé différent avec (P=0,006). Quant aux couples NPK2-NPK1et NPK3-NPK2 sont identiques. Il convient de signaler que toutes les moyennes de doses sont identiques notamment D2-D1 ; D3-D1etD3-D2 car pour touts ces couples (P>0,05).

Tableau 3 : La combinaison d'engrais minéraux et de l'herbicide sur un Ferralsol est-elle une alternative pour accroitre le rendement du haricot commun (Phaseolus vulgaris L.) par une gestion des mauvaises herbes à Lubumbashi R.D.Congo ? Analyse de la variance à 2 facteurs. Moyennes ±écart type. Les mêmes lettres à côté des moyennes indiquent des différences non significatives après et les lettres différentes indiquent de différences significatives après l'Anova (P=0,05). D.Herb : doses glyphosate ; HPF : hauteur des plants à la floraison ; NG/pl : Nombre des gousses par plant ; NF : Nombre des feuilles ; Taux ger : Taux de germination ; Rdt(t/ha) : Rendement en tonnes par hectare ; NGgousse : Nombre des graines par gousse.

Engrais	D.Herb	HPF	N F	NG/pl	NGgousse	Poids100gr	Taux ger	Rdt(t/ha)
NPK1	D1	25,77 ± 7,7	16,33 ± 6,43	17,0 ± 7,0	4,66± 0,57	2,77 ± 0,71	74,33 ± 8,62	2,17 ± 0,07
	D2	23,23 ± 8,5	18,0 ± 8,72	18,6± 3,5	5,0 ± 0,0	2,23 ± 1,53	84,33 ± 7,51	2,12 ± 0,2
	D3	20,35 ± 13,5	14,50 ± 7,78	14,5 ± 4,9	5,500 ± 0,7	2,37 ± 4,21	87,67 ± 9,45	2,13 ± 0,42
Moyenne NPK1		**23,62**±7,79**a**	**17 ±6,48a**	**17 ± 4,6b**	**4,8 ± 0,60a**	**21,3±1,74a**	**82,11±9,54ac**	**2,1± 0,1ac**
NPK2	D1	20,83± 1,3	20,67 ± 3,21	1,36 ± 3,1	4,66 ± 0,57	18,19 ± 0,5	70,67± 9,45	1,9 ± 0,209
	D2	20,33 ± 4,1	19,0 ± 3,46	13, ± 2,52	5,33 ± 0,57	21,6± 1,04	73,33 ± 9,87	2,1 ± 0,116
	D3	25,70 ± 4,7	19,33 ± 2,52	14,0± 2,65	4,66 ± 0,57	20,11 ± 1,4	71,0± 7,81	1,91 ± 0,15
Moyennes NPK2		**22,28 ± 4,1a**	**20±2,78a**	**14± 2,39a**	**4,8 ± 0,60a**	**19,9 ±1,7a**	**71,66±7,96a**	**1,9 ± 0,2b**
NPK3	D1	25,83± 1,70	21,3 ±1,5	17 ± 1,155	17,3 ± 1,15	18,95± 0,3	79 ± 7,0	2,03 ± 0,20
	D2	26,57 ± 2,0	21± 3,0	18 ± 0,00	18,0 ± 0,00	21,7± 0,79	78 ± 9,85	1,36 ± 0,41
	D3	22,90 ± 4,5	22± 0,00	19± 2,31	19,33 ± 2,3	20,3± 2,67	81,67 ±4,16	1,70 ± 0,31
Moyennes NPK3		**25,10**±3,10**a**	**21**±1,74**a**	**18**±1,56**ac**	**4,8 ± 0,52a**	**20,3 ±1,8a**	**79,55 ± 6,59b**	**1,7 ± 0,4a**
Effet(A)	**P**	**0,595**	**0,184**	**0,030**	**0,424**	**0,1737**	**0,0419**	**0,00362**
Effet(B)	**P**	**0,955**	**0,998**	**0,915**	**0,744**	**0,0705**	**0,384**	**0,33253**
Effet(A) x(B)	**P**	**0,591**	**0,976**	**0,764**	**0,571**	**0,2958**	**0,635**	**0,06129**

Tableau 4 : La combinaison d'engrais minéraux et de l'herbicide sur un Ferralsol est-elle une alternative pour accroitre le rendement du haricot commun (Phaseolus vulgaris L.) par une gestion des mauvaises herbes à Lubumbashi R.D.Congo ? Test de Kruskal-wallis au seuil (P=0,05) en fonction des taux de recouvrement des mauvaises herbes inventoriées 35jours.

Espèces des mauvaises herbes	Effets engrais	Effetherbicide
	P(0,05)	P(0,05)
Ageratum conyzoides	0,33	0,46
Bidens oligoflora	0,21	0,12
Commelina benghalensis	0,04	0,61
Cyperus rotundus	0,15	0,94
Galsonga palmavirens	0,49	0,08
Nicandra physaloides	0,70	0,47
Panicum maximum	0,36	0,36
Setaria pumila	0,14	0,55
Spilanthes oleraceae	0,00	0,65
Tithonia diversifolia	0,59	0,12
Trifolium sp	0,012	0,11

Les résultats issus du test de Kruskal-wallis présentés par**(le tableau3)** nous révèle que l'herbicide via différentes doses appliquées n'a exercer aucune influence sur touts les spécimens des mauvaises herbes (P>0,05) Cependant il a réduit le stock semencier de certaines espèces inventoriées avant le labour *Hephorbia hirta, Aspilia kocthii, Cynodon dactylon, Celosia trygina, Spermacoce pusila, Acanthospernum hispidum,* par contre pour les autres le labour a limité leur dispersion. Néanmoins, une action non négligeable des effets de l'engrais sur certaines espèces végétales (P<0,05) dont : *Commelina benghalensis* et *Trifolium sp* voir même des effets très significatifs sur *Spilanthes oleraceae.* Nous observons que 2 espèces dont *Ageratum connyzoides et spilanthes oleraceae* ont colonisé presque toutes les parcelles.

4 DISCUSSION DES RESULTATS

4.1 PARAMETRES VEGETATIFS ET DU RENDEMENT POUR LE HARICOT

Les résultats obtenus pour notre étude montrent que l'engrais combiné à l'herbicide n'a pas influencé le taux de germination des graines. Cependant la levée serait induite par les conditions climatiques favorables enregistrées au cours du mois de janvier coïncidant avec le semis voir (**tableau1)** associées à l'état physiologique des graines. La référence [15] appui nos résultats pour ce paramètre en spécifiant les gammes de températures pour la germination dont l'optimum varie entre 15 et 30^{o}C. Il convient de signaler que le glyphosate bien qu'appliqué en prés-levée n'inhibe pas le processus de levée des graines, contrairement aux résultats obtenus par [16] qui après avoir appliqué le gramoxone sur les graines de haricot commun et de blé soumises à la germination ont constaté que l'herbicide ralentissait l'action de la catalase qui conduisait au ralentissement de la germination des graines de haricot seulement s'accentuant après chaque 24heures et devenant critique 72heures. La hauteur des plants, et le nombre des feuilles n'ont pas été influencé significativement par les 2 facteurs (P>0,05). Ceci pourrait s'expliquer par le faite que la carence en azote était importante suite aux exportations du précédent cultural le maïs dont les besoins sont élevés en azote pour sa croissance peuvent varier de 200kg/ha à 800kg/ha [17], à cela nous pouvons aussi évoquer le faite que le haricot a une faible aptitude fixatrice de l'azote atmosphérique que le soja. Car la référence [18] montre que la croissance végétative du soja est induite par son aptitude élevée à mieux utiliser l'azote ammoniacale soluble en dehors des apports azotés contrairement au haricot. De ce fait pour le rendement et nombre des graines par gousse les résultats de [19] corroborent aux nôtres car le traitement à base de glyphosate dont 4l/ha dans un sol gravillonnaire sur le soja non inoculé n'a pas eu des effets significatifs sur le rendement et nombre des graines par gousse. Les résultats de [19] se rapprochent aussi de ceux obtenus par [20] sur un ferralsol pour la meme culture se rapprochent de nos résultats pour le nombre de gousses par plant où ni la biomasse de *Tithonia diversifolia* ni le NPK n'a pas manifesté de différence significative, mais il convient de relever que la hauteur des plantes et le rendement ont été influencés par le *Tithonia diversifolia*. Les engrais minéraux utilisés n'ont pas induit un bon développement des structures axillaires dont les feuilles, la hauteur des plantes car ils ont subit une dégradation rapide dans le sol. Ce phénomène est expliqué par [21] qui ont démontré l'inefficacité des engrais minéraux à se maintenir longtemps dans le sol car ils subissent une dégradation rapide imposée par les propriétés physico-chimiques des ferralsols.

4.2 LES TAUX DE RECOUVREMENT DES MAUVAISES HERBES

Les résultats d'absence d'effets du glyphosate sur les 11 espèces reprises dans le tableau ont été aussi confirmés par [22] ont montré que le glyphosate appliqué seul en prés-semis n'assure pas un bon contrôle des mauvaises herbes, mais au contraire associé au paraquat il assure un bon contrôle des espèces : *Commelina benghalensis*, *Tridax procumbens* et *Digitaria horizontalis*. Nous pouvons dire que l'inefficacité du produit a été aussi induite par rapport au moment d'application, car les résultats de[23] qui sont en désaccord avec les nôtre pour le même produit appliqué en post-levée sur un ferralsol en côte d'ivoire en culture d'ananas ont révélé l'efficacité du glyphosate en post-levée à faible dose 3l/ha n'altère pas le produit utile. Cependant il élimine certaines espèces dont *Chloris pilosa* et *Euphorbia forskalii* par contre d'autres espèces deviennent résistantes : *Cyperus rotundus* et *Ficus exasperata*. L'inefficacité du produit pourrait être expliqué par une dégradation rapide du produit dans le sol, car [24] ont confirmé que Le glyphosate se dégrade rapidement dans les sols, mais la durée de demi-vie est très différente en fonction des sols. [25] ajoutent que, la température et l'humidité sont deux facteurs climatiques régulant la dégradation des pesticides le plus souvent lorsque la température diminue, la dégradation des herbicides diminue aussi et leur persistance augmente. La fertilisation minérale par l'azote qu'elle renferme a agit sur les adventices au point de vue levée de la dormance des graines pour certaines espèces car la graine est une forme de vie à l'état latent[26] montre La fertilisation minérale en phosphore et en potassium a peu d'influence sur les populations de mauvaises herbes et [27] ressort l'importance de l'azote après avoir constaté que l'addition de fertilisants qui contiennent des nitrates et nitrites peut stimuler la germination des graines. Le nitrate augmente la germination lorsqu'il est combiné avec d'autres stimuli comme la lumière, les fluctuations de températures et l'éthylène. Les engrais apportés peuvent aussi jouer le rôle de supplément surtout pour une catégorie des mauvaises herbes de la famille des légumineuses notamment *Trifolium sp* selon[28] qui a utilisé 2 types de légumineuses dont la vesce velue(*Viscia villosia*) et les trèfles (*Trifolium spp*) comme couvre sol afin de lutter contre les mauvaises herbes vue leur aptitude pour la fixation symbiotique de l'azote atmosphérique ou d'absorption de l'azote minérale. Le trèfle blanc utilisé comme couvre sol, il joue un rôle effectif de répression des mauvaises herbes, il n'entre pas en compétition avec la culture principale. L'action de l'engrais sur les adventices a été aussi observée par [29] qui ont remarqué l'accroissement de la hauteur et talles de *Tridax procubensens* après application de l'engrais NPK qui a influencé ces 2 paramètres par rapport aux apports de Superphosphate 20kg et nitrate de calcium 25% dont 50kg. Il est à noter que les degrés d'infestation parcellaire était

différents, les parcelles fortement infestées étaient celles soumises à l'application du NPK3 avec un taux de recouvrement moyen supérieur à 50% suivies des celles fertilisées par NPK2 où le taux de recouvrement pour l'ensemble des espèces était égal à 50% contrairement aux parcelles fertilisées par NPK1 où l'ensemble des espèces avait un taux de recouvrement inferieur à 20%.

5 CONCLUSION

Cette étude visait la réduction du nombre des opérations de sarclage car la gestion des mauvaises herbes reste une opération de routine dans une exploitation agricole. Les résultats ont montré que seuls 3 paramètres ont été influencés par l'engrais seul il s'agit du taux de germination pour lequel le plus grand nombre d'individus levés a été observé dans les parcelles fertilisées par NPK 10-20-10, il en est de même pour le rendement qui s'est révélé élevé dans les mêmes parcelles. Cependant, le nombre élevé des gousses par plant a été observé dans les parcelles fertilisées par le NPK3 14-18-18. En revanche pour ces paramètres : la hauteur des plants, le nombre des graines par gousse, le nombre des feuilles et le poids de 100graines la fertilisation minérale n'a pas exercé des effets significatifs. Pour l'herbicide appliqué aucune dose ne s'est révélée efficace car la prolifération des mauvaises herbes était importante presque dans toutes les parcelles, néanmoins l'herbicide a réduit le stock semencier dans le sol et la combinaison des doses glyphosate et engrais n'a influencé aucun paramètre étudié. De ce fait, il s'avère impérieux de prendre en considération l'importance de la matière organique pour les ferralsols en vue de permettre à la plante de bien puiser dans le sol les éléments nutritifs et souligner l'action des microorganismes dans l'amélioration des propriétés physicochimiques de ces derniers, car cette situation limiterait une migration verticale de l'herbicide dans les couches profondes du sol suite à sa faible adsorption sur les particules humiques ces amendements limiteraient aussi les risques de pollution environnementale car l'herbicide au contact du sol sera minéralisé par les microorganismes telluriques. Par conséquent pour cette raison évoquée, le choix va porter sur la faible dose dont 1,5l/ha car toutes les doses utilisées ont induit des effets similaires et assurer un second traitement post-levée avec un herbicide sélectif pour compléter l'action du précédent.

REFERENCES

[1] Jean-Paul Chausse, Thomas Kembola, Robert Ngonde, « *L'agriculture : Pierre Angulaire de L'économie de la République Démocratique du Congo »*, Volume II: Etudes sectoriels ,Ed. Medias Paul, Kinshasa, pp 1-97, 2012.

[2] A. Kaloma, K. Kitambala, N.L Ndjango, U. Sinzahera, T. Paluku, Effet des poudres d'*Eucalyptus citriodora*, de *Cupressus lucitanica* et de *Tagetas minitiflora* dans la conservation du maïs (*Zea mays*) et du haricot (*Phaseolus vulgaris*) dans les conditions de Rethy (République Démocratique du Congo) , *Tropicultura*,vol26,n° 1, pp 24-27, 2008.

[3] Léandre Kabulo Kabengele , *La réorganisation du secteur agricole et son impact dans l'économie Congolaise (Cas de la province du Katanga)mémoire de fin de cycle du diplome d'etudes de licence en Economie et Finance*, Université de Lubumbashi Ed Jhon libbey,2010 [on line] Aviable :http://www. Mémoire on line.com/ p51,(october10, 2013)

[4] A.Kanyenga-Lubobo, C. Funny-Biola, M. Ngoie-Lubwika, J.Mudibu, L. Tshilenge-Lukanda, A. Kalonji-Mbuyi, Yield Performance and Resistance to Angular Leaf Spot Disease in Bean (*Phaseolus vulgaris* L.) at Five Agro-ecological Zones of Katanga, Democratic Republic of Congo, *International Jounalof Research in Plant science,* 2(1),pp 16-22, 2012.

[5] G. Mergeai, L'agriculture en tant que moteur de la croissance pour lutter contre la pauvreté : potentialités et contraintes de l'agriculture de conservation pour lutter contre la pauvreté rurale en Afrique-subsaharienne, Tropicultura,vol 28,n° 3,pp 129-132, 2010.

[6] Mongana J.C.E., Bolakonga A.N.E, Musungayi J.M.T, Kashema C.B., Détermination du moment d'application de *Tithonia diversifolia* et son évaluation agro économique sous culture de haricot (*Phaseolus vulgaris* L.), *Congo science*, vol2 n°1, p5, 2014.

[7] Etienne.T.Pamo,Benoit Boukila,Christopher M.Tankou,Femand Tendonkeng,Jean Raphael KANA, Apolite D.Loudjom, Effet des differentes sources d'azote sur la croissance et le rendement du haricot commun (*Phaseolus vulgaris*.L)à l'Ouest du Cameroun,*Cameroon journal of Experimental Biology*, Vol1,N°1,pp1-7, 2005.

[8] Boudjedjou Lamia. Etude de la flore adventice des cultures de la région de la région de Jijel, Mémoire de MAGISTER, Faculté des sciences, Département de Biologie, Université Ferhat Abbas-Setif, pp 155, 2010.

[9] FAO, Gestion de mauvaises herbes pour les pays en développement .Addenum1, Organisation des Nations Unies pour l'Alimentation et l'Agriculture, Ed RLabrada, Italie, Rome, 2005.

[10] C.Careme, T.Sghaier , Conséquences de la nuisibilité des mauvaises herbes sur la production du blé d'hiver en Tunisie : Les seuils d'intervention et la rentabilité du désherbage, *Tropicultura*,vol9,n°2, pp53-57, 1991.

[11] Luciens Nyembo Kimuni, Ilunga Tabu Hugues, Emmanuel Muyambo Musaya, Augustin Ekondo Okese, Mick Assani Bin Lukangila, Antoine Kanyenga Lubobo, Michel Mpundu Mubemba, Louis Baboy Longanza, Influence de la fertilisation à base des déchets humains recyclés, des engrais minéraux et de leur combinaison sur le comportement de 3 variétés de maïs (*Zea mays* L.), *Journal of Applied Biosciences* vol 77, pp 6500– 6508, 2014.

[12] Mpundu MM, *Contamination des sols en Eléments Traces Métalliques à Lubumbashi (Katanga/RD Congo). : Evaluation des risques de contamination de la chaîne alimentaire et choix de solutions de remediation ,* thèse de doctorat, Faculté des sciences agronomiques, Université de Lubumbashi, 432p, 2010.

[13] Emery Kasongo, 2009. Système d'évaluation des terres a multiples échelles pour la détermination de l'impact de la gestion agricole sur la sécurité alimentaire au Katanga ,R.D. Congo, thèse de doctorat , Faculté des Sciences , Université de Gent, Belgique, pp 48-336

[14] F.Malaisse, La couverture végétale de Lubumbashi. *In* Bruneau J.C., Pain M., (Ed), atlas de Lubumbashi. Ed publidix,université Paris X- Nanterre, pp 30-31, 1990.

[15] Hubert P, Recueil de fiches techniques d'agriculture spéciale à l'usage des lycées agricoles à Madagascar Antananarivo, 1978.

[16] Anca humă, antoanela patraş, VL. Artenie, PaulaAmagdei , L'influence De l'herbicide Gramoxone sur l'activité de la catalase dans les Grains De Blé et de Haricot Au Cours De La Germination ,G et BM,Tome4, IASI, 2003.

[17] Useni Sikuzani Yannick, Mwema Lumbala Alain, Musambi Luhanga, Chinawej Mbar MukazDieudonné, Nyembo Kimuni Luciens, L'apport des faibles doses d'engrais minéraux permet-il d'accroitre le rendement du maïs cultivé à forte densité ? Un exemple avec deux variétés de maïs à Lubumbashi, *Journal of Applied Biosciences*, vol 74,pp 6131- 6140, 2014.

[18] G.R.Mandimba, E. Makéla, P.Moussongo, J.Pandzou, Nodulation et rendements du soja *Glycine max.*L.MERRIL Inoculé par Bradyrhizobium japonicum dans differents systemes de culture à Kombé Brazzaville Congo,*Tropicultura*, vol12,n°4, pp 134-140,1994.

[19] Tamia Joséphine Ama-Abina , Guy Ferrand Beugre , Mako François De Paul N'gbesso , N'Guessan Dominique Brou Gballou Réné Yoro, *International. Journal of. Biological and Chemical Sciences*,vol 6,n°5 ,pp1970-1978,2012

[20] Kasongo Lenge Mukonzo Emery, Mwamba Mulembo Théodore, Tshipoya Masumbuko Patient,Mukalay Muamba Joseph, Useni Sikuzani Yannick, Mazinga Kwey Michel , Nyembo KimuniLuciens, Réponse de la culture de soja (Glycine max L. (Merril) àl'apport des biomasses vertes de Tithonia diversifolia (Hemsley) A. Graycomme fumure organique sur un Ferralsol à Lubumbashi, R.D. Congo, *Journal of Applied Biosciences*,vol 63, pp 4727- 4735, 2013.

[21] Useni S.Y., Baboy L.L., Nyembo K.L. & MpunduM.M., Effets des apports combinésde biodéchets et de fertilisants inorganiques sur le rendement de troisvariétés de Zea mays L. cultivées dans la région de Lubumbashi, *Journal of AppliedBiosciences*, vol 54,pp 3935- 3943, 2012.

[22] Jean-Paul Olina Bassala, Venasius Wirn Karlend Zemo, Pascal Marnotte , Acte du colloque « Savanes Africaines en développement : Innover pour durer »20-23 Avril 2009, Garoua, Cameroun .*OCL*-00471427, Version1-8,2010.

[23] Mangara Ali, Kouame N'dri, Marie-Thérèse, SORO Kafana, N'da Adopo Achille Aimé, Gnahoua Guy Modeste, Soro Dodiomon, Test d'efficacité d'un herbicide en culture d'ananas, à la station d'expérimentation et de production d'Anguédédou en Côte d'Ivoire, *Journal of Applied Biosciences*,vol 80, pp 7161-7172, 2014.

[24] L.Mamy, E.Barriuso, 2002**.** soil behaviour of herbicides and evaluation of the environmental impacts ofpesticides when introduction the glyphosate-resistant crops, Séminaire de restitution des résultats de l'AIP "OGM et Environnement" « 1998-2001 »,Paris, 2002.

[25] Laure Mamy, Comparaison des impacts environnementaux des herbicides à large spectre et des herbicides sélectifs : caractérisation de leur devenir dans le sol et modélisation, thèse de doctorat, Institut National Agronomique, Paris-Grignon, p17- 357,2004.

[26] Yvon Douville, « Prévention des mauvaises herbes : Grandes cultures », Ed,Technoflora, 9485, des Merisiers, Becancour, Canada, p23,2002.

[27] M.L. Leblanc, D.C. Cloutier, G.D. Leroux et C. Hamel,Facteurs impliqués dans la levée des mauvaises herbes au champ *Phytoprotection*, vol. 79, n° 3, 1998, p. 111-12 ,1998.

[28] Kossi Édjamé Rolland Mensah, Utilisation de la fève adzuki (*Vigna angularis*), du radis huileux (*Raphanus sativus*) et du seigle d'automne (Secale céréale), combinés ou non à des doses faibles d'herbicides pour la maîtrise des mauvaises herbes annuelles dans le maïs sucré, Mémoire présenté à la Faculté des études supérieures de l'Université Laval dans le cadre du programme de maîtrise en Biologie végétale pour l'obtention du grade de Maître es sciences (M.Sc.), Québec. Département de Phytologie pp15-119,2011.

[29] O.S. onifade,A.T.Omokanye, J.T. Amaodu, The influence of seed rates and fertiliser type on growth of *Tridax procubensens* in Sub-Nigeria , *Tropicultura*, vol19,n°2,pp70-74,2001.

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Biradrism As Stronger Determinant Of Voting Behavior; Exploring The Voting Behavior Of People Towards Different Political Parties During Election 2013 In District Layyah

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ABSTRACT: Voting is the main form of political participation in democratic societies and the study of voting behavior is a highly specialized sub-field in political and social science. The study was concerned with the reasons why people vote the way they do. The main objectives of the present study were to find out the factors which affect the voting behavior & to explore the factors that constitute political affiliation in District Layyah. A sample of 160 household respondents was selected systematically from District Layyah through multistage sampling technique. Specifically explored through this study the relationship of voting behavior with education, internal changes in the party, voter's satisfaction and barbarism are those factors that had strong effect on voting decisions. More than fifty percent (55%) of the respondents vote for the candidate not for the party and (53.1%) of the voters change their behavior due to the internal changes in the party. The value of Chi-Square and Gamma showed a significant and strong association between voter satisfaction with particular political party, favor of biradrism and internal change in the party are strongly associated with voter's behavior.

KEYWORDS: voting behavior , religion, caste, ethnicity and biradri.

1 INTRODUCTION

Man is a social being, and as such he always contributes in social life. But this contribution is not constant: the intensity and types of participation are relevant variables in political analysis. Voting behavior is very important topic because through this we can know the will of people and also the way they want to have it .Voting is very important tool in democratic societies. Democracy provides a chance to the people to become a dynamic citizens rather than inactive subjects (Jost, 2006). A person who is the citizen of Pakistan, is not less than 18 years of age on the first day of the January of the year in which the rolls are prepared or revised, is not declared by a competent court to be of unsound mind and is or is deemed to be the resident of an electoral area, can get himself enrolled as a voter in the electoral area. The citizens registered on the electoral roll are only eligible to cast their vote. (GOP, 2011). Voting defined by Universal Declaration of Human Right as "Voting is the fundamental right of almost all citizens over the age of eighteen. It ensures that will of the people is preserved" (HRCP, 2008). Voting is the expression of a person's preference for a candidate, or a group of candidates, as well as the person's preference of one political system rather than another (Blais, et al., 2004). A person who is the citizen of Pakistan, is not less than 18 years of age on the first day of the January of the year in which the rolls are prepared or revised, is not declared by a competent court to be of unsound mind and is or is deemed to be the resident of an electoral area, can get himself enrolled as a voter in the electoral area. The citizens registered on the electoral roll are only eligible to cast their vote. (GOP, 2011)

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The people of Pakistan do not have much experience in elections. The first 23 years of Pakistan were without elections while from 1970 to 2010 nation has experienced 4 regimes of dictatorship. Frequent military interventions hindered the development of a country. The election system has been changing since independence. Hence the political system of Pakistan is still in its experimental stage. Political behavior is a central part of politics of any political system. Politics is an activity related to political system. It is not only a part of political life but social life too (Ahmed, 2004). Studies allied with voting behavior report that voters can be classified into seven most important types by their inspiration to vote: Party Loyal, Morality Seeking Voters, supporter Seeking Voters, Legislation Minded Voters, advance Seeking Voters, Biradari Bound, and disbeliever Voters (Gallup, 2008).Voting decisions are the most important decisions that public make, They decide who will rule the country and how the resources and capital are allocates. Voters do not know all of the issues. They only relay on informational cues (Cohen, 2003). Demographic factors do effect the voting decisions like gender, race are more important than socioeconomic factors like education (Leighley and Nagler, 1992).In the last few years ethnic and racial influence on voting decisions was studied more than other issues. Race and ethnicity had great influence on voting behavior (Branton, 2004). Social class plays a significant importance in voting behavior. However, other factors are showing an ever increasing importance today, such as, social class, party policies, and ethnicity and region issues (Lednum, 2006). Voting for a candidate of one's own race might be a product of racism, or it may be the result of reliance on a simple, readily available cue. In other words, voters may support a candidate of their own race or ethnicity based on the assumption that a candidate who shares their racial or ethnic background also shares their basic political views (Michelson, 2005).

2 METHODOLOGY

This study was designed to assess the voting behavior of people towards different political parties. This research uses a statistically valid random sample of 160 respondents to study the voting behavior of the respondents in Layyah. The study was carried out in randomly selected town. The universe of the present study was Layyah district. Out of eight towns of Layyah district one town namely Eid Gah town was selected randomly. At the 2nd stage two union councils were selected randomly and at 3rd stage four localities from each Union Councils were selected randomly. At the 4th stage 20 respondent from each locality were selected by systematically sampling technique. A well structured questionnaire consisting of open and closed ended questions was prepared. Descriptive analysis such as percentage distribution, frequency distribution and bi-variate analysis was made by using SPSS. Significant relationship was tested through chi-square and gamma test.

3 RESULTS AND DISCUSSION

Voting is the expression of a person's preference for a candidate, or a group of candidates, as well as the person's preference of one political system rather than another. The results about literacy level of respondent exhibited by this study were very typical of Pakistani society. Study showed that nearly half (45.5%) respondents were without education while (16.9%) were with 10 years of schooling while only (10.6%) achieved graduation or above level. In Pakistan overall literacy rate is (57%) according to economic survey (Anonymous, 2010). In view of literacy level (Birner et al, 2006) depicted that in his pattern survey more than half of the candidates were illiterate. Because of illiteracy the people of Pakistan do not have much awareness about the politics. They are inclined by the campaigns and party slogans and vote accordingly. There are also various economic factors behind their decisions. There are many factors that influence the voter's decision like biradrism was found sound effect on the voting behavior. More than fifty percent (55%) respondents vote to the candidate because of the candidate and nominee belong to their own biradri or caste. Biradriism is the most powerful element in Pakistan and it is the main basis of the voting behavior in Pakistani society. These results are analogous with (Ahmad, 2004) who found that major part of voters has no political fidelity. People caste their votes to survive as a group or biradri. In case of candidates belonging to the same biradari, voters use their preferences. There is no party identification that is the psychological connection of a voter to a particular biradri. (Wilder, 1999) was also pointed out this phenomenon. He depicts that in Pakistan, particularly in Punjab the leading aspect of the social system is biradarism. It has impact on the political system at national as well as at local levels. Biradari is a stronger determinant of voting behavior. In Pakistani culture family is considered the strong element and most of the people live in joint family system that's why family members have strong influence about any decision or matter. A mainstream of the (34.4%) respondents vote to the parties because their parents and family members pursued them to do that. They have not their own choice. They just pursue their parent's decision. These figures indicate that the people of the Pakistan are not sovereign yet to take their own decisions. They depend on their parents and family members. The similar observations were (Birner et al, 2006) they stated that an ample share of the voters also considered the opinions of others, including the landlord, the community and husband or father as important. The results of present study was also supported by (Ahmad, 2004) who said that people vote for the same party because their

biradari support them. It means people caste their votes to biradri supported candidate. The ratio of biradri supported candidate in Faisalabad district is (74%). The Pakistani people have keen interest about political matters and party manifesto. Data exhibited that (45.6%) respondents know about the party agenda. These findings line up with (Lednum, 2006) who reported that the agenda of the party had dominated explanations for voting behavior in U.K for example in 1992 (56%) of the social class AB voted for the conservatives and only 20% voted for labor. About (13.1%) respondents acquire information about political matters by newspaper. In developed countries media has great exposure and have sizeable impact in shaping the public's political knowledge, attitudes and behavior. But in developing countries like Pakistan people rely on their parents and peer group experiences. Result demonstrated that (62%) of the respondents caste the vote in the previous (2008) general election. The male respondents were found dynamic role in casting the vote. In the total population about (65%) of male respondents had cast their vote and (35%) of the female respondents cast their vote in the present research. It was also repotted by (Anonymous, 2010) that the voting turn out in the previous general election 2008 was (44.5%) and in the 2002 general election the voting turnout was (41.8%). It shows that Pakistani people have no much interest in the casting the vote. If we compare with other developed countries such as Sweden, Australia, Switzerland, Denmark and Italy etc. have more than (80%) voting turn out. (Adma, 2007) It also depicted that Pakistan had the problem a lack of political participation in the politics. (Adma and Schoersh, 2007) marked that between 1945 and 1997 about (41.8%) of the populations, who are allowed to vote, are voting. This compares with about (90.6%) in India, 56% in Bangladesh and 63.7% in Nepal.

Data exhibited that Female voting turnout is low, if we compare with the male respondents. (Birner et al, 2006) are also in consonance to the findings of the present study. They also identified that women's vote turnout was considerably lower than men's vote turnout in all Provinces. The difference was particularly pronounced in khyber pakhtunkhwa, followed by Sindh. At the national level, (39.5%) of the women voted, as compared to (56.8%) of the men. The researchers also found that the main causes of the non-casting vote are inconvenient atmosphere did not have I.D card, had no name in voting lists, not take the interest in the selection of the representative and fear of violence were the major causes of non-casting vote in the election. The findings of the study carried out by (Birner et al, 2006) they observed that more than a few of the respondents who did not vote because they did not have an I.D card, were not registered as voters, or because their name was not in the electoral list. Lack of possessing an I.D card was also a major reason non-casting the vote.

Data revealed that (53.1%) of the voter's alleged that due to the Internal change in the party they vote to the party. Best example of internal changes in the party effect the voter's decision was shown in the previous elections where Pakistan People's Party (PPP) got lead in the elections just due to the assassination of their leader Banzeer Buhtoo. The voting behavior of the people abruptly changes and the entire sympathy vote goes to PPP. In the history of Pakistan the voting prototype of Pakistani people remain the same if a family gave vote to a particular party then they vote again and again to that party. And this affiliation goes generation to generation. This is not done due to the contentment they get by the party work but in Pakistan there are many other factors that effect the voting decisions and most important is biradrism in the present study this phenomenon is studied. Data demonstrated that (61.3%) respondents decide before the election that to which party they will support in the next election. These statistics presented by (Anonymous$_1$, 2011) who explored that the voting preference of the respondents in the previous election towards different political parties such as Pakistan People's Party (PPP) 47.5%, Pakistan Muslim League N (PML N) 30.0%, Pakistan Muslim League Q (PML Q) 11.3% and 11.2% others political parties. These findings strongly grasped up the 2008 general election consequences in Faisalabad. There are total 11 seats of members in national assembly (MNA) and 22 members in Punjab assembly (MPA) in Faisalabad district. In 2008 general election members of national assembly (MNA) in Pakistan the winning candidate of Layyah district belonged to different political parties such as (PPP) having 6/11, (PMLN) 3/11 and (PMLQ) 2/11. (Anonymous$_2$, 2011) was the eye viewed of Members of Punjab Assembly (MPA) (PPP) having 7/22 Pakistan Muslim League N (PMLN) 10/22 and Pakistan Muslim League Q (PMLQ) 5/22 respectively. This data show that two major parties PPP and PMLN are dominating in the Layyah politics. These findings are also lined up with (PILDAT, 2008) also identified that all elections since 1970 show that there are four clusters of voters: The PPP cluster, the Pakistan Muslim Leagues cluster, the Religious Parties and local Parties cluster. Past electoral behavior demonstrates that roughly 60 to 75% of votes are alleged by the first two clusters (PPP and PML) while the lingering gets distributed among the other two clusters as well as independents and miscellaneous.

Table1. Association between internal change of the party and behavior of the voter

Internal change in the party setup affect	In next election will you vote for this particular party			Total
	Yes	No	Uncertain	Above
Yes	62	21	4	87
	71.3%	24.1%	4.6%	100.0%
No	25	31	7	63
	39.7%	49.2%	11.1%	100.0%
Uncertain	2	8	0	10
	20.0%	80.0%	.0%	100.0%
	89	60	11	160
	55.6%	37.5%	6.9%	100.0%

Chi-square value = 23.23 d.f. = 4 P-value = .000 Gamma value = .53

Table 2 shows that Chi-square value (23.23) shows a highly significant (P-value = .000) association between internal change in the party setup affect and casting of their vote in next election to their particular party. The gamma value shows a positive relationship between the variables. Its mean internal changes effected their decision in election.

Table 2: Association between biradrism and voter behavior

Do you prefer to vote that candidate who belongs to your caste?	In next election will you vote for this particular party			Total
	Yes	No	Uncertain	Above
Yes	70	37	5	112
	62.5%	33.0%	4.5%	100.0%
No	19	21	4	44
	43.2%	47.7%	9.1%	100.0%
Uncertain	0	2	2	4
	.0%	50.0%	50.0%	100.0%
	89	60	11	160
	55.6%	37.5%	6.9%	100.0%

Chi-square = 18.47 d.f. = 4 P-value = .001 Gamma = .440

Table 3 shows that Chi-square value (18.47) shows a highly significant (P-value = .001) association between biradrism with their voting decision and in next election will they vote for this particular party. The gamma value shows a positive relationship between the variables. It's mean if the candidates are from their biradri than they cast their vote next time to their particular party. So the hypothesis "If the candidates are from their biradri then they also cast their vote in the next election to that particular party" is accepted.

4 CONCLUSION

The people of Pakistan do not have a lot of experience in elections. . The first 23 years of Pakistan were with out election while from 1970 to 2010 nation has experienced 4 regime of dictatorship. The election system has been changing since independence. Hence the political system of Pakistan is still in its experimental stage. Political behavior is a central part of politics of any political system. Politics is an activity related to political system. It is not only a part of political life but social life too. Caste system seems to be stronger than political loyalty now-a-days as far as motivations for voting behavior are concerned. Party affiliation determines voting behavior. The strong and national level political parties are expected to wipe out the influence of biradarism. The better level of education and political knowledge will reduce the power of discouraging elements of biradarism. Biradarism as a racial or group prejudice should be discouraged. Because of that our public does not have awareness' about politics we are still living in a non- politicalised society.

REFERENCES

[1] Adma, S. and Schoresch D. (2007). The Political crisis of Pakistan in 2007. European University center for peace studies (EPU) Standtschlaining, Austria. Issue 08/07. pp. 10.

[2] Ahmed, M. (2004). Faisalabad Division ke Siasat per Biradarism kay Asraat, Un-published Ph. D Thesis, Department of Political Science and International Relations, Multan, B. Z. University. pp: 46.

[3] (2010). Voter turnout data for Pakistan.
Available : http://www.idea.int/vt/country_view.cfm?CountryCode=PK. Assessed by 28/03/2011.

[4] (2011). Province Assembly of the Punjab. Member's directory.
Available : http://www.pap.gov.pk/index.php/members/bydistrict/en/19/51. Assessed by 22/03/2011

[5] (2011). Complete list of Member's National Assembly of Pakistan. National Assembley of Paksitan.

[6] Birner, R., S. K. Qureshi, K. Akramov and B. H. Khan. (2006). Voice and Votes—Does Political Decentralization Work the Poor and for Women? Empirical Evidence from 2005 Local Government Elections in Pakistan. The Pakistan Development Review. 45 : 4 Part II pp. 1345–60.

[7] Branton, R. P. Voting in Initiative Elections: Does the context of racial and ethnic diversity matter? State Politics and Policy Quarterly. 2004, 4(3): 294-317

[8] Blais, A., G. Elizabeth and N. Neil. (2004). Where Does Turnout Decline Come From? European Journal of Poitical Research. 43:221-23.

[9] Branton, R. P. (2004). Voting in Initiative Elections: Does the context of racial and ethnic diversity matter? State Politics and Policy Quarterly. 2004, 4(3): 294-317

[10] Cohen, K. (2003). Journal of Personality and Social Psychology, 85: pp: 808-22

[11] Gallup. P. (2008). Exit poll – Election Day Survey. Election. 2008. Gallup Pakistan in collaboration with PILDAT exclusively for the Daily Business Recorder and Aaj TV.

[12] GOP. (2011). Government of Pakistan. Election Commission of the Pakistan.
Available: http://www.ecp.gov.pk/ElectionLaws/EligibilityofVoter.aspx Assessed by 02/04/2011

[13] HRCP. (2008). Human right comession of Pakistan. State of human rights: An annual report Lahore, Pakistan.

[14] Jost, J. T. (2006). The end of the end of ideology. American Psychologist. 61: (7). 651-70.

[15] Leighley, E. and J. Nagler. (1992). Individual and Systemic Influences on Turnout: Who Votes? Journal of Politics. 54 :(3). 718-40.

[16] Lednum, G. (2006). Assess the Importance of Social Class to Voting Behaviour in the U.K. 2006. Available at this sight. http://lednum.wordpress.com/2006/12/28/assess-the-importance-ofsocial-class-to-voting-behaviour-in-the-uk/

[17] Michelson, M. R. (2005). Does Ethnicity Trump Party? Competing Vote Cues and Latino Voting Behavior. J. Political Marketing. 2005, 4 (4). Available : http://www.haworthpress.com/web/JPOLM.

[18] PILDAT. (2008). Pakistan Institute of legislative and transparency (PILDAT). A Dispassionate Analysis of How Elections are stolen & will of the People is Defeated. Islamabad. Pakistan. ISBN 978-969-558-067-7.

[19] Wilder. A. R. (1999). The Pakistani Voter: Electoral Politics and Voting Behavior in the Punjab, Karachi: Oxford University Press. Page. 179.

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A Study on Drying Kinetics of Shrimps

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ABSTRACT: In this study, samples of shrimps were dried in a convective tunnel dryer at 60^{o}C, 70^{o}C and 80^{o}C. Moisture kinetics was investigated and fitted into various models based on Fick's second law of diffusion. Logarithmic model had the best fit for the drying condition and effective moisture diffusivity increased as drying temperature increased. The activation energy was found to be 33.851kJ/mol.

KEYWORDS: Drying Kinetics, Shrimps.

1 INTRODUCTION

Shrimp, any of about 2,000 species of small, aquatic animals related to crabs, lobsters, and crayfish. It ranges in size from animals not much bigger than a fingernail to ones over 20 cm (8 in) long **(**De-Grave *et al.,* 2008; Christian 2011**)**. Shrimp lives in a wide variety of freshwater and saltwater habitats, including lakes, coral reefs, and the depths of the sea. Some shrimp are good swimmers and spend nearly their entire life swimming in open water. But many species are bottom-dwellers and swim only occasionally. These shrimps crawl over submerged rocks, sand, or mud on the lake or ocean floor.

Shrimp has become increasingly popular in many part of Nigeria. Over the past decades, interest in the demand of this animal has again increased due to health benefit accrued from nutritional standpoint in that shrimp meat is high in protein but low in fat, which makes it a highly nutritious food (Ajala and Oyategbe 2013). Shrimp by-products have been identified as an animal protein source of great potential; also, as an important source of chitin and asthaxanthin (Shahidi and Synowiecki, 1991).

Various methods abound for preservation of shrimps. Such methods include freezing, canning and drying (Rungtip *et al.,* 2005; Lourdes *et al.,* 2007). Canning and freezing are viable options to preserve shrimp in advanced economy. However, in developing economy such as in Nigeria, drying is prefer option due to its lower cost compared to canning and freezing. Furthermore, most drying of shrimps is done by spreading it on mat in open sun (Rungtip *et al.,* 2005, Nwanna *et al.,* 2004). This resulted in poorly dried shrimps; some are fermented before drying is accomplished. Because of this problem, there is need to develop a better and efficient drying method which can accurately drying this product. This is accomplishable by means of studying the drying behaviour of the shrimps to determine amount of energy needed to dry the samples. Then, mathematical models can then be used to design an efficient drying process using tunnel dryer. Therefore the objectives of this study are (i) to study the effect of temperatures on the drying characteristics of the shrimps (ii) to determine the effective diffusivity and activation energy of the samples in the dryer using Fick's law of diffusion (iii) to fit in the experimental drying curve data into seven mathematical models.

2 MATERIALS AND METHODS

2.1 DRYING EXPERIMENT

A sample of fresh white shrimp (*Penaeus vannamei*) was obtained from Sasi Lagoon Resort, Lagos State. Nigeria. The shrimps were immediately placed in ice with an ice/ shrimp ratio of 2:1 (w/w) for 6 hrs. The samples were prepared for drying by beheading, washing and draining the shrimps. The drying experiment was performed in a tunnel dryer built in the Department of Food Science and Engineering, Ladoke Akintola University of Technology, Ogbomoso Nigeria. The dryer was operated at air temperature of 60^0C, 70^0C and 80^0C at constant air velocity of 1.5 m/s. The dryer was installed in an environmental condition of 48% relative humidity and 29^0C ambient temperature. The temperature and the air velocity in the dryer were at steady state before samples were introduced into the dryer. Rounded and spherical shape shrimps were selected for the drying operations. The shrimps had average radius of 5.00 mm measured with a micrometer screw guage. The samples were placed in the dryer and removed manually every 1 hour to determine weight loss of the sample. The drying experiment was stopped when three consecutive sample weights remained constant.

2.2 MATHEMATICAL MODEL

In this work, Fick's second law of moisture diffusion in porous media was adapted for the drying operation. This is as represented in equation 1

$$\frac{\partial m}{\partial t} = D\frac{\partial^2 m}{\partial t^2} \qquad 1$$

Where *m* = moisture content (kg water/kg solid); t = time (s); D = diffusion coefficient for moisture in solids (m^2/s).

To solve this equation for certain geometries or shapes, the following assumptions were made;

- free water content at the surface is zero and moisture is evenly distributed
- the shape and size of the sample remain constant during drying i.e negligible shrinkage
- heat transfer proceeds very quickly (negligible internal and external heat transfer effect)

To investigate the drying behaviour of the shrimps, the experiment data were fitted into seven different models as presented in Table 1. These models described the relationship between moisture diffusion and drying time with different coefficients attached to each model.

Table 1: Mathematical drying models

Models	Equation	References
Henderson and Pabis	MR=aexp(-kt)	Chinnman, (1984)
Midilli	MR=aexp(ktn) +bt	Togrul and Pehlivan, (2003)
Newton	MR=exp(-kt)	Kingly et al., (2007)
Page	MR=exp(-kt^n)	Karathanos and Belessiotis, (1999)
Logarithmic	MR=aexp(-kt) +c	Togrul and Pehlivan, (2003)
Two-Term	MR=a exp(k_1t) + b exp(k_2t)	Hodge & Taylor, (1999)
Diffusion Approximation	MR=a exp(-kt) + (1-a) exp(kbt)	Sacilik *et al.,* (2005)

These models in Table 1 show relationship between moisture ratio and drying time. Moisture ratio (MR) during the thin layer drying was obtained using equation 2

$$\text{MR}=\frac{M_i - M_e}{M_O - M_e} \qquad (2)$$

Where MR= dimensionless moisture ratio, Mi = instantaneous moisture content (g water/g solid), Me =equilibrium moisture content (g water/ g solid), Mo = initial moisture content (g water/ g solid). However, due to continuous fluctuation of relative humidity of the drying air in the dryer, equation 2 is simplified in equation 3 according to Goyal *et al.,* (2007)

$$\text{MR}=\frac{M_i}{M_O} \qquad (3)$$

2.3 STATISTICAL ANALYSIS

The drying model constants were estimated using a non-linear regression analysis. The analysis was performed using Statistical Package for Social Scientist (SPSS 15.0 versions) software. The reliability of the models was verified using statistical criteria such as coefficient of determination (R^2), reduced chi-square (χ^2), root mean square error (RMSE) and mean bias error (MBE). The comparison criteria method can be determined as follows:

$$\chi^2 = \frac{\sum_{i-1}^{n}(MR_{(\exp,i)} - MR_{(pred,i)})^2}{N - z} \quad (4)$$

$$\text{MBE} = \frac{1}{N}\sum_{i=1}^{n}(MR_{(pred,i)} - MR_{(\exp,i)}) \quad (5)$$

$$\text{RMSE} = \left[\frac{1}{N}\sum_{i=1}^{n}(MR_{(pred,i)} - MR_{(\exp,i)})^2\right]^{1/2} \quad (6)$$

2.4 DETERMINATION OF EFFECTIVE DIFFUSIVITY

The simplified equation of Fick's second law was adapted to determine the moisture diffusion from the shrimp samples during the drying process. The analytical solution of the equation 7 represents the mass transfer in terms of specific geometrical representation of spherical shape (Azzouz, 2002 and Sacilik *et al*., 2006)

$$\text{MR} = \frac{M - M_0}{M_0 - M_e} = \frac{6}{\pi^2}\sum_{n=1}^{n=\infty}\frac{1}{n^2}\exp\frac{-n^2\pi^2 D_{eff}t}{r^2} \quad (7)$$

The effective moisture diffusivity (D_{eff}) was calculated from the slope of plot of ln MR against drying time (t) according to Doymaz (2007) and is represented in equation 8

$$k = \frac{\pi^2 D_{eff}t}{r^2} \quad (8)$$

Where *k* represents the slope of the graph.

2.5 DETERMINATION OF ACTIVATION ENERGY

Arhenius equation describes the relationship between moisture diffusion and temperature of drying. This relationship is as shown in equation 9

$$D_{eff} = D_0 \exp\frac{-E_a}{RT} \quad (9)$$

Where D_0 is the pre-exponential factor of the Arrhenius equation in m^2/s, E_a is the activation energy in kJ/mol, R is the universal gas constant in kJ/mol K and T is the absolute air temperature in K. The activation energy was calculated by plotting the natural logarithm of D_{eff} against inverse of the absolute temperature. Figure 3 shows the plot of the relationship between these parameters.

3 RESULTS AND DISCUSSION

The discussion entails studies on the effect of the drying temperature on the shrimps, statistical results of the model parameters, effective diffusivity and the activation energy.

3.1 EFFECT OF DRYING TEMPERATURES ON THE SHRIMPS

The drying pattern of the shrimps is as shown in Figure 1. The moisture loss exhibited falling rate profile which basically is the drying pattern of most agricultural products **(**Ramaswamy and Marcotte, 2006**).** Another observation from the graph is that it exhibited a second falling rate period mostly at the 2nd hr of drying which was as a result of the plane of evaporation which slowly receded from the surface and all evaporation occured at the interior of the food. At this stage, moisture is drastically reduced in the samples and the drying rate is controlled by internal resistance caused by moisture diffusion which is analogous to conductive heat transfer. Therefore, apart from temperature factor, changes in the external conditions such as air velocity no longer affected the rate of drying as reported by Ajala *et al.,* (2011), Ramaswamy and Marcotte (2006), Ivaldo and Gilson (2005). The same trend of drying is observed in figure 2

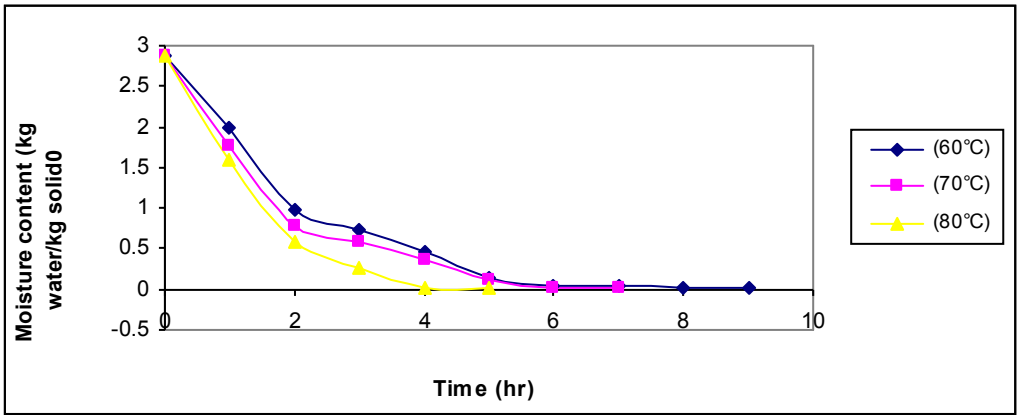

Figure 1: Moisture content against Time

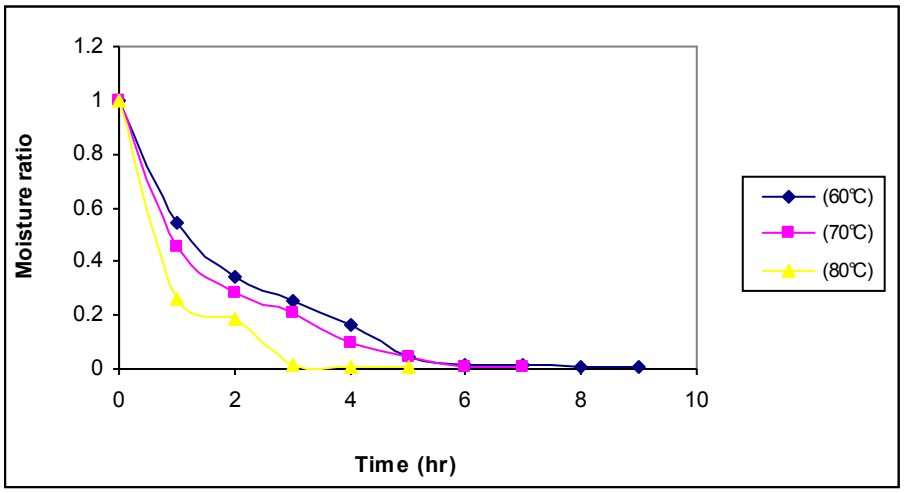

Figure 2: Moisture ratio against Time

3.2 STATISTICAL RESULTS AND CONSTANTS OF THE DRYING MODELS

Table 2 shows the values of statistical parameters used to test the models to evaluate the best fit. A good fit is said to occur between experimental and predicted values of a model when R^2 is high and χ^2, RMSE and MBE are lower (Demir *et al.,* 2004)**.** From the table, careful analysis of the average R^2 for each is as follows: Handerson and Pabis; 0.992, Midilli; 0.815, Newton; 0.991, Page; 0.993, Logarithmic; 0.9943, Two-term; 0.992 and diffusion approximation; 0.994. These values showed that Logarithmic model had the highest average value of R^2. Hence, it can be deduced from the models that Logarithmic model had the best fit for the experimental drying of the shrimp samples. The constant values of different model are as shown in Table 3. Two-term model exhibited both the highest and lowest constant value of 61.126 and -21.399 respectively.

Table 2: Values of statistical parameters

Models	Temp	R^2	χ^2	MBE	RMSE
Henderson and	60	0.992	0.001061	0.007487	0.023675
Pabis	70	0.997	0.000628	0.007939	0.022454
	80	0.987	0.002604	0.012817	0.031395
	Average	0.992	0.001431	0.009414	0.025841
Midilli	60	0.747	0.040658	0.004487	0.014188
	70	0.805	0.041461	0.006689	0.018919
	80	0.893	0.040198	0.004484	0.010982
	Average	0.815	0.040772	0.00522	0.014696
Newton	60	0.992	0.000823	0.007487	0.023675
	70	0.997	0.000533	0.009189	0.02599
	80	0.986	0.002404	0.012817	0.031395
	Average	0.991	0.001253	0.009831	0.02702
Page	60	0.993	0.000885	0.009487	0.03
	70	0.997	0.000559	0.011689	0.033061
	80	0.990	0.002208	0.012817	0.031395
	Average	0.993	0.001217	0.011331	0.031485
Logarithmic	60	0.992	0.001049	-0.00051	0.001623
	70	0.997	0.000576	0.001689	0.004776
	80	0.994	0.001524	0.00115	0.002818
	Average	0.9943	0.00105	0.000776	0.003072
Two-Term	60	0.993	0.001065	0.006	0.018974
	70	0.996	0.000722	0.004189	0.011847
	80	0.989	0.003659	0.00615	0.015065
	Average	0.992	0.001815	0.005446	0.015295
Diffusion	60	0.992	0.001074	0.001487	0.004701
Approximation	70	0.996	0.000671	0.004189	0.011847
	80	0.994	0.001524	0.00115	0.002818
	Average	0.994	0.00109	0.002275	0.006455

3.3 EFFECTIVE DIFFUSIVITY AND ACTIVATION ENERGY

Effective diffusivity (D_{eff}) of a material is defined to describe the rate of moisture movement using transport mechanism such as liquid diffusion, vapour diffusion, Knudsen diffusion, surface diffusion and hydrostatic pressure differences. As shown from Table 4, the values of D_{eff} in this work fall within the range of food products (10^{-11} to 10^{-8} m/s^{-2}) as reported by Doymaz (2007). Moreover, the D_{eff} values reported in this work are less than the values for fish dried in microwave with values of 7.158×10^{-8} to 3.408×10^{-7} m^2/s as reported by Hosain *et al.,* (2012). Also the values are less than the values of clams dried in the cabinet with the values of 3.14×10^{-9} to 11.0×10^{-9} m/s^2 as reported by Betty-Tello *et al.,* (2004). However, the values are comparable with that reported by Mehran *et al.* (2013) with values of $3.24\text{-}6.49 \times 10^{-9} m^2/s$ for foam mat drying of shrimps. Moreover, the effect of temperatures on the effective moisture diffusivity is also observed in Table 4 which shows an increment from 1.27×10^{-9} m^2/s at 60°C to 2.53×10^{-9} m^2/s at 80°C. This clearly showed that moisture diffusivity increased as the temperature increased. This has been earlier observed by some authors such as Ajala, *et al,.* (2012), Guine *et al.,* (2009), Abraham et al., (2004) and Jaya and Das (2003). Besides, Jangham *et al.,* (2010) asserts that not only the temperature affects D_{eff} but also moisture content of the material being dried

Table 3: Values for model constants

Model	Temp	a	b	c	k	k_1	k_2	n
Henderson	60	0.985			0.521			
and Pabis	70	0.994			0.562			
	80	1.011			0.619			
Logarithms	60	0.997		-0.015	0.505			
	70	1.010		-0.023	0.523			
	80	1.110		-0.114	0.483			
Newton	60				0.528			
	70				0.565			
	80				0.613			
Page	60				1.000			-0.840
	70				0.582			0.967
	80				0.546			1.156
Logarithmic	60							
	70							
	80							
Two terms	60	0.099	0.901			-23.650	-0.489	
	70	-21.399	22.391			-0.651	-0.648	
	80	63.126	-62.129			-0.961	-0.969	
Diffusion	60	1.002	-0.487		0.528			
Approximation	70	4.845	1.022		0.630			
	80	1.060	0.996		-0.983			

Table 4: Values of effective moisture diffusivities at different temperatures

Drying air velocity (m/s)	Drying air temperature (^{0}C)	Effective moisture diffusivity (m^2/s) (D_{eff}x 10^{-9} m^2/s)
2.7	60	1.27
2.7	70	1.77
2.7	80	2.53

The activation energy which describes the influence of temperature on the diffusion coefficient of the materials is being derived from the plot of natural log of D against the inverse of the absolute temperatures at which the drying was carried out. In this study, the gradient of the curve produced the activation energy with the value of 33.851kJ/mol and diffusivity coefficient (D_0) of $2.57x10^{-4}m^2/s$.This has a close value with the work of Mehran *et al.* (2013) on the study of foam mat drying characteristics of shrimps with the value of 32.16 kJ/mol.

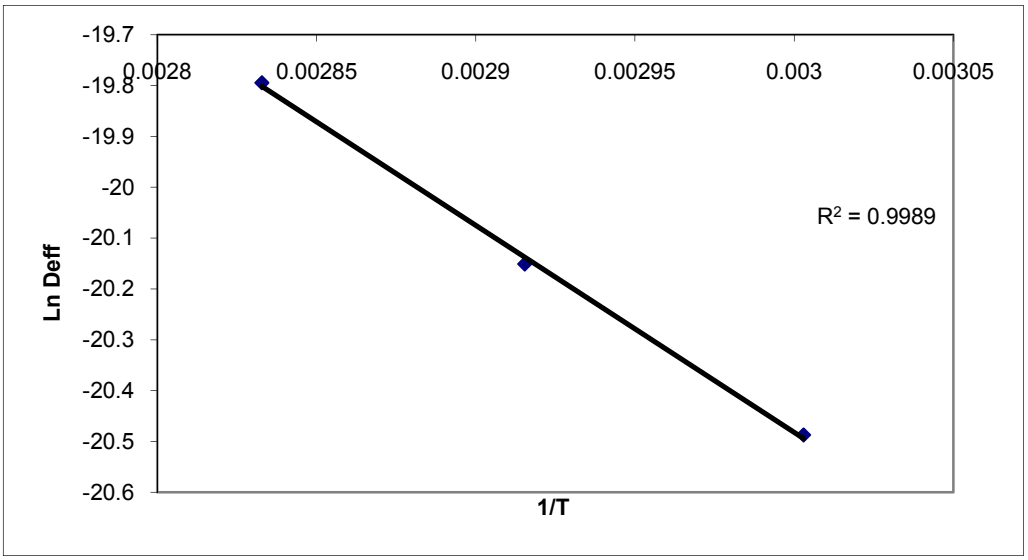

Figure 3: Plot of lnD_{eff} against inverse of absolute temperature

4 CONCLUSIONS

Shrimps were dried at 60°C, 70 °C and 80 °C in a tunnel dryer. The moisture kinetics showed a second falling rate period and Logarithmic model gave the best fit for the experimental drying of the samples having the R^2 average value of 0.9943. The effective moisture diffusivity values were temperature dependent and values were comparable with other research work. The activation energy value was found to be 33.851kJ/mol.

NOMENCLATURE

a,b,c,k, k_1, k_2	Drying constant in the model
l	half of the thickness of the sample (m^2)
D_{eff}	effective diffusivity, m^2/s
D_0	pre-exponential factor, m^2/s
E_a	activation energy, kJ/mol
M_0	initial moisture content of the sample (g water/g solid)
M_i	instantaneous moisture content of the sample (g water/g solid)
M_e	equilibrium moisture content of the sample (g water/g solid)
MBE	mean bias error
MR	moisture ratio
MR_{exp}	experimental moisture ratio
MR_{pre}	predicted moisture ratio
n	drying constant in the model
N	number of observation
R	universal gas constant kJ/mol K
RMSE	root mean square error
R^2	coefficient of determination
t	drying time (hr)
χ^2	reduced chi square
z	number of constant in the models

REFERENCES

[1] Abraham, D.G., Arolilo, A.P., Rosimeire, M.R., Cala, S.S.L., and Amanda, C.F. 2004. The air dryingbehaviour of osmotically dehydrated jackfruit. Proceeding 14th int. drying symposium, pp1-3

[2] Ajala, A.S, Falade, K.O. and Tunde- Akintunde T.Y. (2011). Effect of osmotic pretreatment on the drying kinetics of okra (*Hibiscus ecsulentus*). Journal of Engineering and Technology,vol.6 (2): 41- 44

[3] Ajala, A.S., Aboiye, A.O, Popoola, J.O., Adeyanju, J.A. (2012). Drying Characteristics and Mathematical Modelling of Cassava Chips. Chemical and Process Engineering Research, Vol 4,pp1-6

[4] Ajala, A. S. and Oyategbe, A.O. (2013) Influence of Packaging and Storage on Nutritional Quality of White Shrimp (Penaeus vannamei), International Journal of Advanced Scientific and Technical Research, Issue 3 volume 2, pp 232-235

[5] Azzouz, S.; Guizani, A.; Jomaa, W.; Belghith, A. (2002:): Moisture Diffusivity and Drying Kinetics Equation of Convective Drying of Grapes. Journal of Food Engineering 55. 323-330

[6] Betty, T., Yliana G., Mari M. and Oscar,M. (2004). Air drying of clams (*Anodontites trapesialis*) and tilapia (*Oreochromis niloticus*) fillet. Proceedings of the 14th International Drying Symposium, vol. C, pp. 1977-1983

[7] Chinnman 1984. Evaluation of selected mathematical models for describing thin layer drying of in-shell pecans. Transaction of the ASAE, 27: 610-615

[8] Christian W. Hofstätter 2011,shrimps and crayfish in www.garnelenzucht.dereferences

[9] De-Grave, S., Cai, Y. and Anker (2008). Global diversity of shrimps in freshwater in Estelle, V.B., Leveque, C., Segers, H. and Martens, K. Freshwater animal diversity assessment, Hydrobiologia (Springer) 595 (1) : 287-293

[10] Demir, V., Gunhan, T., Yagcioglu, A.K. and Degirmencioglu, A. 2004. Mathematical modeling and the determination of some quality parameters of air dried bay leaves. Biosystems Engineering, 88: 429-437Doymaz, I. 2007. Air drying characteristics of tomatoes. Journal of Food Engineering, 78:1291-1297

[11] Doymaz, I. 2007. Air drying characteristics of tomatoes. Journal of Food Engineering, 78:1291-1297

[12] Goyal, R.K., Kingsley, A.R.P., Manikantan, M.R., and Ilyas, S.M. 2007. Mathematical modeling of thin layer drying kinetics of plum in a tunnel dryer. Journal of Food Engineering 79(1): 176-180

[13] Guine, R., Lopes, P., Joao, B.M. and Ferreira, D.M.S 2009. Effect of ripening stage on drying kinetics and properties of S. Bartolomeu pears. International Journalof Academic Research, vol.1 no 1, p3

[14] Hodge, B. K. & Taylor, R. P. (1999) Analysis and Design of Energy Systems, 3rd Ed., Prentice Hall Inc., New Jersey,

[15] Hosain D., Asie, F. and Eisa, H. (2012) Mathematical Modeling of Thin-Layer Drying of Shrimp. Global Journal of Science Frontier Research Mathematics and Decision Sciences, Vol 12 Issue 3. pp 80-85

[16] Ivaldo, P. J. and Gilson, R.V. (2005).Drying behaviour and permeability of Eucalyptus grandis lumber. Maderas ciecia technologia 7(1) 17-21)

[17] Jangham, S.V., Law, C.L. and Mujumdar, A.S. (2010). Drying of foods, vegetables and fruits. Volume 1, p19

[18] Jaya, S. and Das, H. 2003. A vacuum drying model for mango pulp. Drying Technology, 21: 1215-1221

[19] Kingly, R.P., Goyal, R.K., Manikantan, M.R. and Ilyas, S.M. 2007. Effect of pretreatment and drying air temperature on drying behaviour of peach slice. International Journal of Food Science and Technology, 4:65-69

[20] Karathanos, V.T. & Belessiotis, V. G. (1999). Application of a thin layer equation to drying data of fresh and semidried fruits. Journal of Agricultural Engineering Research, 74, 335-361,

[21] Lourdes, M. D., Fernando L. G. and Ramón, P. (2007). Comparison of freezing and thawing treatments on muscle properties of white leg shrimp (*litopenaeus vannamei*). Journal of Food Biochemistry 31: 563–576

[22] Mehran Azizpour, Mohhebbat Mohebbi, Mohammad Hossein, Haddad Khodaparast and Mehidi Varidi (2013). Foam mat drying of shrimp: characterization and drying kinetics of foam. Agricultural Engineering International Journal CIGR Journal, Vol 15, no 3

[23] Ramaswamy, H.; Marcotte, M.(2006). Food Processing - Principles and Applications. London: Taylor and Francis Group.

[24] Rungtip T., Sakamon D. and Ampawan T. (2005). Drying methods and quality of shrimp dried in a jet-spouted bed dryer. Journal of Food Process Engineering 28 : 35–5

[25] Nwanna, L. C., Balogun, A. M., Aenifuja, Y. F., & Enujiugha, V. N. (2004). Replacement of fish mean with chemically preserved shrimp head in the diets of African Catfish, Calias gariepinues. Food, Agriculture & Environment, 2(1), 79–83.

[26] Sacilik, K., Keskin, R. and Elicin, A. K. (2005). "Mathematical modelling of solar tunnel drying of thin layer organic tomato". Journal of Food Engineering.73(3): 231-238.

[27] Shahidi, F., and Synowiecki, J. (1991). Isolation and characterization of nutrients and value-added products from snow crab (Chinoecetes opilio) and shrimp(Pandalus borealis) processing discards. Journal of Agricultural and Food Chemistry, 39, 1527–1532.

[28] Togrul, I.T., Pehlivan, D., 2003. Modeling of thin layer drying of some fruits under open-air sun drying process. Journal of Food Engineering 65, 413–425.

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Yorùbá indigenous folksongs as a veritable source for revitalizing moral education among pre-school children in Osun State of Nigeria

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ABSTRACT: One of the pillars of peace and prosperity for any society is a sound moral education which supposed to be inculcated in children early in life. However, the decadence of varying degree in the society raises a course for alarm to examine the issues of moral education. Children's sense of goodness, fairness, respect for others and the like is fostered through encouragement, motivation, examples and assistance offered by significant adults in their lives. One of such encouragement, motivation or assistance may come through folksongs which parents especially mothers could offer to children. Hence, this study therefore examined Yorùbá indigenous folksongs as a veritable source for the impartation of moral education in children. Two hundred grandparents and two hundred young mothers were sampled randomly for the study. The instrument titled, indigenous folksongs for moral education questionnaire (IFFMEQ) was used for the study. The findings were revealing and recommendations were proffered.

KEYWORDS: Yorùbá indigenous folksongs, moral education, revitalize, pre-school children.

INTRODUCTION

Man is naturally a moral being and many of his perfect attributes are attained through moral values. Without morality grave problems face man especially in the social dimension and he is deprived of a happy life. Man will be a man in the real sense of the word when he respects the boundaries of morality and doesn't encroach upon them. In fact, one of the pillars of prosperity for a society is moral education (NBF News (2011); Zhu, (Ed.) (2014). Unfortunately, moral discourse especially among contemporary youths has witnessed a radical departure from its conception in ancient times. Several clarion calls have been made on Nigerians to inculcate moral discipline in youth. As a matter of fact, the launchings of War Against Indiscipline (WAI) by the Buhari-Idiagbon and War Against Indiscipline and Corruption (WAI-C) by the Abacha-Diya regimes respectively were meant to achieve this objective (Fasoro, 2012).

According to Nucci, (2001), children's sense of "goodness" is constructed through their own thinking about their experiences and through dialogue with others about what these experiences mean. This sense of goodness is fostered through encouragement offered by significant adults in their lives. One of such encouragement is the daily announcements that children should be kind to one another" (Comora, 2004). (Berkowitz & Grych, 1998) and Wyckoff, (2000), asserted that children should be helped to understand the reason behind rules, especially rules relating to such moral concerns as justice, fairness, and other aspects of human welfare. Not only that, reasons why one behaviour is preferable to another should be given (e.g, sharing a box of crayons is preferable to pushing another child away from the art area). In discussing these contrasting behaviours with a young child, the focus should be on how what the child does affects someone else (e.g., sharing crayons makes a play partner happy while pushing the child away makes the other child sad). Such discussions foster empathy, higher levels of moral reasoning, and altruism (Berkowitz & Grych, 1998; Wyckoff, 2000). These types of discussions also help children develop perspective-taking abilities in that it focuses on how someone else might think or feel in a given situation (Berkowitz & Grych, 1998; Wyckoff, 2000).

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DEFINITION OF MORAL

There is no clear cut definition of moral because each society divines moral as she viewed it. According to Oladipo (2009), moral is a right conduct, not only in our immediate social relations, but also in our dealings with our fellow citizens and with the whole of human race. It is based upon the possession of clear ideals as to what actions are right and what are wrong and the determination of our conduct by a constant reference to those ideals. Therefore, there is no gain saying that the definition of right conduct is relative, and that right or wrong conduct is defined by the society. Therefore, moral is defined as right conducts as guided by or defined by the respective society **(**Oladipo, 2009**).**

MORAL EDUCATION

Moral Education is the inculcation of refined ideals, values, principles with a view to bring a purposeful behavioural change (Sadavarte, & Akolkar, 2010) among children in the society. Moral education involves education in morality with emphasis on what is morally good. What then is morality? Morality refers to a doctrine or system of beliefs, values, or principles that govern human conduct in two ways: by prescribing positive behaviours that benefit others and by proscribing negative actions that harm others. The positive behaviours, are called pro-social behaviours which include sharing, helping, and comforting. In terms of moral judgment, these actions are viewed as good and ought to be carried out. The negative actions, are inhibitory or negative behaviours which include violations of others' rights and welfare, such as hitting, harming, and otherwise injuring others physically or psychologically, actions viewed as bad which one ought not to do.(Jason, & Garcia, (2009). Therefore, morality is viewed as the "system of rules that regulate the social interactions and social relationships of individuals within societies and is based on concepts of welfare (harm), trust, justice (comparative treatment and distribution) and rights" (Smetana 1997). Therefore morality is germanne in every aspect of our social life.

FOLKSONGS IN YORUBA LAND

The Yoruba are a song loving people. No aspect of their life is devoid of song. In joy or in sorrow, time of meeting and departure, time of exhortation or rebuke and so on. There is always song to express the situation. In fact songs are seen as a powerful channel through which the Yorùbá people express their mind. Songs encompasses their daily lives and inspire them while at work. Songs among the Yoruba is a reflection of people's feelings and those feelings center especially around their world view. That the Yoruba enjoy expressing part of their world view through music shows the appealing nature of music in their society (Olagunju, 1997:24 - 25).

Kennedy (1980) defined folksongs as songs of unknown authorship passed orally from one generation to another, sung without accompaniment and often found in variants (of words and tunes) in different parts of a country. Folksongs used to be predominantly found among peasants or country dwellers, but have since spread to towns and urban cities where they chronicle the people's lives in terms of design, melody and rhythm; hence they have become traditional among them (Samuel, 2003). One of these media of moral education therefore was folksong in which various songs were sung by women both young and old while the young ones listened attentively draw conclusions and learnt some lessons as well. The moral consequences or implications of the songs were usually emphasized or highlighted. Some of these songs are:

Ki ni n o fole se laye ti mo wa	What will I do with stealing
Ki ni n o fole se laye ti mo wa	What will I do with stealing
Laye ti mo wa, kaka ki n jale	In this world, instead of stealing
Ma kuku deru	I will be a slave
Ki ni n o fole se laye ti mo wa	What will I do with stealing

The moral taught with this song is that stealing is not good. A robber is a dangerous person and so people do not want to associate with a robber.

Ofofo ile yii o yera	Busy-body should keep away from this house
Ka ma gbodo soro	should'nt we talk
Ka ma gbodo senu wuye	should'nt we whisper
Ofofo ile yii o yera	Busy-body should keep away from this house

Another lesson or moral drawn from this song is that it is not good to be a busy-body. They are always disgraced in the society.

Omode o e gbohun ti mo fe so children listen to what I have to say

Nibikibi ti e ba wa e gbo wherever you are listen

Ma se je koju kokoro mo e lara do not allow covetousness become part of you

Je kohun te ba ni te yin lorun be contented with what you have.

The above song is a warning to the children. They are been advised not to allow covetousness in their life and that satisfied with whatever they have.

Moral education therefore begins from infancy and it continues in adult life through a variety of processes one of which is folksong. Thus folksong is used to correct and educate young and old, male and female, literate and illiterate (Lasis, 2012).

THE ROLE OF PARENTS IN THE MORAL EDUCATION OF THE CHILD

One of the most consistent findings from research examining the family interactions that facilitate Kohlbergian moral reasoning stages is that the affective components or those interactions, such as parental warmth, involvement and support are related to moral reasoning development (Hart 1988; Powers 1988; Walker and Taylor 1991). Therefore, a warm, supportive bond between parents and children may enhance and motivate children to listen to and respond to parental messages through folksongs.

Parents are vital in the moral development of the child because they are the first moral teachers and role models that young people have. This they do by providing the necessary affective relationship and extensive interactions that facilitates moral development. Parents' responses to children's transgressions and moral dispute and their explanations of the reasons for rules and expectations may facilitate children's moral development.

Unfortunately families who are seen as the first moral teachers no more attach importance to moral education of their children and adolescents. Some parents focus their minds entirely on the academic education of their children and attach less importance to moral education. Education should not aim at academic aspects alone. Academic achievement does not make someone a real human being. Humanity is valued in terms of moral standards. The contemporary families do not pay due attention to the moral education of their children thereby abandoning their most fundamental duty towards them. To teach moral education therefore the best method in education is in the form of behavioural patterns, that is, parents should behave in such a way as to introduce their children to acceptable decent morality and sow the seeds of moral values in their minds. (NBF News (2011). Therefore preparing children for their moral responsibilities as adults is a crucial part of the education process that parents must give to their children.

This paper re-visits some of these teachings and attempts to impart moral education on the children among traditional Yoruba through folksongs as a way out of the present moral degeneration.

OBJECTIVES

- Determine the knowledge of parents (grand and young) on indigenous folksongs
- Identify the moral value drawn by parents (grand and young) from indigenous folksongs
- Determine the perception of parents (grand and young)on indigenous folksongs as a tool for moral education in the contemporary time
- Assess the influence of demographic variables of parents (grand and young) on their perception of indigenous folksongs

METHODOLOGY

THE RESEARCH DESIGN

The study employed the descriptive research design.

POPULATION OF THE STUDY

The study population is made up of young mothers .and grandmothers in Ife metropolis, Osun State.

SAMPLE SIZE AND SAMPLING TECHNIQUES

The sample size was made up 200 young mothers and 200 grandmother randomly selected in Ife metropolis.

INSTRUMENTATION

The design adopted for this study was a descriptive survey design using structured interview technique. Data were collected through in-depth interview sessions with young and grandmothers with the researcher's self-made questionnaire. The instrument consisted of sections A and B. Section A sought information on personal data of the respondents and teacher; while section B consisted of 5 item questions with Yes or No response to sought information on the relevance of Yorùbá indigenous folksongs in teaching morals in Yorùbá society.

RELIABILITY AND VALIDITY OF THE INSTRUMENT

The face and content validity of the research instrument was ascertained by the researcher and an expert in Tests and Measurement to ensure that the items in the questionnaire were capable of eliciting the needed information. Test-re-test reliability of the instrument was found to be 0.89.

HYPOTHESIS

There is no significant influence of parental category on their knowledge of Yoruba indigenous folksongs.

RESEARCH QUESTIONS

1. What moral values do parents (Grand & Young) draw from Yoruba Indigenous Folksongs?
2. What is the perception of parents (Grand & Young) on Yoruba Indigenous Folksongs as tools for moral education?
3. Will the demographic variables of Parents (Grand & Young) influence their perception?

RESULT

HYPOTHESIS

There is no significant influence of parental category on their knowledge of Yoruba indigenous folksongs.

Table 1: Chi-square Analysis of influence of parental category on their knowledge of Yoruba indigenous folksongs

Category	YES	NO	Df	χ^2-cal	χ^2-Tab
Grand Mother	150	50	3	52.51	7.52
	110	90			
Young Mother	80	120			
	100	100			

Table 1 above showed that the influence of parental category on their knowledge of Yoruba indigenous folksongs and it can be observed that the χ^2-calculated value exceeds χ^2-Table value at 0.05 level of confidence with degree of freedom of 3. Since the χ^2-calculated value (52.51) is greater than χ^2-Table value (7.52), the stated null hypothesis is therefore rejected. This result concludes that parental category significantly influence the knowledge of Yoruba indigenous folksongs.

RESEARCH QUESTION 1

What moral values do parents (Grand & Young) draw from Yoruba Indigenous Folksongs?

Table 2: Response of parents (Grand & Young) on moral values draw from Yoruba Indigenous Folksongs?

ITEMS	GRAND		YOUNG	
	Yes	No	Yes	No
Can these songs address the following:				
(a) Honesty	165 (82.5)	35 (17.5%)	200 (100%)	-
(b) Hard work	177 (88.5%)	23 (11.5%)	200 (100%)	-
(c) Laziness	200 (100%)	- (-)	200 (100%)	-
(d) Cleanliness	180 (90%)	20 (10%)	150 (75%)	50 (25%)
(e) Truthfulness	120 (60%)	80 (40%)	180 (90%)	20 (10%)

From the above table 2, majority of the respondents 82.5% grandmothers and 100% young mothers agreed that folksong addresses honesty while 17.5% of grandmothers disagreed. For hard work, 88.5% grandmothers and 100% young mothers agreed that folksong can be used to instill hard work in the children while 11.5% of grandmothers responded negatively. All the respondents (100%) both grand and young mothers responded positively that folksong can be used to curb laziness among children. For item d, a large percentage of the respondents, 90% grandmothers and 75% young mothers opined that issue of cleanliness can be addressed by folksong while 10% of grandmothers and 25% young mothers disagreed. 60% of grandmothers and 90% young mothers asserted that folksong addresses truthfulness while 40% of grandmothers and 10% of young mothers responded otherwise. From the above finding, it can be concluded that moral values drawn from indigenous folksong include honesty, hard work, laziness, cleanliness and truthfulness.

RESEARCH QUESTION 2

What is the perception of parents (Grand & Young) on Yoruba Indigenous Folksongs as tools for moral education?

Table 3: Response of parents on the perception of parents (Grand & Young) on Yoruba Indigenous Folksongs as tools for moral education

S/N	ITEMS	GRAND		YOUNG	
		Yes	No	Yes	No
1.	Are these songs relevant to today's children?	100 (50%)	100 (50%)	80 (40%)	120 (60%)
2.	The contemporary song has no moral value.	175 (87%)	25 (12.5%)	100 (50%)	100 (50%)
3.	What is your suggestion about these songs:				
	(a) Discard	-	200 (100%)	20 (10%)	180 (90%)
	(b) Revitalize	200 (100%)	-	185 (92.5%)	15 (7.5%)
	(c) Use in Schools	200 (100%)	-	200 (100%)	-

Table 3 above showed that 50% and 40% of the respondents, grand and young mothers respectively confirmed that indigenous folksongs are relevant to contemporary children while 50% and 60% of the respondents, grand and young mothers respectively responded negatively. Also, a larger percentage of the respondents 87% and 70% of grand and young mothers respectively agreed that contemporary song has no moral value while a smaller percentage 12.5% and 30% responded otherwise. Both the grand and young mothers 100% and 90% respectively suggested that folksongs should not be discarded while 10% of the young mothers responded otherwise. A larger percentage of the respondents 100% and 92.5% of grand and young mothers respectively agreed that folksongs should be revitalized for moral development while only 7.5 % of young mothers responded negatively. All the respondents agreed that folksongs should be incorporated into the school curriculum to teach morals in schools. From these findings, it can be concluded that both parent type have the same perception on the use Yoruba Indigenous Folksongs as tools for moral education

RESEARCH QUESTION 3

Will the demographic variables of parents (Grand and Young) influence their perception of indigenous folksongs?

To answer this research question, parents' demographic variables such as age, occupation, educational qualification, and number of grand children were cross tabulated with their respective perception while Chi-square and p-values were also obtained. The result is presented in Table 4.

Table 4 : Chi-square Analysis of Influence of Demographic Variables of Parents (Grand and Young) on their perception of indigenous folksongs

	Socio-demographic Variables	Young Mother			Grand Mother		
		χ^2	df	p	χ^2	Df	P
Perception	Occupation	155.000	4	.000	-	-	-
	Educational Background	136.000	3	.000	155.556	1	.000
	Age	-	-	-	97.143	2	.000
	No of grand Children	-	-	-	98.413	2	.000

Table 4 shows the influence of demographic variables of parents (Grand and Young) on their perception of indigenous folksongs. It can be observed from the table that all of such variables as the case applied had significant influence on perception of indigenous folksongs. For instance, perception of indigenous folksongs and occupation for young mother, χ^2 (n = 200) = 155.000,df = 4, p = .000; and perception of indigenous folksongs and educational qualification, χ^2 (n = 200) = 136.000, df = 3, p = .000. Also, for grandmother: perception of indigenous folksongs and educational qualification, χ^2 (n = 200) = 155.556, df = 1, p = .000; perception of indigenous folksongs and age, χ^2 (n = 200) = 97.143, df = 2, p = .000; and perception of indigenous folksongs and number of grandchildren, χ^2 (n = 200) = 98.413, df = 2, p = .000. Since the p-value is less than .05 thresholds across board, the result therefore concludes that demographic variables of parents have significant influence on their perception of indigenous folksongs.

DISCUSSION

In this study, Yorùbá indigenous folksongs are used as a veritable source for revitalizing moral education among pre-school children. The findings have shown that parental category significantly influence the knowledge of Yoruba indigenous folksongs with the young mothers having low knowledge of the songs. This could be as a result of. the generational gap between the grandmothers and the young mother's knowledge of folksongs. The grandmothers still remember some of the folksong they sang for their children whereas the young mothers could not sing these songs. This was corroborated by Ukrainian Winnipeg.ca (2014) that people knew all the symbolism of folksongs which seems to have been forgotten over the ages. Another finding is that moral values drawn from indigenous folksong include honesty, hard work, laziness, cleanliness and truthfulness. This supported the work of Aluede and Buraimah (2005) who pointed out that folksongs can perform different functions such as economic, political, social and moral inclusive. Also it was found out that both parent types have the same perception on the use of Yoruba Indigenous Folksongs as tools for moral education. This is in line with Pakarsky (1998) who recognized the role of culture above other variables in the moral education of the child. The mothers in Yoruba setting recognized the role of song especially folksongs in the moral development of the child. Samuel (2013) also identified folksongs as a source to impart worthwhile values in the society and called for teachers to serve as preservers and transmitters of cultural heritage including folksongs.

CONCLUSION AND RECOMMENDATION

This paper has examined folksongs as a tool for the inculcation of moral education in children in this present society that is permeated with various vices. Moral education was held in high esteem in the African traditional community and diverse means like folksongs were used to inculcate the values. However, in the contemporary society, it has become an aberration; though our educational system advocate the inculcation of moral education but it has not been pursued appropriately to achieve the desired level that could make it have impact in our pupils and students as well as in the society at large. It is therefore recommended that teachers should adopt folksongs in the classroom. This will not only preserve or transmit cultural heritage but also impart moral education in children in lively way.

REFERENCES

[1] Aluede, C.O. & Buraimah, A.A. (2005). Edo folksongs as sources of historical reconstruction Kamla-Raj 2005 Stud. Tribes Tribals, 3(2): 123-128 .

[2] Berkowitch, M.W., & Grych, J.H. (1998). Fostering goodness: teaching parents to facilitate children's moral development. *Journal of Moral Education*, 27(3), 371- 391.

[3] Comora, B. (2004). Principal creates great start to school day. *Herald-Tribune*, Sarasota, FL, p. 4F.

[4] Fasoro, J.O.(2012). Myth and proverb as a vehicle of moral education among traditional Yorùbá

[5] International Journal of Arts and Commerce Vol. 1(5) http://www.ijac.org.uk/images/frontImages/gallery/Vol._1_No._5/24.pdf

[6] Hart (Eds). (1998). *Morality in Everyday Life*. Cambridge:Cambridge University Press, pp. 87-128.

[7] Jason, S. & Garcia , GNA. (2009). Moral development. Education.com, http://www.education.com/reference/article/moral-development1/

[8] Kennedy, M. (1980) .The concise Oxford dictionary of music. Oxford: OUP

[9] Kohlberg, L. (1973). The Claim to Moral Adequacy of a Highest Stage of Moral Judgment. *Journal of Philosophy*. 70, No. 18) 70 (18): 630–646. doi:10.2307/2025030. JSTOR 2025030.

[10] Lasis, S.A. (2012). Traditional music in Nigeria example of ayinla omowura's music. *International Institute for Science, Technology and Education* (IISTE). Vol 2, No.10, 2012

[11] NBF News (2011). The moral education of children. General News http://www.thenigerianvoice.com/news/52619/1/the-moral-education-of-children.html

[12] Nucci, L. (2001). *Education in the moral domain.* Cambridge, England: University Press.

[13] Oladipo, S.E.(2009). Moral Education of the Child: Whose Responsibility?. Kamla-Raj 2009 J Soc Sci, 20(2): 149-156.

[14] Olagunju, A. O. (1997). Orin as a means of expressing world-views among the Yoruba. Journal of YorubaFolklore Vol. 1, Ago-Iwoye: Ogun State University Press.

[15] Pakarsky (1998). The Role of Culture in Moral Development. Journal of Parenthood in America)

[16] Powers SI 1988. Moral Judgment Development within The Family. *Journal of Moral Education,* 17: 209- 219.

[17] Sadavarte, Smt U K & Akolkar, R. S. (2010). Role of School in Moral Education. Blahorkar ; http://www.studymode.com/essays/Role-Of-School-In-Moral-Education-430498.html

[18] Samuel, K. M. (2013). African Folksongs as Veritable Resource Materials for Revitalizing Music Education in Nigerian Schools. Research on Humanities and Social Sciences www.iiste.org ISSN 2222-1719 (Paper) ISSN 2222-2863 (Online) Vol.3, No.10, 2013 30. http://www.slideshare.net/AlexanderDecker/african-folksongs-as-veritable-resource-materials-for-revitalizing-music-education-in-nigerian-schools

[19] Smetana JG (1997). Parenting and The development of social knowledge reconceptualized: A Social Domain Analysis. In: JE Grusec, L Kuczynski (Eds.): *Parenting and the Internalization of Values*. New York: Wiley, pp. 162-192.

[20] Walker LJ, Taylor JH (1991). Family Interactions and the Development of Moral Reasoning. *Child Development*, 62: 264-283.

[21] Wyckoff, C.L. (2000, Fall) Children who care. *Childhood Education*, 77, p. 43

[22] www.ukrainian Winnipeg.ca (2014). Songs your mother should never have taught you:

[23] Zhu, T. (Ed.)(2014). Have Children with Moral values, responsibility and imagination, says Scholar Yu http://www.womenofchina.cn/html/womenofchina/report/173794-1.htm

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Precipitable water vapor, temperature and humidity retrieval using AMSU-A, MHS and HIRS

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ABSTRACT: A multiple linear regression method and a neural network method are performed to retrieve the Precipitable Water Vapor, surface temperature and relative humidity using microwave (AMSU-A, MHS) and infrared (HIRS) ATOVS sounders. Each method is performed using microwave, infrared, and mixed data separately to assess the best. Near nadir ATOVS data of Dakar region (Senegal) at 12:00 AM and 12:00 PM are used for the whole year 2013. Learning data are from radiosonde and in situ measurements. By comparing them with retrieved data, ECMWF reanalysis data help to validate the different methods. The multiple linear regression method provides good results for microwave data with an RMS of 4.65 mm, 2.27 °K and 2.37 % respectively for PWV, surface temperature and surface relative humidity retrieval. Mixed data presents the greatest RMS error, except for PWV retrieval (2.3 mm) whose regression equation, moreover, contains only microwave channels. The neural network significantly improve the results, providing RMS error of 0.56 mm for the PWV retrieval with the microwave neural network, 0.87 °K for the surface temperature restitution with the mixed data neural network and 8% for the surface relative humidity retrieval with the mixed data neural network too. Additionally with the neural network method we retrieved the temperature and relative humidity profiles at 33 pressure levels from the surface to 300 hPa. Mixed data provide better results with an RMS between 0.7 °K and 0.87 °K for the temperature profile and between 6% and 8% for the relative humidity profile.

KEYWORDS: AMSU-A, MHS, HIRS, PWV, Temperature, Humidity, Neural network, Regression.

1 INTRODUCTION

Radiosonde is the reference tool for atmospheric sounding; however the effectiveness of radiosonde is limited by their low and inhomogeneous spatial distribution on the globe, especially in African region, and also by their insufficient time availability (usually twice a day). Nowadays numerous atmospheric observation satellite platfoRMS orbiting around the earth embark, mostly, multiple sensors at different (microwave, visible, infrared) wavelengths. Despite the availability of these multi-frequency observations, little effort has been invested to design algorithms that exploit the best potential synergies for atmospheric variables retrieval. Several sensors can be sensitive to the same atmospheric variables, so using them in conjunction can improve the accuracy of the retrievals.

ATOVS (Advanced TIROS Operational Vertical Sounder) radiometers flying on the NOAA (National Oceanic and Atmospheric Administration), MetOp, AQUA and other polar orbiting satellites have several potential not exploited enough. ATOVS sounders AMSU-A, MHS (evolution of AMSU-B) and HIRS measure the outgoing radiances from the atmosphere and the Earth surface in the microwave band (AMSU-A and MHS) or the infrared band (HIRS).

Several retrieval techniques have been developed for temperature and/or humidity sounding with ATOVS and other sounders measurements [[1], [2], [3], [4], [5], [6], [7], etc.]. Over ocean, the ATOVS measurements are now routinely assimilated in NWP systems and they provide unique atmospheric profiling capabilities. Over land however, the ATOVS measurements are not fully exploited. At best, only the channels that are not contaminated by surface contributions are assimilated, thus limiting the profiling potential to the higher atmospheric layers.

Contrarily to the ocean emissivity, the land surface emissivity is high, often close to unity, leading to difficulties in discriminating between surface and atmosphere contributions. In the present study, we used AMSU-A, MHS and HIRS brightness temperature data to retrieve Precipitable Water Vapor (PWV), surface temperature and humidity with two (02) methods: A multiple linear regression method and a neural network approach. Initial guess data are radiosonde and in-situ measurements. ECMWF data are used for validation by comparing them with retrieved data.

Additionally with the neural network method, we retrieved the atmosphere's vertical temperature and humidity profiles from the surface to 300 hPa altitude. Information of temperature and moisture distribution in the vertical atmosphere is useful in Aviation meteorology, synoptic forecasting and numerical modeling.

In the first section we describe the study data. The retrieval approaches are presented in section 2. In the section 3 we will present the retrieval results and discussions. Section 5 concludes this study.

2 DATA

Several data sets are used for this study; it is mainly satellite ATOVS sounders AMSU-A, MHS and HIRS, radiosonde, climate observations tables and ECMWF reanalysis. The study area is that of Dakar, Senegal.

2.1 RADIOSONDE

Radiosonde observations provide independent and unique reference for many altitude meteorological variables such as PWV, temperature and humidity profiles, wind speed etc. However, they are unevenly distributed over the Earth with different measurement accuracy. They are particularly scarce in Africa. Launched at the Dakar point latitude 14.73° and longitude 17.5°, radiosonde system provides data at fixed times twice a day at 12:00 AM and 12:00 PM. Records of radiosonde measurements are archived at many meteorological centers. We used data available on the University of Wyoming (United States) website: http://weather.uwyo.edu/upperair/sounding.html.

2.2 ATOVS DATA

The main objective of our study is the use of ATOVS sounders retrieval potential. In keeping with the availability of radiosonde at 12:00 AM and 12:00 PM, we are interested in satellite data of Dakar at these times. By using a tracking satellites software, those passing over Dakar at any hours were listed, it is the NOAA 19 and Metop-A for the year 2013. A database of AMSU-A, MHS and HIRS sounders was formed for the Dakar region for the full year 2013 at 12:00 AM and 12:00 PM. ATOVS data are freely available on the website of the NOAA CLASS (Comprehensive Large Array-data Stewardship System): http: // www.class.noaa.gov/. The raw satellite data are pre-processed using the AAPP (ATOVS and AVHRR Pre-processing Package) software produced by the Met Office, in partnership with ECMWF, KNMI and Météo-France. Data's spatial resolution is 0.5° x 0.5° around the Dakar point 14.73 ° latitude and 17.5 ° longitude, the radiosonde balloon launching point. The brightness temperature data included in this grid are averaged.

2.2.1 AMSU

AMSU (Advanced Microwave Sounding Unit) radiometers measure microwave radiations emitted by the earth, the ocean and the atmosphere in different frequencies. This radiation is converted into brightness temperature. Microwave measurements at frequencies below 20 GHz have the advantage of having very large wavelengths compared to the size of water droplets in the atmosphere, and large enough to cross the atmosphere and reach the surface (Smith and Mugnai 1989).

They are two AMSU sensors, AMSU-A and AMSU-B (former to the MHS). With channels in the oxygen absorption band, AMSU-A is designed to retrieve the atmospheric temperature from about 3 hPa (~45 km) down to the Earth's surface. AMSU-B module makes measurements in the vicinity of the strong water vapor absorption line at 183 GHz and is used for atmospheric water vapor sounding. Therefore, the use of AMSU measurements in operational Numerical Weather Prediction (NWP) models can potentially provide accurate monitoring of both air temperature and moisture profiles with good temporal

and spatial sampling. Compared to infrared sounding measurements, AMSU observations are less sensitive to high thin and non precipitating clouds.

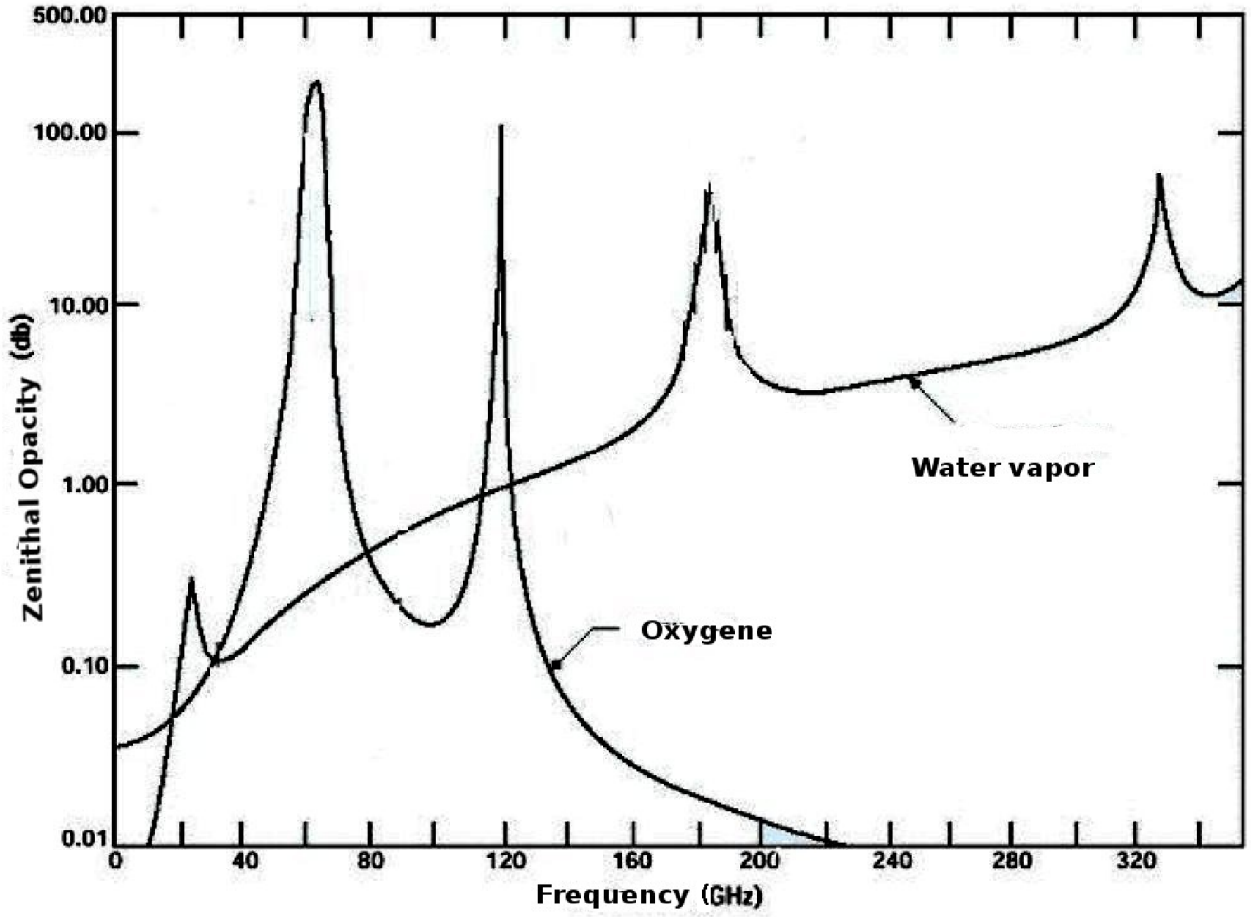

Fig. 1. Electromagnetic spectrum region used by microwave radiometers

AMSU-A is designed to measure radiances in 15 channels (Table 1) in discrete frequency. It is used to measure the vertical profile of atmospheric temperature and humidity and provides information on atmospheric water in all its foRMS (except for ice small particles transparent to microwave).

Table 1. Frequencies, absorbing constituent and atmospheric layer of maximum sensitivity corresponding to AMSU-A channels

Channel	Frequency (GHz)	Principal absorbing Constituant	Level of maximum sensitivity (hPa)
1	23.8	H_2O	Surface
2	31.4	H_2O	Surface
3	50.3	H_2O	Surface
4	52.8	H_2O	950
5	53.596 ± 0.115	O_2	750
6	54.4	O_2	400
7	54.94	O_2	250
8	55.5	O_2	150
9	57,290	O_2	85
10	57.29 ± 0.217	O_2	50
11	57.29 ± 0.322 ± 0.048	O_2	25
12	57.29 ± 0.322 ± 0.022	O_2	10
13	57.29 ± 0.322 ± 0.010	O_2	5
14	57.29 ± 0.322 ± 0.0045	O_2	2.5
15	89	H_2O	Surface

AMSU-B has 5 frequency channels created for humidity sounding and comprises (Table 2). Two (02) channels are centered at 89 GHz and 150 GHz, and the other three are centered on the water vapor absorption line at 183.31 GHz.

Table 2. Frequencies, absorbing constituent and atmospheric layer of maximum sensitivity corresponding to AMSU-B channels.

Channel	Frequency (GHz)	Principal absorbing Constituent	Level of maximum sensitivity (hPa)
1	89.9 ± 0.9	H_2O	Surface
2	150 ± 0.9	H_2O	Surface
3	183.31 ± 1.00	H_2O	500
4	183.31 ± 3.00	H_2O	700
5	183.31 ± 7.00	H_2O	950

Atmospheric maximum sensitivity level with respect to a molecule for each channels frequency channels, is determined using the sensors weighting functions (Figure 2). Figure 1 shows the opacity due to oxygen (O2) and water vapor (H2O) according to the microwave frequencies. At 23.8 GHz (Channel 1 of AMSU-A) we have a weak water vapor absorption ray. Around 89 GHz (Channel 15 of AMSU-A) and channel 1 of AMSU-B, we notice the existence of atmospheric windows (frequency band where the absorption by the atmosphere is minimal). These windows facilitate "access to the surface" and thus make possible its variables study.

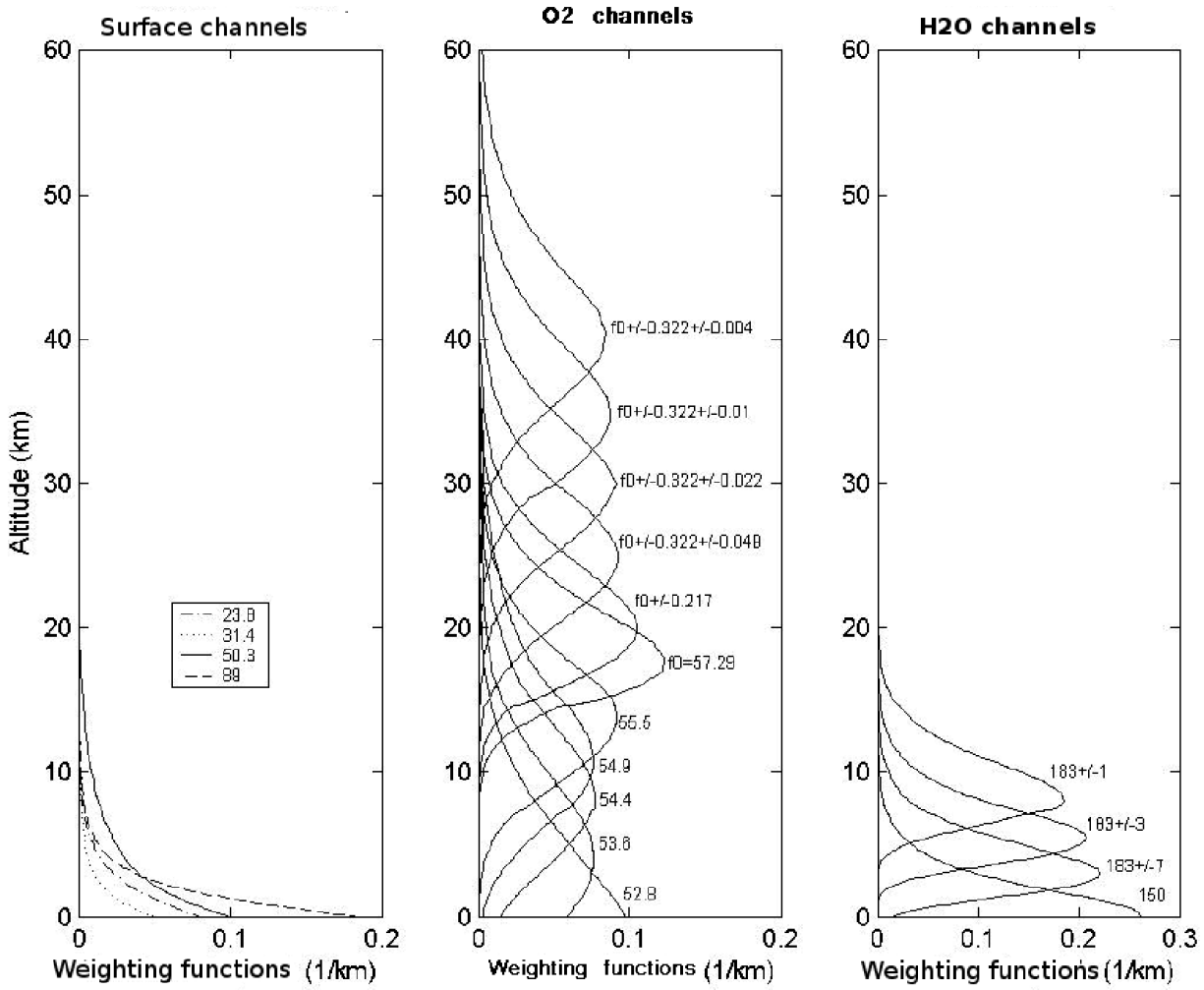

Fig. 2. AMSU frequencies Weighting functions (23 to 190 GHz) for a tropical atmosphere and a nadir measurement configuration (Karbou et al., 2006)

2.2.2 MHS

MHS (Microwave Humidity Sounder) is a 5 channels radiometer which is a development of AMSU-B. Channels 1, 3 and 4 are the same for the two sensors (Table 3).

Table 3. Frequencies, absorbing constituent and atmospheric layer of maximum sensitivity corresponding to MHS channels.

Channel	Frequency (GHz)	Principal absorbing Constituant	Level of maximum sensitivity (hPa)
1	89.9	H2O	Surface
2	157	H2O	950
3	183.31 ± 1.00	H2O	500
4	183.31 ± 3.00	H2O	700
5	190.3	H2O	900

2.2.3 HIRS

HIRS (High-resolution Infrared Radiation Sounder) is a 20 atmospheric sounding channels (Table 4) operating in the infrared. It provides multi-spectral data of a visible channel (0.69 microns), 07 shortwave channels (3.7 to 4.6 microns) and 12 long wave channels (6.7 to 15 microns) using one telescope and a rotating filter containing 20 individual spectral filters.

Table 4. Frequencies, absorbing constituent and atmospheric layer of maximum sensitivity corresponding to HIRS channels.

Channels	Frequency		Principal absorbing Constituant	Level of maximum sensitivity (hPa)
	(cm^{-1})	(µm)		
1	668	14,95	CO2	30
2	680	14,71	CO2	60
3	690	14,49	CO2	100
4	703	14,22	CO2	400
5	716	13,97	CO2	600
6	733	13,64	CO2 / H2O	800
7	749	13,35	CO2 / H2O	900
8	900	11,11	Window	Surface
9	1,030	9,71	O3	25
10	802	12,47	H2O	900
11	1,365	7,33	H2O	700
12	1,533	6,52	H2O	500
13	2,188	4,57	N2O	1000
14	2,210	4,52	N2O	950
15	2,235	4,47	CO2 / N2O	700
16	2,245	4,45	CO2 / N2O	400
17	2,420	4,13	CO2	5
18	2,515	4,00	CO2	Surface
19	2,660	3,76	Window	Surface
20	14,500	0,69 (m)	Visible	Surface / Clouds

Since its first launch on NOAA TIROS-N in 1978, there have been four generations of HIRS but only minor changes were made to the original design. The basic sounding channels remain the same. The sensor measures the brightness temperatures in the infrared spectrum of which data can be used in conjunction with microwave data to calculate the temperature and humidity vertical profiles, oceans surface temperature, atmospheric ozone or cloud cover.

2.3 CLIMATE OBSERVATION TABLE

The daily climate observation table provides meteorological surface parameters every hour. They can provide almost instant overview of climate with various parameters such as temperature, humidity, dew point temperature, pressure, visibility, wind speed, wind direction, rainfall, etc.

2.4 ECMWF REANALYSIS

It is an operational model of the European Center for Medium range Weather Forecasting (ECMWF). It produces 04 global analyzes per day, 00, 06, 12 and 18H obtained from two cycles of assimilation 4D-var (method of fitting the model to observations). ERA-Interim reanalysis [8] realize the synthesis of all in situ and remote sensing data from 1979. The data we use are sized on the grid set around the radiosonde launch point in Dakar. They can be retrieved from the dedicated website: http://data-portal.ecmwf.int/data/d/interim_full_daily/.

3 METHODOLOGY

ATOVS sounders have meteorological parameters retrieval potential not fully exploited [5]. Over the ocean, temperature, humidity or PWV retrieval is now well advanced, and even assimilated into some global models (Météo-France, ECMWF, NOAA, etc.). Therefore it is very interesting to be able to implement effective retrieval methods over the continents.

Two (02) approaches are used in order to retrieve the temperature, humidity and PWV: Multiple linear regression, and neural networks. PWV, temperature and humidity profiles data used for learning are from radiosonde. Surface temperature and humidity are from climate observations tables. Each retrieval method uses three (03) types of data:

- Microwave data (AMSU-A and MHS): 19 channels are concerned, having held a malfunction at the channel 7 of AMSU-A.
- Infrared data (HIRS): Similarly, the HIRS channel 20 does not provide enough usable data, thus has 19 channels.
- Microwave and infrared data synergy: 19 microwave channels and 19 infrared channels, so a total of 38 channels.

This approach will allow us to measure the effectiveness of the data type in relation to the retrieved variable. Our objective is to retrieve the satellite data in all conditions, day or night, cloudy or clear sky, etc. Thus day time data (12:00 PM), night data (12:00 AM) and 2013 all seasons data are mixed.

So the final database that we have is:

- 617 microwave data;
- 546 Infrared data;
- 528 microwave and infrared mixed data.

The difference between the data numbers is due to the fact that for some samples, data from some sensors are unavailable (especially HIRS), according to the operational sensors independence. For each case, 1/3 of the data are assigned to the test database whereas 2/3 of the data are attributed to the learning database. ECMWF reanalysis data are used for validation.

4 RESULTS AND DISCUSSIONS

4.1 MULTIPLE LINEAR REGRESSION METHOD

Multiple linear regression method allows identifying easily the predominant channels. A filter of inputs variables (channels) is set up with a significance test at 5 %. In the linear regression, each output of the algorithm is a linear combination of the inputs and an eventual bias. The parameters (different weights for each input and bias) of the regression are adjusted to minimize the difference between the retrieved variables and real variables (in the sense of least squares) through the learning base.

Statistical variables used to evaluate the model performance are: The model coefficient of determination R^2, the RMS (root mean squared) of the model, correlation coefficient (corr) and standard deviation (std) between real data of the test database and data predicted by the model. The RMS variable is the square of the residual variance of the model while R^2 measures the difference between the data and the fitted regression line.

The standard deviation (std) and the correlation between retrieved data and ECMWF data will evaluate the validation.

4.1.1 PWV RETRIEVAL

The precipitable water vapor (PWV) is essential for weather studies because of its greenhouse effect and its influence on the prediction. Table 5 reports the model equations found for 03 types of data, which AMAi is channel i of AMSU-A, MHSi channel i of MHS and HIRSi channel i of HIRS.

Table 5. Multiple linear regression equations for precipitable water vapor restitution

Inputs	Model equation
AMSU-A and MHS	-202.20 + 0.68 * AMA1 – 0.57 * AMA2 + 0.41 * AMA3 – 1.31 * AMA4 + 1.68 * AMA6 + 0.43 * MHS1 – 0.20 * MHS2
HIRS	7.93 + 6.34 * HIRS2 – 7.14 * HIRS3 – 3.84 * HIRS4 + 7.49 * HIRS5 – 6.56 * HIRS7 + 2.51 * HIRS8 – 2.82 * HIRS9 + 1.22 * HIRS14 + 2.29 * HIRS15
AMSU-A, MHS and HIRS	-298.6 + 0.68 * AMA1 – 0.49 * AMA2 + 0.99 * AMA6 + 0.46 * MHS1 – 0.25 * MHS2

Performance parameters (statistics) of these equations (Table 6) can judge what kind of data retrieve the PWV with utmost accuracy. Retrievals model RMS errors clearly show that the infrared data are not informative enough for PWV retrieval (10.74 mm).

Microwave and infrared data used synergistically provide a better outcome with an RMS of 4.3 mm. Data are also well correlated (96 %) with the regression line the std between the rendered data and the actual data in the database test is 3.2 mm. The model using microwave data has results quite close to the model combining the microwave and infrared data. This explains why the model designed with mixed microwave and infrared data has no infrared channel.

Table 6. Regression equations for precipitable water vapor restitution performances.

Inputs	R^2 (%)	RMS (mm)	corr (%)	std (mm)	ECMWF corr (%)	ECMWF std (mm)
AMSU-A and MHS	93	4.65	93	3.8	87	4.4
HIRS	64	10.74	59	8.3	47	10.9
AMSU-A, MHS and HIRS	96	4.3	94	3.2	87	4.3

ECMWF Validation data confirm the results found above. The model using microwave and infrared data synergistically has the best results. PWV data retrieved with this model have a correlation of 87% and a standard deviation of 4.3 mm with reanalysis PWV data. Similarly, the validation of the microwave model presents a correlation of 87% and a standard deviation of 4.4 mm. PWV data retrieved from the infrared model are weakly correlated with the ECMWF data with a standard deviation of 10.9 mm.

4.1.2 SURFACE TEMPERATURE RESTITUTION

The Ocean emissivity is about 0.5 which enables the sea surface temperature (SST) assimilation in NWP models. Continental surfaces emissivity close to 1 increases the difficulty of surface parameters restitution. Our study area, Dakar region is located on the coast so our remote sensing data are contaminated by continental emissivity. Table 7 details the regression algorithms implemented.

Table 7. Multiple linear regression equations for surface temperature retrieval

Inputs	Model equation
AMSU-A and MHS	-146.99 + 0.19 * AMA1 – 0.11 * AMA2 – 0.19 * AMA3 + 1.86 * AMA5 – 2.18 * AMA8 + 0.79 * AMA10 – 0.66 * AMA11
HIRS	17.95 – 0.6 * HIRS3 + 1.02 * HIRS4 + 0.94 * HIRS6 – 2.76 * HIRS7-0.39 * HIRS9 + 1.23 * HIRS10 + 0.5 * HIRS17
AMSU-A, MHS and HIRS	-276.86 + 1.4 * AMA5 – 1.09 * AMA6 + 0.09 * AMA9 – 1.02 * HIRS7 + 0.7 * HIRS10 – 1.23 * HIRS13 + 1.02 * HIRS15 + 1.38 * HIRS18 – 0.83 * HIRS19

The passive microwave emission can penetrate non-precipitating clouds, providing a better representation of the surface temperature in almost any condition with respect to cloud cover. Thus microwave data provide a better result with an RMS of 2.27 °K (Table 8).

The RMS of the infrared equation is quite close to that of the microwave (2.74 ° K) but the equation does not fit the regression line (R^2 = 0.49). This is confirmed by a correlation of 0.53 between the inverted data and real data of the test database. Microwave and infrared mixed data model is not accurate. Its RMS is 5.07 °K and the retrieved data has a correlation of 42 % with surface temperature data.

Table 8. Regression equations for surface temperature restitution performances.

Inputs	R^2 (%)	RMS (°K)	corr (%)	std (°K)	ECMWF corr (%)	ECMWF std (°K)
AMSU-A and MHS	82	2.27	86	2.24	82	2.47
HIRS	49	2.74	53	2.6	49	4.2
AMSU-A, MHS and HIRS	40	5.07	42	3.5	35	5.1

ECMWF data confirm the microwave model good performance with a correlation of 82 % and 2.47 °k standard deviation with retrieved data. Surface temperature retrieved from infrared model and mixed data model are poorly correlated with reanalysis data (respectively 49% and 35 %). these models are not accurate enough.

ATOVS sensors are not used enough to retrieve land surface temperature. Reference [2] retrieved the surface temperature over the state of Louisiana (United States). Using AMSU-A data, his model has an RMS of 4.8°C. In clear sky, [7] obtained an RMS of 2.2°K with a multiple regression model using AMSU-A and MHS data. They performed also a model using microwave AMSU-A and MHS in synergy with infrared IASI data, it provides an RMS of 1.8°K. While over ocean in clear sky, the RMS is 2.6° K for the microwave model, and 0.9°K for mixed data model. Land surface temperature retrieved are also performed with other sensors, [9] established a linear regression model between the microwave sensor AMSR-E (Advanced Microwave Scanning Radiometer-EOS) and MODIS (Moderate-Resolution Imaging Spectroradiometer) surface products. Data refer to the Guangdong Province of China and the RMS of the retrieval is about 3°K.

4.1.3 SURFACE RELATIVE HUMIDITY RESTITUTION

Surface humidity retrieval over ocean from satellite data using a multiple linear regression method was the subject of much research. Reference [10] proposed an algorithm for the specific humidity retrieval by setting up an empirical relationship between the content of integrated water vapor and surface specific humidity between 10 and 20 m. This relationship was established using radiosonde data on four islands and verified using SMMR (Scanning Multichannel Microwave Radiometer) radiometer observations. The RMS between retrieved values and in situ observations is 0.8 g/kg.

To get a better specific humidity estimation using the SSM/I (Special Sensor Microwave/Imager) radiometer at instantaneous scale, [11] developed a method for the integrated water vapor retrieval over an altitude between 0 and 500m, whereas the majority of the water vapor in the boundary layer. To establish the algorithm, they used data from radiosonde carried out by different research boats in the Atlantic Ocean, the North Sea, the Indian Ocean and the North East Atlantic. To validate their results, they used the research boats data. Their results show a standard deviation of 1.2 g/kg compared with in situ measurements.

Reference [11] used SSM/I brightness temperatures measured at 19 GHz, 22 GHz and 37 GHz frequencies, as well as measurements of radiosonde to establish multiple linear regression model. The accuracy of this relation is 0.06 g/cm RMS.

Reference [12] have slightly improved the specific humidity estimation quality through the use of a more direct relationship between the brightness temperature and the humidity, which uses different frequencies from those operated by [11]. In their work, [12] used boats in situ observations instantaneously. The retrieval RMS is 1.1g/kg.

However, a comparison made by [11] between [12]'s model and in situ measurements, shows a low bias of 0.06 g/kg, but a significant RMS of 1.6 g/kg. This proves that model does not take account for all possible situations, and it is only suitable for a specific region.

Similarly, [13] showed that [11]'s model had a sizeable seasonal bias. To eliminate this bias they proposed, by the linear regression method, a new model that uses the same SSM/I channels frequency than [11], but in situ data are from buoys TAO, NDBC (National Data Buoy Center) and ODAS (European Offshore Data Acquisition System). This model was validated with COADS (Comprehensive Ocean Atmosphere Data Set) measurements which represent a collection of ocean surface observations from 1784 to 1997. Reference [13]'s algorithm has an RMS of 1.1 g/kg.

Reference [14] was the first to explore AMSU potential for specific humidity retrieval. They mainly focused on improving the specific humidity retrieved SSM/I. To this purpose, they developed a new instantaneously humidity retrieval method, based on AMSU data but also SSM/I data. In situ measurements used for the retrieval method adjustment are from a

hygrometer operating at infrared wavelengths, and placed aboard research boats during several measurement campaigns. The difference found by [14] is 0.96 g/kg.

Using AMSU-A and AMSU-B data over the ocean, [6] developed an algorithm for specific humidity retrieval with an RMS of 1.01g/kg and 0.86 g/kg, compared to the validation data, which are hourly PIRATA and TAO observations.

Table 9. Multiple linear regression equations for surface relative humidity retrieval

Inputs	Model equation
AMSU-A and MHS	552.93 – 4.6 * AMA5 + 6.74 * AMA6 – 4.47 * AMA8 - 2.39 * AMA10 + 1.93 * AMA11 + 0.54 * MHS1
HIRS	94.68 + 1.81 * HIRS3 – 2.68 * HIRS4 + 1.44 * HIRS6 – 1.7 * HIRS9 – 1.87 * HIRS13 + 2.66 * HIRS14 + 0.94 * HIRS17 – 0.59 * HIRS19
AMSU-A, MHS and HIRS	339.96 – 4.34 * AMA5 + 6.4 * AMA6 – 4.08 * AMA8 + 0.61 * MHS1 + 0.3 * MHS2 – 3.37 * HIRS8 + 3.79 * HIRS10 – 0.45 * HIRS19

Table 9 reports algorithms found from the three used data sets. The maximum emissivity over continents strongly influences the surface parameters retrieval from satellite data. Microwave model have accurate retrieval RMS of 2.37% but the model fitted 75% the regression line (Table 10). The correlation between retrieved surface relative humidity from this model and real data is about 70%. Infrared model's RMS increase to 6.7% for R^2=0.44 and a correlation of 52%. Mixed data model provide a 15.5 % with R^2=0.23 and 25 % of correlation. Microwave model provide best results.

Table 10. Regression equations for surface relative humidity restitution performances.

Inputs	R^2 (%)	RMS (%)	corr (%)	std (%)	ECMWF corr (%)	ECMWF std (%)
AMSU-A and MHS	75	2.37	70	6.4	63	9
HIRS	44	6.7	52	10.2	43	15.2
AMSU-A, MHS and HIRS	23	15.5	25	14.8	31	18.3

Validation performances are in respect with models performances. So the biggest standard deviation is for the mixed data model (18.3%), then the infrared model (15.2%) and finally the microwave model (9%).Correlations are distributed inversely with 63% for the microwave model, 43 % for the infrared model and 31 % for the mixed data model.

4.2 NEURAL NETWORK APPROACH

Multiple linear regression, as the name suggests is a linear method, which can be inadequate to simulate non-linear relationships between inputs and outputs. It is common to use this method as a first test for neuronal method used thereafter [7]. Neural methods are particularly efficient algorithms for remote sensing. Retrievals done following are with neural networks. Neural networks that we use are Multi Layer Perceptrons [15]. If enough samples are provided, all continuous relations, as complex as they are, between inputs and outputs can be represented by a multi-layer perceptron.

This study is divided into two parts; firstly, we will retrieve the previous study parameters: PWV, surface temperature and relative humidity. Then a method to retrieve 33 temperature and relative humidity profiles from surface to 300 hPa is performed. Data of 33 pressure levels are from radiosonde.

Retrievals will be made with three (03) data sets: Microwave, infrared and mixed. Neural networks are a form of non-linear regression. Thus for each data type temperature, relative humidity and/or PWV will retrieve simultaneously. This allows us to design a network by data type (Table 11). 2/3 of the database are used for learning, the third to test the network and ECMWF data will be compared with data returned for validation (only for PWV, surface temperature and humidity retrieval).

The neural network using microwave data for PWV, surface temperature and specific humidity retrievals have 19 inputs (15 AMSU-A channels and 5 MHS channels), 2 hidden layers of 20 neurons each. The number of outputs is 3 (Table 10).

Similarly for the neural network using infrared data, the number of inputs is 19 (channels 1 to 19 HIRS), the provisions of hidden layers are the same. Network using data synergy will therefore have 38 inputs (2 x 19).

Table 11. Retrieval neural networks Architectures.

Retrieval type	Data	Inputs	Hidden layers	Neurons per hidden layer	Outputs
03 parameters	Microwave	19	2	20-20	3
03 parameters	Infrared	19	2	20-20	3
03 parameters	Microwave and infrared	38	2	30-20	3
Temperature and relative humidity profiles	Microwave	52	2	40-35	66
Temperature and relative humidity profiles	Infrared	52	3	40-40	66
Temperature and relative humidity profiles	Microwave and infrared	71	3	50-40	66

For the vertical profile of temperature and relative humidity at 33 pressure levels retrieval, we set these pressure levels as inputs. Thus the network using microwave data have 52 (19 + 33) inputs, even for the network using infrared data. Network using data synergy has 71 inputs (19 x 2 + 33). The number of outputs is the same for the various networks and equal to 66 (33 temperature profiles and 33 humidity profiles).

Three (03) variables are used for statistical evaluation of PWV, surface temperature and specific humidity retrievals. The RMS (between retrieved data and test data), correlation (corr) and standard deviation (std) between the ECMWF data and retrieved data. Only RMS will evaluate the temperature and humidity profiles neural networks performances.

4.2.1 PWV RESTITUTION

Reference [16] was the first to use AMSU-B data to retrieve the PWV with a neural network. Above the Arctic region they got a 1 mm RMS. Using MHS data combined with AMSU-A, we got a 0.56 mm RMS (Table 12). Infrared data show the largest RMS, in keeping infrared radiation absorption by water particles. However, neural networks improve the restitution relative to the multiple linear regressions with an RMS difference of 7.34 mm for infrared data and 2.05 mm for the data used in synergy.

Table 12. Performances of PWV retrieval neural networks.

Inputs	RMS (mm)	ECMWF corr (%)	ECMWF std (mm)
AMSU-A and MHS	0.56	92	2.7
HIRS	3.4	73	5.6
AMSU-A, MHS and HIRS	2.25	81	3.4

Reanalysis data are well correlated (92%) with the retrieves PWV by the microwave network whose standard deviation is 2.7 mm data. The standard deviation is 5.6 mm (73 % of correlation) with the infrared network retrieved data and 4.4 mm (81 % of correlation) with the mixed network retrieved data. Improvements are respectively 5.6 mm and 0.9 mm from the multiple linear regression models.

Retrieval RMS with the microwave sensor AMSR-E data using a neural network is about 3 mm above Europe [17], and the infrared data to 6.8 mm above the Europe and Africa [18].

4.2.2 SURFACE TEMPERATURE RETRIEVAL

Reference [3] developed a new neural network and variant assimilation method, and the theoretical RMS of land surface temperature retrieval over globe is 1.3K in clear-sky conditions and 1.6K in cloudy scenes. Reference [19] performed a neural network with 2.9 °K RMS for the surface temperature restitution using the SSM/I and ISCCP data. Reference [5] retrieved land surface temperature using neural network model with a RMS of 2.1 °K taking into account emissivity data with AMSU-A and AMSU-B, ECMWF and ISCCP data.

The RMS of the neural network (Table 13) designed with microwave data is 1.18 °K thus a decrease in RMS of 1.09 °K relative to the multiple linear regression model. Synergy data network give the best result with an RMS of 0.87 °K, 4.2 °K less than the regression model RMS. The neural network using infrared data provides an RMS of 2.75 °K.

Table 13. Performances of surface temperature retrieval neural networks

Inputs	RMS (°K)	ECMWF corr (%)	ECMWF std (°K)
AMSU-A and MHS	1.18	88	2.3
HIRS	2.75	79	1.7
AMSU-A, MHS and HIRS	0.87	92	1.2

Surface temperature retrieved data using the microwave neural network is well correlated with the ECMWF surface temperature data. The standard deviation is 2.3 °K. For the network using infrared data, performances are slightly lower. But the data used synergistically improve validation results with a correlation of 92% and a standard deviation of 1.2 °K.

4.2.3 SURFACE RELATIVE HUMIDITY RESTITUTION

Using a neural network model, [5] retrieved specific humidity on a land surface with a RMS of 9% with AMSU-A and AMSU-B, ISCCP and ECMWF data taking into account the emissivity. This same RMS is found with the neural network designed by learning microwave data (Table 14). The RMS of the microwave network is slightly lower (8%) than the while the infrared neural network has an RMS of 13%.

Table 14. Performances of surface relative humidity retrieval neural networks

Inputs	RMS (%)	ECMWF corr (%)	ECMWF std (%)
AMSU-A and MHS	9	84	9
HIRS	13	64	15
AMSU-A, MHS and HIRS	8	88	7

ECMWF data show good correlation (80 %) and lower standard deviation (7%) with surface relative humidity retrieved from the neural network using microwave and infrared data synergistically. The network using microwave data has similar results. For the infrared neural network the correlation is weak (64%) and 15% of standard deviation.

4.2.4 TEMPERATURE AND HUMDITY PROFILES RETRIEVAL

4.2.4.1 TEMPERATURE PROFILE RETRIEVAL

Temperature profiles, from the surface to 300 hPa, retrieved with three (03) datasets are presented in Figure 3. The network with the mixed data has an RMS of 0.87 °K at the surface, which decreases with the height reaching a minimum of 0.7 °K. The microwave network has an RMS of 1.18 °K on the surface; it reaches a minimum of 0.86 ° K at 552 hPa and remains constant up to 300 hPa.

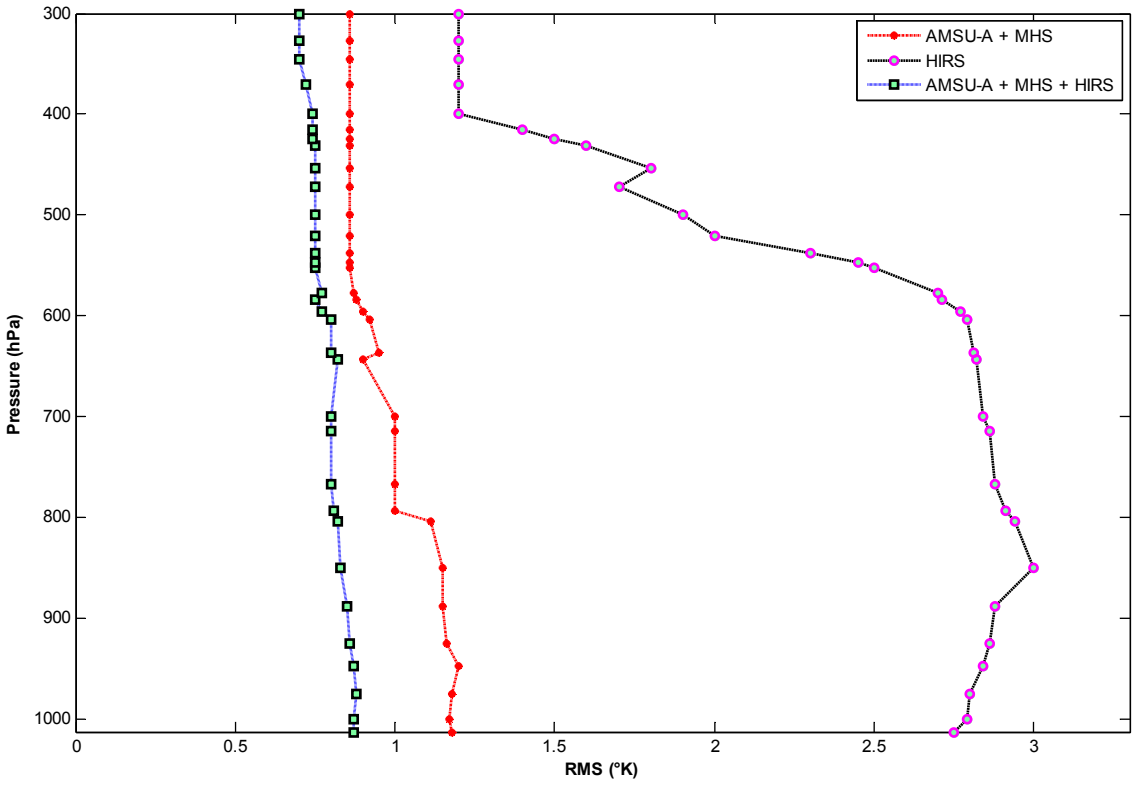

Fig. 3. RMS error profiles for temperature profile retrieval

The network performed with infrared data has the largest RMS of all datasets. The surface RMS is 2.75 °K, peaking 3° K at 850 hPa, it begins to decrease with altitude. A minimum of 1.2 °K is reached at level 400 hPa and remains constant up to 300 hPa.

Reference [2] carried out temperature profile retrieval with a neural network using AMSU-A data over Louisiana State (United States). The RMS on the surface is 3.2 °C, decreasing to 2.4 °C at 1000 hPa, 1.6 °C at 800 hPa, 1.2 °C to 600 hPa. The RMS level remains constant until 300 hPa.

Microwaves (AMSU and HSB) and infrared data (AIRS) used in synergy [20] provide an RMS less than 1 °K from the surface to 300 hPa at partial cloud cover situation.

Reference [5] combined AMSU A and AMSU-B data taking into account the surface emissivity improve the restitution with an RMS of 2.1°K at the surface. The RMS decreases to 1.2°K at 930 hPa and 0.9°K at 850hPa. Between 800 and 300hPa it remains constant at 0.8°K. Using AMSU-A, AMSU-B and HIRS January 2002 data over India, [21] developed a neural network retrieving the vertical temperature profiles. The RMS obtained throughout the profile is superior or equal to 4°K. This result is probably due to their very limited data base.

Reference [22] also uses a neural network approach for temperature profile retrieval from AMSU-A measurements of 2006 and 2007 over the Indian region. The RMS is about 3 °C at the surface, 0.9 °C to 2.2 °C between 700 and 300 hPa.

Reference [7] is the first to use AMSU-A and MHS data to retrieve the temperature profile on continental surface. In cloudless situation, they get an RMS of 2.3 °k at 938.53 hPa, which decreases to 1.3 °K at 600 hPa and remains constant between 600 and 300 hPa. Using these data in synergy with the IASI infrared data, they improve retrievals.

4.2.4.2 RELATIVE HUMIDITY PROFILE RETRIEVAL

The vertical relative humidity profile retrieved from the 03 datasets neural networks present enough similarity to the temperature profile (Figure 4). The data used in synergy help to minimize the RMS which is between 8% and 6% from the

surface to 300 hPa altitude. The network using microwave data presents a 9% RMS at the surface reaching a minimum of 7% at the 430 hPa; it remains constant up to 300 hPa altitude.

The infrared network provides the biggest restitution errors. With an RMS of 13% at the surface, it grows, and reaches its maximum peak of 20.7% at the altitude 700 hPa. It started to decrease and reached its minimum of 10.4% at 450 hPa level. This RMS remains constant up to the altitude 300 hPa.

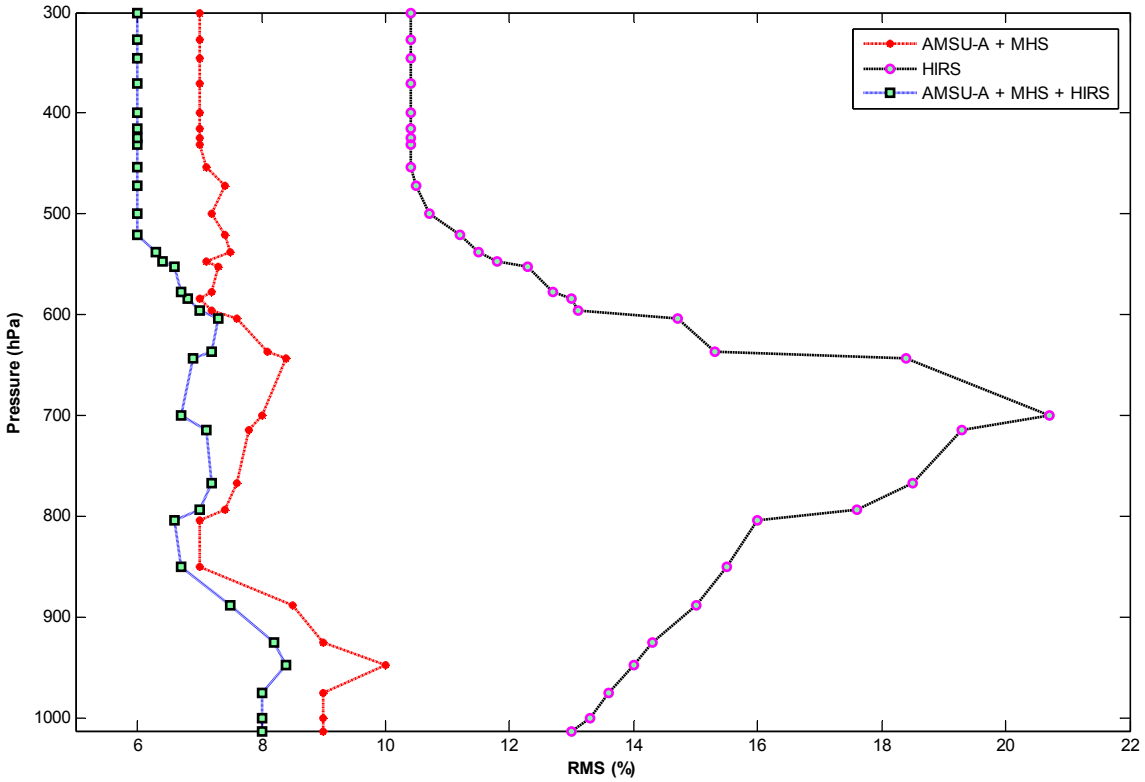

Fig. 4. RMS error profiles for relative humidity profile retrieval

Reference [5] conducted humidity profile retrieval simultaneously with temperature profile retrieval described in the previous section. The network they have designed has an RMS of 9% at the surface which decreases to 7.5% at 910 hPa. The RMS returns to 9% at 800 hPa altitude before reaching its maximum of 10% at 700 hPa. Finally, it decreases to 7.5% at the 300 hPa altitude. Similarly, [7] retrieved the humidity profile with a RMS from 7% to 9% between 300 and 938.53 hPa.

5 CONCLUSION

In this study, we use two methods to retrieve PWV, surface temperature and surface relative humidity from ATOVS microwave sounders (AMSU-A, MHS) data, infrared (HIRS) data, and mixed data (AMSUA, MHS and HIRS); Multi-linear regression and neural network methods.

With the multiple linear regression method, results show that microwave data are more suitable for the retrievals, with an RMS of 4.65 mm, 2.27 °K and 2.37 % respectively for PWV, surface temperature and surface relative humidity. While mixed microwave and infrared data are not appropriate.

Neural Network (NN) techniques have proved very successful in developing computationally efficient algorithms for remote sensing applications. They are found capable of connecting the nonlinear relation between ATOVS channel measurements and atmospheric variables, providing RMS error of 0.56 mm for the PWV retrieval with the microwave neural network. The mixed data neural network provides the smallest RMS for surface temperature (0.87°K) and surface relative humidity (8%) retrievals. ECMWF data show good correlation and relatively small standard deviation with mixed neural network retrieved data.

Additionally, with the neural network approach, we retrieved temperature and relative humidity profiles from surface to 300 hPa altitude at 33 pressure levels. A neural network uses maximum a priori information to limit the number of free parameters in the neural model so as to constrain the retrieval to a ''better-posed'' problem. Therefore mixed microwave and infrared data provide the best results with a RMS between 0.7 °K and 0.87 °K for the temperature profile, respecting the World Meteorological Organization (WMO) specifications; 1 °K RMS error for the instantaneous temperature retrieval with 1-km vertical resolution. Mixed neural network relative humidity retrieval RMS is 8% at the surface, which decreases with altitude to its minimum 6%.

REFERENCES

[1] P. Rosenkranz, "Retrieval of temperature and moisture profiles from AMSU-A and AMSU-B Measurements," *IEEE Transactions on Geoscience and Remote Sensing*, vol. 39, pp. 2429-2435, 2001.

[2] L. Shi, "Retrieval of atmospheric temperature profiles from AMSU-A measurements using a neural network approach," *Journal of Atmospheric and Oceanic Technology*, vol. 18, pp. 340-347, 2001.

[3] F. Aires, C. Prigent, W. B. Rossow, and M. Rothstein, "A new neural network approach including first guess for retrieval of atmospheric water vapor, cloud liquid water path, surface temperature, and emissivities over land from satellite microwave observations," *Journal of Geophysical Research*, vol. 106, no. 14, pp. 887-907, 2001.

[4] Franquet, S., *Contribution à l'étude du cycle hydrologique par radiométrie hyperfréquence: algorithmes de restitution (réseaux de neurones) et validation pour la vapeur d'eau (instruments AMSU, SAPHIR) et les précipitations (AMSU,Radarsau sol Baltrad)*, PhD dissertation, Université Paris-Diderot (Paris VII), 2003.

[5] Karbou, F., *Inversion des mesures radiométriques haute fréquence au dessus de surfaces continentales*, PhD dissertation, Université de Versailles Saint-Quentin. 2004.

[6] Mbengue, A. A., *Estimation par satellite de l'humidité spécifique au dessus de l'ocean par radiometrie hyperfrequence,* PhD dissertation, Université de Versailles Saint-Quentin, 2009.

[7] M. Paul, F. Aires, C. Prigent, I. Trigo, and F. Bernardo. "An innovative physical scheme to retrieve simultaneously surface temperature and emissivities using high spectral infrared observations from IASI," *Journal of Geophysical Research*, vol. 117, no.11, 2012.

[8] D. Dee, S. Uppala, A. Simmons, P. Berrisford, P. Poli, S. Kobayashi, U. Andrae, M. Balmaseda, G. Balsamo, P. Bauer, A. Beljaars, L. van de Berg, J. Bidlot, N. Bormann, C. Delsol, R. Dragani, M. Fuentes, A. Geer, L. Haimberger, S. Healy, H. Hersbach, E. Holm, L. Isaksen, P. Kallberg, M. Kohler, M. Matricardi, A. McNally, B. Monge-Sanz, J.-J. Morcrette, B.-K. Park, C. Peubey, P. de Rosnay, C. Tavolato, J.-N. Thépaut, and F. Vitart, "The ERA-Interim reanalysis : configuration and performance of the data assimilation system," *Quarterly Journal of the Royal Meteorological Society*, vol. 137, pp. 553–597, 2011.

[9] S. Chen, X. Chen, W. Chen, Y. Su, D. Li, "a simple retrieval method of land surface temperature from AMSR-E passive microwave data — A case study over Southern China during the strong snow disaster of 2008," *International Journal of Applied Earth Observation and Geoinformation*, vol. 13, pp. 140-151, 2011.Shi, L., Retrieval of atmospheric temperature profiles from AMSU-A measurements using a neural

[10] K. B. Mao, J. C. Shi, Z. L. Li, "A physics-based statistical algorithm for retrieving land surface temperature from AMSR-E passive microwave data,", *Science in China Series D: Earth Sciences*, vol. 50, no. 7, pp. 1115–1120, 2007.

[11] W. T. Lui and P. P. Niiler, "Determination of monthly mean humidity in the atmospheric surface layer over oceans from satellite data," Journal of Physical Oceanography, vol. 14, pp. 1451-1457, 1984.

[12] J. Schulz, P. Schlüssel and H. Grassl, "Water vapour in the atmospheric boundary layer over oceans from SSM/I measurements," *International Journal of Remote Sensing*, vo. 14, pp. 2773-2789, 1993.

[13] P. Schlüssel, L. Schanz and G. Englisch, "Retrieval of latent heat flux and longwave irradiance at the sea surface from SSM/I and AVHRR measurements," *Advances in Space Research*, vol. 16, pp. 107-116, 1995.

[14] A. Bentamy, K. Katsaros, A. Nunez, W. Drennan, and H. Rocquet "Satellite estimates of wind speed and latent heat flux over the global oceans," *Journal of Climate,* vol. 16, pp. 637-656, 2003.

[15] D. L. Jackson, G. A. Wick and J.J. Bates, "Near surface Retrieval of air temperature and specific humidity using multisensor microwave satellite observations," *Journal of Geophysical Research*, vol. 111, 2006.

[16] Rumelhart, D.E., Hinton, G.E., and Williams, R. J., *Learning internal representations by error propagation, in Parallel Distributed Processing: Explorations in the microstructure of cognition, Vol.I, Foudations*, edited by D.E. Rumelhart, J.L. McClelland, and the PDP Research group, MIT Press, Cambridge, Massachusetts, pp. 318-362, 1986.

[17] M. Qiao and J Miao, "Retrieving Integrated Water Vapor Using AMSU-B Channels over Arctic Region," *International Journal of Energy and Environment*, Vol. 2, no. 3, 2008.

[18] P. Basili, S. Bonafoni, V. Mattioli, F. Pelliccia, A. Serpolla, E. Bocci and P. Ciotti, "Development of a neural network for precipitable water vapor retrieval over ocean and land," *Microwave Radiometry and Remote Sensing of the Environment*, pp. 1-4, 2008.

[19] M. Schroedter-Homscheidt, A. Drews and S. Heise, "Total water vapor column retrieval from MSG-SEVIRI split window measurements exploiting the daily cycle of land surface temperatures," *Remote Sensing of Environment,* Vol. 112, pp. 249-258, 2008

[20] C. Prigent, F. Aires and W. B. Rossow, "Retrieval of surface and Atmospheric Geophysical Variables Over Snow-Covered land from combined Microwave and Infrared Satellite Observations," *Journal of Applied Meteorology*, vol. 42, pp. 368-380, 2002.

[21] J. Susskind, C. Barnet, J. Blaisdell, L. Iredell, F. Keita, L. Kouvaris, G. Molnar, and M. Chahine, "Accuracy of geophysical parameters derived from Atmospheric Infrared Sounder/Advanced Microwave Sounding Unit as a function of fractional cloud cover," *Journal of Geophysical Research*, vol. 111, 2006.

[22] D. Singh, and R. Bhatia, "Retrieval of Atmospheric Temperature and Moisture Profiles from Satellite Data over India Using the ICI Inversion Model," *Indian Journal of Radio Space Physics*, vol. 36, pp. 44–51, 2007.

[23] A.K. Mitra, P.K Kundu, A. K Sharma and S.K Roy Bhowmik, "A neural network approach for temperature retrieval from AMSU-A measurements onboard NOAA-15 and NOAA-16 satellites and a case study during Gonu cyclone,» *Atmosfera*, vol. 23, no. 3, pp. 225-239, 2010.

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Motives for Telecom Mergers and Acquisitions

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ABSTRACT: The main objective of this work was to catalogue and bring to the fore, the various driving forces or motives that push leaders of Telecom companies to enter into mergers and acquisitions. The aim was to do a comprehensive review of literature on motives for mergers and acquisitions in the Telecommunications industry, to help researchers in this particular area, and also managers of Telecommunications companies, to understand better the dynamics of mergers and acquisitions worldwide. The work was purely a review of literature on motives for mergers and acquisitions. After a comprehensive review, the motives which stood out were Synergy, Growth, Improving market standing, creating wealth for shareholders, and Empire building for managers, in that order.

KEYWORDS: motives, telecommunications, merger, acquisition, synergy, growth.

1 BACKGROUND

Globally, mergers and acquisitions have taken a high lead in corporate strategy due to its perceived benefits. A merger is said to have occurred when two companies (usually corporations) combine to form a new company (http://www.wisegeek.com/what-is-a-merger.htm). It can be horizontal, vertical, or conglomerate.

Mergers and acquisitions in the Telecommunications Sector are mostly horizontal mergers simply because the entities involved operate in the same industry, that is the telecommunications industry, and also on the same product lines. Lately, vertical mergers are beginning to be popular, with Telecommunication vendors merging with Telecommunication operators, especially at the operational level. With acquisition, one company purchases another, generally by buying most of its stock. Ghana Telecom and Vodafone's deal for instance is purely an acquisition by Vodafone. The acquired company may become a subsidiary of the buyer. Over the last few years, a phenomenal growth has been witnessed in the number of mergers and acquisitions taking place in the telecommunications industry. The reasons behind this development include the following:

- Deregulation
- Introduction of sophisticated technologies (Wireless land phone services)
- Innovative products and services (Internet, broadband and cable services)

In countries like India, mergers and acquisitions have increased to a considerable level from the mid-1990s. In the United States, the mergers and acquisitions in the telecommunications sector are going on in a full-fledged manner.

Following are the important mergers and acquisitions that took place in the telecommunications sector as reported by EconomyWatch in 2010 (http://www.economywatch.com/mergers-acquisitions/international/telecom-sector.html):

- The takeover of Mobilink Telecom by Broadcom. This can also be described as a suitable example of product extension merger
- AT&T Inc. taking over BellSouth
- The acquisition of eScription Inc. by Nuance Communications Inc.
- The taking over of Hutchison Essar by the Vodafone Group. Now it has become Vodafone Essar Limited
- China Communications Services Corporation Ltd. taking over China International Telecommunication Construction Corporation

- The acquisition of Ameritech Corporation by SBC (Southwestern Bell Corporation) Communications
- The merger of GTE (General Telephone and Electronics) with Bell Atlantic
- The acquisition of US West by Qwest Communications
- The merger of MCI Communications Corporation with Worldcom

There are always driving forces behind the strong desire for mergers and acquisitions. These are often known as motives in merger and acquisition literature. Gaughan [1] established that the most often driving force mentioned is synergy realization. Others include new market access [2], Knowledge transfer ([3],[4],[5],[6],[7]), and Organizational learning ([8],[9],[7]).

Aside the above, it is also a known fact that mergers and acquisitions result in competitive advantage due to cost reductions and increased revenues. Following are other benefits provided by the mergers and acquisitions in the telecommunications industry:

- Building of infrastructure in a more convenient way
- Licensing options for mergers and acquisitions are often found to be easier
- Mergers and acquisitions offer extensive networking advantages
- Brand value
- Bigger client base
- Wide array of products and services

According to Ernst & Young's 2011 valuation paper[10] titled " Valuation drivers in the Telecommunications Industry", the following facts were gathered:

- Year 2000 saw recorded the highest number of mergers and acquisitions globally in terms of volumes in US dollars and number of deals. This was followed by year 2006, and then 2005. Data was taken from 2000 to 2010.
- With the exception of 2001, local market deals exceeded cross-border deals from 2000 to 2010
- With answers from telecom operators, main strategic reasons for acquisitions were ranked with the highest reason to the lowest as indicated below:

  - To enter new geographic markets
  - To strengthen the core business
  - To achieve economies of scale
  - To eliminate or reduce competition
  - To acquire new technology
  - To enter new product markets
  - To acquire liquid assets
  - To take advantage of low valuations/distressed assets

- During the slowdown in 2007, predating the global financial crises, large European operators increased their exposure to emerging markets, with Africa outperforming developing Asia as a target market for footprint.

This clearly shows that Africa, as an emerging market has become the destination for most of these multinational Telecom companies, the reason being the motives discussed above. This is the more reason why attention must be paid to these acquisitions to help them succeed, so that Governments would not be disadvantaged, but benefit thoroughly from the deals in the short to long term. These motives or driving forces are expected to be achieved in the short, medium, and long term once the deal for the merger or acquisition is sealed.

The main objective of this work is to catalogue and bring to the fore, the various driving forces or motives that push leaders of Telecom companies to enter into mergers and acquisitions.

There are a number motives behind a particular merger and acquisition. In the Telecoms sector, these motives are usually overshadowed by the motives "To enter new geographic markets", "To strengthen the core business", and so on as was listed by Ernst & Young's 2011 valuation paper titled " Valuation drivers in the Telecommunications Industry". This work intends to explore from literature all the various motives behind mergers and acquisitions in the Telecoms industry, most of which may be silent, and yet are the main underlying motives.

2 MATERIALS AND METHODS

This work is basically a comprehensive review of literature on merger and acquisition motives. The various motives are discussed, and ranked in order of prevalence.

3 RESULTS AND DISCUSSIONS

Motive is simply "something that causes a person to act in a certain way, do a certain thing, etc; incentive. It is also the goal or object of a persons actions(http://dictionary.reference.com/browse/motive, retrieved 07/02/2012). Merger or acquisition motives therefore, means "the driving force/s that push managers and owners of companies to opt for merger or acquisition as a corporate strategy". Motives may differ from one industry to another, one geographical area to another, one era to another, one market to another, etc. The dynamics may be different depending on the prevailing circumstances at the time. M & A literature talks extensively about merger and acquisition motives. This is confirmed by Kaushal [11], who pointed out that factors that affect mergers change with the changing legal, political, economic, and social environments. We look at some of the viewpoints of researchers over the years, and determine the most common ones that run through.

Harari [12] lists several reasons given by CEOs to justify a merger or acquisition. These include: to obtain synergies, economies of scale, cost savings, increased products and rationalisation of distribution channels, as cited in Mcdonald, Coulthard, and de Lang [13]. Albizzatti and Sias [14] identify that the reasoning for an acquisition needs to be more strategic than simply the use of excess cash. The strategic reasons they identify for acquisitions are:

(i) acquire new products, capabilities and skills;

(ii) extend their geographical reach;

(iii) consolidate within a more mature industry; and

(iv) transform the existing industry or create a new industry, as cited in Mcdonald Coulthard, and de Lang [13].

Other research findings also reveal M & As as growth strategies, as cited in Lynch and Lind [15]. Perry and Herd [16] underscore the critical role of strategic planning when using M & As to grow an organisation. They suggest that in the 1990s companies shifted the focus for undertaking M & As from a cost saving perspective to using M&As as a strategic vehicle for corporate growth, which the authors viewed as an inherently more difficult challenge, as cited in Mcdonald, Coulthard, and de Lang [13]. The 1990's was the era of the Telecommunications wave, and growth was central in their motives to enter into M & As.

Selden and Colvin [17] even suggest that most common reason companies buy one another is to acquire customers.

Bohlin, Daley, and Thomson[18] pointed out seven motives for merger and acquisitions which were a result of Surveys of senior executives. They are:

- To create and exploit synergies (the primary motivation)
- To increase market share
- To protect markets by weakening or eliminating rivals
- To acquire products and/or technologies
- To strengthen the core business by expanding in areas of greatest competence
- To gain footholds in other countries or continents
- To achieve critical mass or competitive size

In commenting on these motives, they made it clear that most of these motives are not realized, and that the success rate was below 20 percent. More on failure perspectives are dealt with into more detail later on in this write up.

Neary [19] indicated that business organization literature has identified two major common reasons why mergers and acquisitions are sought after; they are *efficiency gain and strategic rationale.* Efficiency gain means the merger would at the end of the day produce benefits in the form of economies of scale and economies of scope. Economies of scale and scope are achieved because of the integration of the volumes and efficiences of both the entities put together. Strategic rationale is also derived from the point that mergers and acquisitions activity would lead to change in the structure of the combined entity which would have a positive impact on the profits of the firm. Inspite of these two broad motives, there are others worth mentioning to make the literature complete. Following are a few of them:

- **Synergy**

Synergy stems from the Greek word which simply means to co-operate or work together [20]. Synergies are the present value of the net additional cash flow that is generated by a combination of two companies that could not have been generated by either company on its own [21].

Synergy is particularly important because it is one of the main reasons for mergers to start with. Merger theoretically, revolves around it, and it simply means putting together the expertise and resources of the entities involved to perform better. It is believed that as individual entities, their effect will not be felt much, but when put together, the combined effect will be colossal [22].

Pearson [23] described synergy as 2 + 2 = 5. Shearman [24] interpreted this by implying the whole would be greater than the sum of its parts. There are four reasons why estimating synergies in a merger process is so important. First of all, assessing the value that would be created by synergies is so important, because mergers primarily is meant for value creation. Secondly, assessing how investors would react to the merger deal is another important consideration. Thirdly, because managers need to disclose these strategies and benefits of such deals to investors, perfect knowledge and estimation of them is very important. Lastly, valuing synergies is important for developing post-merger intergration strategies [20].

Synergy can be discussed in terms of *operational, financial,and managerial*. Peck and Temple [25] indicated that operational synergies refer to those classes of resources that lead to production and/or administrative efficiencies. Peng [26] also related operational synergy to common technology, marketing techniques like common brands and manufacturing facilities like logistics. Bakker and Helmink [22] explained further that operational synergy is a combination of economies of scale, which would reduce average costs as a result of more efficient use of resources and economies of scope, which would help an entity deliver more from the same amount of inputs. Financial synergy occurs when the cost of capital are lowered as a result of M & A impact on the newly formed entity[27].

Whiles cost of capital is reduced, there is an increase in borrowing power[28]. Financial synergies are possible between related and unrelated firms, unlike operational synergies that take place only between related firms[25]. Managerial synergy occurs when the management teams of the companies involved in the M & A come together, and strenghts and expertise are drawn from each other [29].

These synergies occur when competively relevant skills possessed by managers of previously independent entities can be successfully transferred to the merged entity[30]. Ficery, Herd, and Pursche [21] listed six most common mistakes that acquiring executives make and what can be done to improve the success of achieving synergistic benefits. This is captured in the table 1 below.

Table 1: Correcting Synergy Slip-ups

Slip-up	Correction	Example
Defining synergies too narrowly or too broadly	Post-close integration priorities should precisely match the value and type of synergies that drove the deal in the first place. When done correctly, pre-deal synergy estimates should determine the total valuation and premium	When Sony and Bertelsmann formed Sony BMG Music Entertainment, they mapped financial and overhead spending for 60-plus geographies and businesses to identify baseline elements such as payroll expenses (one company classified them as HR expenses, the other as finance). Only when the baseline was agreed to by both parties was it possible to implement the synergy targeting
Missing the window of opportunity	Successful acquirers tend to capture 70-75 percent of synergies in the first year after the deal. The synergy capture effort should be ''front loaded'' so that the emphasis is to go after the biggest synergies as soon as possible	When a major specialty chemicals company began to plan its acquisition of a large global rival, it focused ruthlessly on planning and achieving the major source of synergies – savings from procurement of direct materials. That singular focus led the client to exceed its publicly stated cost synergy target of $200 million by more than 40 percent – a quarter ahead of schedule
Incorrect or insufficient use of incentives	they should create meaningful rewards which are Incentive programs should be explicit and timely;directly tied to synergy goals	After Cadbury Schweppes purchased candy and gum maker Adams, the external rallying cry was ''Beat Wrigley!'' Internally, it was ''Beat the Model!'' Personal financial incentives were tied to the performance of each functional and regional teamagainst the integration model
Not having the right people involved in synergy capture	Just as companies must appropriately match people with the skills needed in a given position, so too must they get the right people doing the right things in relation to capturing synergies	Early in a large merger of wireless providers, core finance staff was tied up preparing the integration plans for their own department. The merger integration team saw that these people were needed to craft a synergy management process for the whole company. Key Finance staff were adjusted their roles accordingly
Mismatch between culture and systems	Achieving synergies requires some degree of''measurement culture'' where the idea of tracking a success and tying it to a financial metric is a way of life	A merger of Medicare Advantage providers was predicated on achieving scale economies and sharing operational best practices to fuel continued rapid growth. But without formal budgeting and KPI processes, the NewCo could not agree to how many cost synergies could be harvested without sacrificing growth. As a result, synergies were not captured, operational dis-synergies began to show up in the absence of clear integration action, and the NewCo quickly faced a major slowdown in growth – with big profitability problems
Using the wrong process	Companies must use a rigorous, holistic process to capture synergies. Such a process includes Detailed tracking mechanisms, linking synergy targets to ongoing budgets and financial plans, and a system to quickly determine if synergy capture is on schedule (and fix it if it is not)	When Rogers Communications was merging with Microcell, clear synergy guidelines were established before the integration teams kicked off

Source: *Ficery, Herd, and Pursche [21]*

- **Growth**

Growth is essential for the survival of any entity. This growth can be achieved through two major means; organic amd inorganic. Mergers and acquisitions are examples of means of achieving inorganic growth. Among other things, mergers come with consumer demand [31]. Mergers also come with them access to facilities, brands, trademarks, technology, and employees [32]. Cameron and Green [32] also noted that growth cannot be dissociated from risk as far as mergers and acquisitions are concerned, even though mergers and acquisitions are quite easier than organic growth.

- **Diversification and risk management**

Diversification in mergers and acquisitions is more pronounced in conglomerate mergers where the entity's eggs are put into different baskets instead of one in the area of goods and services it offers or trades in. Levy and Sarnat[33] pointed out that the probability of a financial failure of two individual corporations is more than that in case of a conglomerate merger of the two. Diversification normally leads to possession of the necessary management, technical and marketing expertise which leads to an increase in market share [23]. Each type of merger offers some kind of reduction in risk. Vertical integration reduces risk by controlling the production process. Horizontal mergers reduce competition and hence uncertainties. It is asserted that conglomerate mergers are normally done in the interest of managers since shareholders can diversify their portfolios themselves [34].

- **Empire Building**

Top Executives of large entities carry out mergers and acquisitions out of their personal egos of building an empire [11]. Managers in their bid to exercise and exert power and authority, engage in empire building [35]. Managers normally state diversification as the motive for engaging in mergers and acquisitions, while in reality are engaging themselves in ambitious empire building [36].

- **Improved Market Standing**

Mergers and acquisitions are normally done to achieve market dominance in a particular sector or industry. Mergers are often seen to be successful if they are able to reduce considerably or remove potential threat of competition. A key source of supply can be protected from a competitor through mergers [23]. Mergers are also used to protect dominant positions [36], but research has also shown that market control through mergers do not necessarily lead to an increase in profitability [37].

Other motives which are on the lighter side are:

- **Increased managerial compensation and reward**

There is a high tendency among managers, especially limited liability companies,where there is a clear distinction of ownership and control, to enter into mergers and acquisitions for the lure of higher remuneration and more rewards. This normally happens in organizations where rewards are tied to employee performance. Such motives are destructive in nature, and result in failed mergers.

- **Managerial Hubris**

Managerial hubris is the unrealistic belief held by managers in bidding firms that they can manage the assets of a target firm more efficiently than the target firm's current management. Managerial hubris is one reason why a manager may choose to invest in a merger that on average generates no profits. While synergies lead to a positive correlation between target and acquirer gains, hubris is likely to result in a negative correlation [38].

- **Free cash flow theory**

A measure of financial performance calculated as operating cash flow minus capital expenditures. Free cash flow (FCF) represents the cash that a company is able to generate after laying out the money required to maintain or expand its asset base. Free cash flow is important because it allows a company to pursue opportunities that enhance shareholder value.

Without cash, it's tough to develop new products, make acquisitions, pay dividends and reduce debt. FCF is calculated as:

EBIT (1-Tax Rate) + Depreciation & Amortization - Change in Net Working Capital - Capital Expenditure

It can also be calculated by taking operating cash flow and subtracting capital expenditures. Jensen [39] pointed out that often managers tend to use sufficient free cash flow available to them to enter into mergers and acquisitions since they perceive mergers and acquisitions as more beneficial and profitable than other forms of investments. Wubben [40] also noted that the distribution of cash flows as dividends would lead to reduced resources at the disposal of managers and also loss of power.

4 CONCLUSION AND RECOMMENDATION

From the above discussions, it is clear that Synergy, Growth, Improving market standing, creating wealth for shareholders, and Empire building for managers stand out. Table 2 below adapted from Trautwein [2] and Cox [41] but cited in Nga and Kamolrat [42] shows the summary of merger and acquisition motives and the corresponding matching merger theories that underpin them.

Table 2: Merger and acquisition motives(adapted from Trautwein[2] and Cox [41])

1. M & A as rational choice	1.1. M & As benefits bidder's shareholders	1.1.1. Net gains through synergy	Efficiency Theory	M & A is planned and executed to achieve synergies of three types: financial, operational, and managerial
		1.1.2. Wealth Transfer from Customers	Monopoly Theory	M & A is planned and executed to achieve MARKET POWER. Horizontal and conglomerate M & A may allow firms to cross- subsidize products, simultaneously limit competition in more than one market, and deter potential entrants from the markets, all of which result in higher market power.
		1.1.3. Wealth transfers from target's shareholders	Raider Theory	A raider is a person who causes wealth transfer from the stakeholders of the companies he bids for in the form of greenmail or excessive compensation after a successful takeover.
		1.1.4. Net gains through private information	Valuation Theory/ Investment Theory	M & A is executed and planned by managers who have better information about the target's value than the stock market
	1.2. M & A benefits managers		Empire Building Theory/ Agency Theory	M & A is planned and executed by managers who thereby maximize their own utility instead of shareholder's value
2. M & A a process outcome			Process Theory	M & A decisions are outcomes of processes governed by one or more of the following influences: organizational routines, political games played between an organization's sub units and outsiders, and individual's limited information processing capabilities
3. M & A a macroeconomic phenomenon			Disturbance Theory	M & A waves are caused by economic disturbances: economic disturbances cause changes in individual expectations and increase the general level of uncertainty, thereby changing the ordering of individual expectation. Previous non-owners of assets now place a higher value on these assets than their owners and vice-versa. The result is an M & A wave.

Source: *Nga and Kamolrat [42]*

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REFERENCES

[1] P. A. Gaughan, "Mergers, Acquisitions, and Corporate restructuring," 3rd ed. New York: John Wiley & Sons, Inc., 2002.

[2] F. Trautwein, "Merger Motives and Prescriptions. Strategic Management Journal," 11 (4), 283-295, 1990.

[3] G. Ahuja, R. Katila, "Technological Acquisitions and the Innovation performance of Acquiring Firms: A longitudinal Study. Strategic Management Journal," 22 (3), 197-220, 2001.

[4] S. Finkelstein, J. Haleblian, "Understanding Acquisition Performance: The Role of Transfer effects," Organizational Science 13 (1), 36-47, 2002.

[5] J. Gammelgaard, "Access to competence: An Emerging Acquisition Motive. European Business forum," 17 (1), 44-47, 2004.

[6] P. C. Haspeslagh, D. B. Jemison, "Managing acquisitions: Creating value through corporate renewal," New York: Free Press, 1991.

[7] S. Karim, W. Mitchell, "Path-dependent and path-breaking change: Reconfiguring business resources following acquisitions in the U.S. medical sector," 1978-1995. Strategic Management Journal, 21, 1061-1081, 2000.

[8] I. Bjorkman, J. Tienari, and E. Vaara, "A Learning Perspective on Socio-cultural Integration in Cross-National mergers. In Stahl, G.K., & Mendenhall, M.E. (Eds.). Mergers and Acquisitions: Managing Culture and Human Resources," Stanford, California: Stanford University Press, 155-175, 2005.

[9] O. Gupta, G. Roos, "Mergers and Acquisition through an intellectual Capital perspective," Journal of Intellectual Capital, 2, 297-309, 2001.

[10] Ernst & Young, "Valuation drivers in the Telecommunications Industry, " EYGM Limited, 2011.

[11] V. K. Kaushal, "Corporate Takeovers in India," Sarup & Sons, New Delhi, 1995.

[12] O. Harari, "Curing the M & A madness," Management Review, 86 (7): 53-56, 1997.

[13] J. Mc Donald, M. Coulthard, and P. de Lang, "Planning for a successful merger or acquisition: Lessons from an Australian study," Journal of Global Business and Technology, Vol1 No. 2., 2005.

[14] N. Albizzatti, D. Sias, "New Tricks for the Old Deal Pro. Mergers and Acquisitions," The Dealmaker's Journal, 39 (6): 28-35, 2004.

[15] J. G. Lynch, B. Lind, "Escaping merger and acquisition madness," Strategy and Leadership, 30 (2): 5-12, 2002.

[16] J. S. Perry, T. J. Herd, "Mergers and acquisitions: Reducing M & A risk through improved due diligence," Strategy and Leadership, 32 (2): 12-19, 2004.

[17] L. Selden, G. Colvin, "M&A Needn't Be A Loser's Game," Harvard Business Review, 81 (6): 70-79, 2003.

[18] N. Bohlin, E. Daley, and S. Thomson, Successful Post-Merger Integration: Realizing the Synergies. Handbook of Business Strategy, Vol. 1 Iss: 1, pp.225 – 231, 2000.

[19] P. Neary, "Cross Border Mergers as Instruments of Comparative Advantage," University College Dublin and CEPR, 2004.

[20] R. F. Bruner, "Applied Mergers & Acquisitions," John Wiley & Sons Inc., New Jersey, 2004.

[21] K. Ficery, H. Tom, and B. Pursche, "Where has all the synergy gone? The M&A puzzle," Journal of Business Strategy. VOL. 28 NO. 5 2007, pp. 29-35, 2007.

[22] H.J.C. Bakker , J.W.A. Helmink, "Successfully Integrating Two Businesses," Gower Publishing Limited, Hamsphire, 2004.

[23] B. Pearson, Successful Acquisition of unquoted Companies. A practical Guide, 4th ed., University press, Cambridge, United Kingdom, 1999.

[24] A. J. Sherman, Mergers and Acquisitions from A to Z. Strategic and Practical Guidance for small-and middle-market Buyers and Sellers, AMACOM, United States of America, 1998.

[25] S. Peck, P. Temple, Mergers and Acquisitions. Critical Perspectives on Business and Management, Routledge, London, 2002.

[26] M. W. Peng, Global Strategy, 2nd ed. Cincinnati, OH: South-Western Cengage learning, 2009.

[27] D. M. Depamphilis, Mergers, Acquisitions, and other restructuring Activities, 3rd ed., Elsevier Inc., London, 2005.

[28] J. A. Hankin, A. Seidner, and J. Zietlow, "Financial management of non-profit organizations," John Wiley & Sons, USA, 1998.

[29] S. A. Ross, R. W. Westerfield, and J. Jaffe, Corporate Finance. Tata McGraw-Hill. New Delhi, 2004.

[30] M. A. Hitt, J. S. Harrison, and R. D. Ireland, Mergers and Acquisitions: A Guide to creating value for stakeholders. Oxford University Press, Inc. New York, 2001.

[31] J. Sloman, "Asymmetric Information and Market Failure," Teaching Business and Economics Vol. 10 No. 3, pp. 11-12, 2006.

[32] E. Cameron, M. Green, Making sense of change management. A complete Guide to the models, Tools and Techniques of organizational change, Cogan Page Limited, U.K.,2004.

[33] H. Levy, M. Sarnat, "Diversification, portfolio Analysis and the uneasy case for conglomerate mergers," The journal of finance, Vol 25(4), pp. 795-802, 1970.

[34] W. H. Goldberg, Mergers, Motives, Modes, Methods, Gower, Aldershot, 1983.
[35] S. Cartwright, C. L. Cooper, Mergers and acquisitions: The Human factor, Butterworth-Heinemann Ltd, Oxford, 1992.
[36] K. D. George, C. Joll, and E. L Lynk, Industrial Organization: Competition, growth, and Structural change, 4th ed., Routledge, London, 2005.
[37] A. Griffiths, S. Wall, Applied Economics, 11th ed., Pearson Education Limited, England, 2007.
[38] E. Berkovitch, M. P. Narayanan, "Motives for takeovers: An empirical Investigation," Journal of financial and Quantitative Analysis, Vol 28(3), pp. 347-362, 1993.
[39] M. C. Jensen, "Agency costs of free cash flow, corporate finance and takeovers," The American Economic Review, Vol. 76(2), pp. 323-329, 1986.
[40] B. Wübben, German Mergers & Acquisitions in the USA – Transaction Management and Success. DUV Gabler Edition Wissenschaft, Wiesbaden, Germany, 2007.
[41] R. A. K. Cox, "Merger and Acquisition: A Review of the Literature," Corporate Ownership & Control, spring, 3 (3), 55-59, 2006.
[42] H. T. V. Nga, L. Kamolrat, Critical success factors in merger and acquisition projects-A study from the perspectives of advisory firms, 2007.

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IMPACT OF LINED/UNLINED CANAL ON GROUNDWATER RECHARGE IN THE LOWER BHAVANI BASIN

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ABSTRACT: Bhavani basin is the fourth largest Sub Basin in the Cauvery basin. The entire command area of all three major canals that takes off from the Bhavani river falls within the Erode District i.e. Lower Bhavani Project (LBP), Kodiveri and Kalingarayan canals. The LBP canal is a major source of irrigation in Erode District. Many of these canals are unlined and leakage takes place from them. Thus the seepage from the canal helps in recharging the wells in the area, enabling to get adequate water supply for the crops when water was not released from Bhavanisagar Dam. In this study, the Groundwater recharge is determined by groundwater flow modeling using Visual MODFLOW model. For this purpose, three major natural sources of groundwater recharge are taken into consideration such as rainfall infiltration, canal seepage and return flow of irrigation. The model was run and ZONEBUDGET gives an idea about the amount of recharge from lined/unlined canal to the field. Unlined canal helps to recharge the groundwater about 20% more than the lined canal. The analysis reveals that the annual rainfall also has rapidly changed in this region. In the LBP canal Head reach meets their requirement with available quantity of water from the canal system. Tail end reach does not receive the required quantity of water because of seepage loss and conveyance loss. Hence the lined canal can be provided for full length of the main canal. Branch canals and minor distributaries are suggested to maintain the canals with unlined canal system.

KEYWORDS: Lower Bhavani basin, Erode, Groundwater flow modeling, Irrigation practice, Lined canal system.

1 INTRODUCTION

Reservoir is a natural or artificial place where water is collected in great amount and stored for use, especially for supplying a community, irrigating land, furnishing power, etc. Storage of water is released from the reservoir through canals for cultivation. Canals are man-made channels to divert or to distribute the available quantity of water to the farmlands. It is designed either lined canal or unlined canal. Lined canals and unlined canals both are manmade. The difference is that lined canal is lined with concrete, bricks or stone. Purpose is to avoid seepage of water through soil, where soil is made of sand. On the other hand unlined canal is used to recharge the ground water through the seepage. Groundwater is recharged from, and eventually flows to the surface naturally; natural discharge often occurs at springs and seeps, and can form oases or wetlands. Hence the canal has an impact on the groundwater recharge.

Groundwater is underground water that completely fills the pores of an aquifer, following only by gravity forces. At present, groundwater is the major source of water supply for about half of the nations. Approximately 40% of the world's population uses groundwater and about 50% of the world's food production depends on irrigated agriculture linked to groundwater.

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2 MATERIALS AND METHODS

2.1 STUDY AREA

The Bhavani basin is laid between 10°55' N and 11°45' N latitudes and 75°30' E and 77°40' E longitudes. The area is compressed of hilly regions and plain terrain with maximum and minimum altitudes of 1487 m and 215 m above mean sea level (MSL) respectively. The entire study area is situated in the state of Tamil Nadu spreading over the Erode District. The index map of the study area is shown in Fig 1.

The LBP Canal was originally designed for the ayacut area of 83.975 ha and the ayacut is spread over in Sathyamangalam, Gobi, Bhavani, Erode, Perundurai and Kangayam taluks. In addition to the above ayacut an extent of 1,012 hectare is also benefited in Karur district. The catchment area for this system is 4200 km^2. The main canal is having a length 124 miles irrigating a total ayacut of 83770 ha mostly lying in Gobi, Bhavani and Erode Taluk of Erode and Karur District. The main canal has three major distributaries taking off at 53 km, 101km and 119km, 69 distributaries, 196 minor distributaries and 118 sluices. Below the distributaries the water courses carry the water to the field channels, which directly irrigate lands. The canal is capable of carrying 2300 cusecs. This is the maximum required at peak period of irrigation. Irrigation period for ayacut under this scheme for the first turn is 15th August to 15th December, second turn 16th December to 15th March. The scheme contemplated dry crops. But the ayacut area under this system is prepared to raise paddy. In first turn, allowing supply of 24 TMC for wet crops is found to be optimal period for wet crops. In second turn for dry crops, with a total permissible quantity of 12 TMC water is supply

2.2 GROUNDWATER MODEL

A groundwater model was developed using geological and hydrogeological information obtained from PWD, WRD in Erode District. The numerical model was built using the software of Visual MODFLOW. The study area was discretized by a uniform quadratic grid size of 103000 x63000 by 1632.4 km^2. The boundary conditions for the model were: i) Bhavanisagar reservoir located in upper side of the topography used as constant head boundary ii) Bhavani river and Cauvery river, used as river boundaries and iii) LBP canal used as stream boundary. Groundwater recharge was estimated from the results of ZONEBUDGET. Data for the topography were obtained from Google Earth (Image LANDSAT), DATA SIO, NOAA, U.S., Navy, NGA, GEBCO.

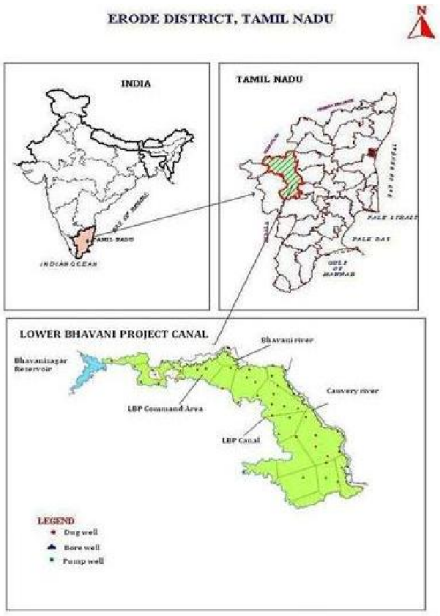

Fig 1. Study area of LBP canal

Totally 46 wells are located under the LBP command area. Out of 46 wells, 37 dug wells and 9 bore wells are selected and the details are collected from CWGB department in Erode. 46 wells are selected to calibrate the model by using Visual MODFLOW for 3 years. 6 layers are entered for 46 wells. 14 Pumping wells are selected and their details are entered in the model to find the recharge in command area. Using calibrated and validated model as well as pumping and recharge inputs,

the results are attained as shown for LBP canal. Head calibration graph shown in Fig 2 & 3. Plot of observed vs. simulated values shows that they are in good agreement i.e., standard error of the estimates and correlation coefficients for the head and concentration are within the allowable limit.

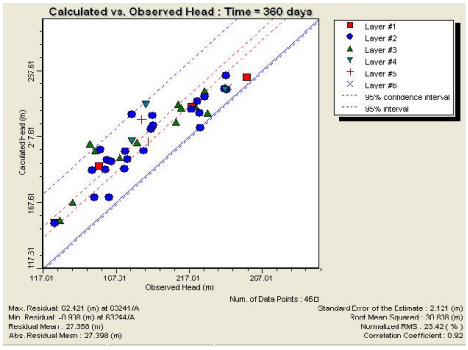

Fig 2. Head calibration for unlined canal

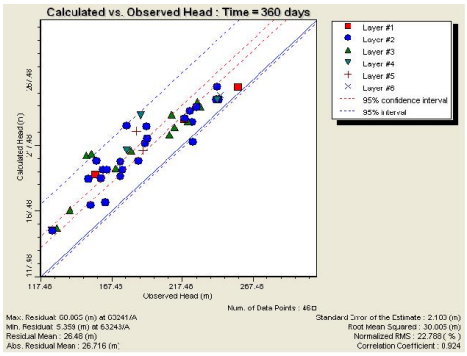

Fig 2. Head calibration for lined canal

3 RESULTS AND DISCUSSION

LBP canal is designed as an unlined canal. in the model domain it was assigned as a stream boundary. Due to the seepage loss groundwater recharged 39.54 % with the actual value of hydraulic conductivity of Erode District. When the canal is assumed to be a lined canal (by considering Concrete lining) seepage loss is arrested due to the cementing materials. The groundwater recharged 20 % by lined canal.

4 CONCLUSION

In the LBP canal Head reach meets their requirement with available quantity of water from the canal system. Tail end reach does not receiving the required quantity of water because of seepage loss and conveyance loss. The annual rainfall also rapidly changed in this region. Results are denoted that the unlined canal is one of the sources for groundwater recharge. Lined canal helps 20% lesser than the unlined canal for groundwater recharge. Hence the lined canal can be provided for full length of the main canal. Branch canals and minor distributaries are suggested to maintain the canals with unlined canal system. It can also helps to recharge the groundwater by diverting the water to the field. While suggesting the lined canal system, it can change the seasonal application and also it will increase the ayacut area in tail end reach.

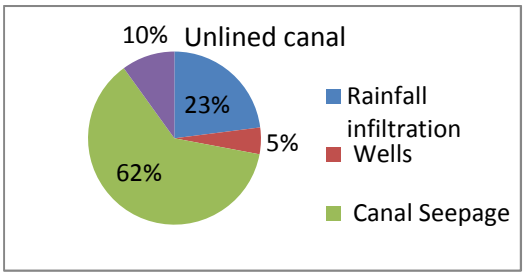

Fig 4. Contribution of groundwater recharge

REFERENCES

[1] M.Arshad, N.Ahmad, M.Usman and A.Sabbir, "*Comparison of water losses between unlined and lined watercources in Indus basin of Pakistan*" Journal of Agricultural Science – Pakistan.

[2] Fakhrealam and Rashid umar, "*Groundwater flow modelling of Hindon-Yamuna interfluves region Western Uttar Pradesh*", Journal geological society of India.

[3] A.G.Fernald and S.J.Guldan, "*Surface water-groundwater interactions between irrigation ditches, Alluvial aquifers and streams"* Fisheries science.

[4] F.E.Harvey and S.S.Sibray, "*Delineating ground water recharge from leaking irrigation canals only water chemistry and isotopes"* School of Natural resource sciences and conservation and survey division –Scottsbluff, Nebraska

[5] M.U.Igboekwe and Adindhuruth, "*Groundwater recharge through infiltration process: A case study of Umudlike, Southeastern Nigeria"* Journal of Water resource and protection – Nigeria

[6] Jose Luis Arumi, Diego river, Eduardo holzapfel, Peter Boochs, Max billib and Alexander fernald , "*Effect of the irrigation canal network on surface and groundwater interactions in the lower valley of the Cachapoal river, Chile*" Chilean journal of agricultural research – Chile.

[7] Kishansinghrawat, Anil kumarmishra and George paul, Rakeshkumar, "*Estimation of ground water resources in Shanergarh block of Allahabad (India) using remote sensing and statistical approach"* Global journal of science, engineering and technology-Allahabad

[8] Meijer, Karen and Boelee, Eline and Augustijn, Denie and Molenvander, Irna , "*Impacts of concrete lining canals on availability of water for domestic use in Southern Sri Lanka"* Elsevier Agricultural water management volume 83

[9] Mohammad Zare and Manfred Koch, "*3D Modeling of the effects of an irrigation/drainage network on ground water table fluctuations in the Miandarband plain, Iran"* Proceeding of 2013 IAHR World Congress

[10] Muhammad Arshad, Niaz Ahmad and M.Usmant, "*Simulating seepage from branch canal under crop, land and water relationship"* International journal of agriculture and biology- Pakistan

[11] G.N.Pradeepkumar and P.Srinivas, "*Estimation of ground water resources in a basin-a case study"* IGC – Hyderabad

[12] R.Rani and K.Elangovan, "*Impact of irrigation on groundwater case study: ParabikulamAliyar Project in Tamilnadu, India*" International journal of engineering research and applications – Kerala.

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Perceptions of Bachelor of Education Students on the Sociological Influences of the Kenya School Curriculum

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ABSTRACT: It is common today to hear parents, political leaders and even church leaders complaining that education and training in general are not facilitating the partakers to become reliable and dependable citizens. This is an evaluative statement on the sociological influences of the school curriculum. This paper is a report of a study that was carried out among Bachelor of Education (B.ED) students in a public university in Kenya. The objectives explored were to: Find out the perceptions of students on the sociological influences of the Kenya School curriculum; Find out the perceptions of the students on how the Kenya school curriculum prepared them to cope with emerging issues in the society; How the Kenya school curriculum has facilitated their understanding and appreciation of their culture; The ways through which religious organizations and families influence school curriculum in Kenya and their perceptions on how the Kenya school curriculum has facilitated their self-actualization. The study was driven by the Structural Functionalism theory and the Sociological foundations of curriculum. Stratified and simple random sampling methods were used in selecting the research sample. A total of 198 students participated in the study and out of these 100 were males and 98 females. The study adopted a descriptive survey design. Questionnaires were used in collection of data. Data was analysed through descriptive and inferential statistics. Among the major findings the study revealed that the Kenya school curriculum does not adequately facilitate learners to understand the cultures of other communities in Kenya, to appreciate other peoples' cultures, and to understand the challenges generally affecting the Kenya society. That the teaching methods adopted by teachers and the methods of evaluation used are inadequate in helping the learners to understand and appreciate their culture. This explains why Kenya is lagging behind in economic growth. Our school leavers are ill prepared to cope with the challenges affecting the society. Therefore, teachers should be provided with professional development opportunities on teaching methods that are learner centred especially those that facilitate problem solving, discovery learning and self-directed approaches.

KEYWORDS: curriculum, sociology, culture, emerging issues, curriculum foundations.

1 INTRODUCTION

From a sociological perspective, education is a process of transmission of culture. Culture refers to the way of life of a society. Schools are formal institutions whose main purpose is to preserve and transmit the culture of the society. Schools discharge this function through the curriculum. Curriculum is the sum total of all the experience provided to the learners under the guidance of the school (Bishop, 1985). Auguste Comte (1798-1857), the founder of the discipline of sociology, define sociology as the study of interaction between human institutions such as the family, education, religion as well as their development and the manner of transformation of societies (Kibera and Kimokoti, 2007:1).

A society is a system whereby people live together in organized communities. Taba (1962) highlights three main functions of education thus: to preserve and transmit culture, to transform culture and as a means of individual development. The first two functions are embodied on the society and its culture.

Education is a value based activity engaging individuals in experiencing and accepting what is valued in society. In favour of this, Ornstein and Hunkins (1998) contend:

> Schools exist within not apart from social context. Through their curricula, schools influence the culture of the people that the schools serve. Likewise, the culture affects and shapes the schools and the curricula. Schools through their teaching of the curriculum can alter society and the society can model the school and its curriculum (Ornstein and Hunkins, 1998:137)

This paper is a report of a study that was undertaken among Bachelor of Education (B.ED) students in a public university in Kenya on their perceptions on the sociological influences of the Kenya School Curriculum.

1.1 PURPOSE OF THE STUDY

The purpose of the study was to find out the perceptions of B.Ed students on the sociological influences of the Kenya School curriculum.

1.2 OBJECTIVES OF THE STUDY

These were to find outthe perceptions of the B.Ed students on:

i) How the Kenya school curriculum had prepared them to cope with emerging issues in the society.
ii) How the Kenya school curriculum had facilitated their understanding and appreciation of their culture.
iii) How religious organizations influencedthe school curriculum in Kenya.
iv) How students' families influencedthe school curriculum in Kenya.
v) How the Kenya school curriculum had facilitated their self actualization.

1.3 FOUNDATIONS OF CURRICULUM

These are forces that influence curriculum planners and developers when deciding on what to include in the curriculum and how to structure it (Glatthorn, Boschee, Whitehead, 2006). Curriculum foundations are the determinants of the school curriculum. They influence the choice of the learning experiences provided in schools.

There are four foundations of curriculum: historical foundations that deal with past events that influence the school curriculum; psychological foundations that are concerned with human behaviour and its effects on curriculum; philosophical foundations that encompass the values and beliefs about life and education and sociological foundations that deal with the society and its influence on the school curriculum. This paper was drawn from the sociological foundations of curriculum. Society is of great influence to school curriculum because as Taba (1962) argues, curriculum developers should look into the moral and artistic development of the society. Dewey quoted in Orntein and Hunkins (1998) concurs with this when he says that it is the primary responsibility of educators to reflect and determine learning experiences that enhance individual personal social growth and lead to the improvement of society.

Tyler (1949) in his curriculum development model recognizes the society as a major influence of the school curriculum and identifies it as an important determinant of educational objectives. Various curriculum scholars (Shiundu & Omulando, 1992; Bishop, 1985; Otunga et al 2011) recognize the curriculum development process should begin by undertaking a situational analysis during which the context is established. The circumstances in the schools and in the society are reflected on. In the society a number of factors are considered like the values, norms of the society, the culture, ideologies, changes in knowledge among others.

The factors in the society should be considered when developing the school curriculum because the society has its own expectations about the aims and objectives that should be considered when designing the school curriculum. It has its own perception of what the product of the school system should look like. The school curriculum is the device used to transmit worthwhile aspects of the society's culture as itreflects cultural and social needs of the society. In addition it should cater for the needs and interests of the different categories of people in the society.

1.4 SOCIOLOGICAL INFLUENCES OF THE KENYA SCHOOL CURRICULUM

The school curriculum in Kenya caters for the emerging issues in the Kenya Society. In Kenya the current emerging issues are the HIV/AIDS epidemic, environmental conservation, ethnic violence, technology changes, unemployment, poverty, drug and substance abuse, population control and gender issues among others.

Glatthorn,Boschee and Whitehead (2006) propose that the use of technology promotes investigative skills, makes learning more exciting, provides opportunities to apply knowledge and prepares students for an increasingly technologically advanced world.Schools in Kenya have continually revised the school curriculum to later for technological changes in the world. This is because as Schever(1999: 16) observe:

> The computer application is already changing how students acquire and use information. If our schools do not rise to their technological opportunity and challenge, they risk becoming completely anachronistic.

It is this thinking that has led to the teaching of computer studies in primary and secondary schools in Kenya. Other innovations in the school curriculum in Kenya that have been driven by technology changes are the use of calculators and Computer Assisted Instruction.

HIV/AIDS is a major disease that affects a large number of people in Africa, Kenya included. Its spread and effects are increasing daily at an alarming rate. It has thus become a major health and social issue in Africa attracting the attention of governments and their various agencies, and the donor communities (Indabawn & Mpofu, 2006).

Environmental degradation is an emerging issue in Kenya. Environment refers to the surrounding of an object. The current environmental issues affecting Kenya aredeforestation, soil erosion, desertification, water shortage and degraded water quality, poaching, and domestic and industrial pollution. Faculties and departments on environmental management have been enacted in Kenyan tertiary institutions and Universities.

Kenya is also affected by ethnic violence. This has greatly affected its economic growth because violence leads to loss of lives and property. In the school curriculum in Kenya, messages on national cohesion and co-existence are passed through an integrated approach in the teaching and learning of all subject areas.

Unemployment is a critical problem affecting thecitizens of Kenya. When addressing Kenyans during the 47th Madaraka day celebrations at Nyayo national stadium in Nairobi on 1st June 2010, president Kibaki cited unemployment as the biggest hurdle in Kenya's quest to transform into a middle income country in East Africa (Otieno, 2010). Kenya is a country affected by poverty too. Kenya is one of the countries in the world with lowest income.Drug and substance abuse is a major issue in Kenya affecting Kenya. Population control is another issue. Despite the governments' population control efforts and strategies, Kenya's population growth rate is still amongst the highest in the world (Central Bureau of statistics , 2004)

Gender issues affect the society in Kenya as well. To promote women education in Kenya, there has been the enactment of gender policy in education which states that:By 2015, all children, with emphasis on girls, should have access to and complete free and compulsory education of good quality to achieve gender equality in education (MOE, 2007). This is in line with Millennium Development Goals and Education for all on: Delivering Quality education and Training to all as a priority.

1.5 STRUCTURAL FUNCTIONALISM THEORY

This study was informed by the structural functionalism theory.The major proponents of structural functionalism theory include Auguste Comte, Emile Durkheim, Herbert Spencer and Talcott Parsons (Kibera and Kimokoti, 2007). This theory emphasises that the society has a specific structure of various institutions which function in harmony. Each institution has a specific function(s) and the different institutions in the society are dependent upon one another for various services. In this case, the school is one of the institutions in the society and is charged with the responsibility of effectively preparing learners for life in the society. Schools preserve and transmit the culture of the society

2 METHODOLOGY

This was a quantitative study. It utilized a descriptive survey design. Stratified and simple random sampling methods were used to select the research sample. Stratified sampling provides more reliable and detailed information (Kothari, 2004). This is partly because a stratified sample comprises of a blend of randomization and categorization. Simple random sampling on the other hand ensures that each member of the population has an equal chance of being included in the sample (Gall,

2005). A total of 198 students participated in the study and out of these 100 were males and 98 females. Questionnaires were used in collection of data.

3 FINDINGS AND DISCUSSION

This section presents the data that was obtained from the study.

3.1 BIOGRAPHICAL INFORMATION OF THE RESPONDENTS

The study sought the biographical information of the respondents to confirm if the respondents were reliable in giving the information that was sought in this study.A total of 198 students participated in the study. The findings revealed that 100 respondents (50.5%) were males and the remaining 98 (49.5%) were females. In addition, 41 respondents (20.7%) were in the age bracket of 18-20 years; 73 (36.9%) fell in the age bracket of between 21-22 years, 65 of them (32.8%) between 23-25 years and the rest 19 (9.6%) were in the age bracket of more than 25 years.

On the area of specialization, 91students (46.0%) were pursuing Bachelor of Education (Arts); 77 of them (38.9%) were pursuing Bachelor of Education (Science). 10 students (5.1%) were selected from each of the rest of the specializations under Bachelor of Education thus: Early Childhood and Primary Education, Guidance & Counselling and Technology Education. Concerning the students year of study, 50 students each were in first and second year while 49 students each were in third and fourth year.The implication of the students' biographic data was that the respondents were from varied specialities, gender, age and levels of study.

3.2 THE PERCEPTIONS OF THE B.ED STUDENTS ON HOW THE KENYA SCHOOL CURRICULUM HAS PREPARED THEM TO COPE WITH EMERGING ISSUES IN THE SOCIETY

The students were asked to indicate how the Kenya school curriculum has prepared them to cope with emerging issues in the society. The responses are indicated on Table 1.

Table 1: The perceptions of the B.Ed students on the extent to which the Kenya school curriculum has prepared them to cope with emerging issues in the society

N=198

Aspects	Adequately prepared		Inadequately prepared	
	f	%	F	%
HIV/AIDS awareness and prevention	80	40.4	118	59.6
Eradication of ethnic violence	72	36.4	126	63.6
Embracing technology changes	101	51.0	97	49.0
Coping with unemployment	65	32.8	133	67.2
Environmental conservation	67	33.8	131	66.2
Poverty reduction	69	34.8	129	65.2
Abstinence to drug and substance abuse	82	41.4	116	58.6
Population control	109	55.1	89	44.9
Gender issues	92	46.5	106	53.5

3.3 THE PERCEPTIONS OF THE B.ED STUDENTS ON HOW THE KENYA SCHOOL CURRICULUM HAS FACILITATED THEIR UNDERSTANDING AND APPRECIATION OF THEIR CULTURE

The students were asked to indicate the extent to which the Kenya school curriculum has facilitated their understanding and appreciation of their culture.The responses are indicated on Table 2.

Table 2: The perceptions of the B.Ed students on the extent to which the Kenya school curriculum has facilitated their understanding and appreciation of their culture

N=198

Aspects	**Responses**				
The Kenya school curriculum:	**SA**	**A**	**U**	**D**	**SD**
Has helped me understand the economic activities of the people of Kenya	56(28.2)	56(28.2)	0(0.0)	45(22.8)	41(20.7)
Has helped me understand the social groups/communities found in Kenya	70(35.4)	72(36.4)	0(0.0)	26(13.1)	30(15.2)
Has helped me understand the political organization in Kenya	69(34.9)	67(33.9)	2(1.0)	25(12.6)	35(17.7)
Has helped me understand the culture of other communities apart from my own	50(25.2)	27(13.6)	11(5.6)	60(30.3)	50(25.2)
Has helped me appreciate other peoples cultures	28(14.1)	19(9.6)	9(4.5)	67(33.8)	75(37.9)
Has helped me understand the challenges generally affecting the Kenya society	50(25.2)	40(20.2)	5(2.5)	43(21.7)	60(30.3)

The students were asked to indicate the extent to which various aspects of the school curriculum have facilitated their understanding of the Kenya society.The responses are indicated on Table 3.

Table 3: Perceptions of B.Ed students on how various aspects of the school curriculum have facilitated their understanding of the Kenya society

N=198

Aspects	**Adequately prepared**		**Inadequately prepared**	
	f	**%**	**F**	**%**
The curriculum objectives	106	53.5	92	46.5
The content in the subjects	102	51.5	96	48.5
The teaching methods	72	36.4	126	63.6
The methods of evaluation	95	48.0	103	52.0

3.4 The Perceptions Of The B.Ed Students On The Ways Through Which Religious Organizations Influence School Curriculum In Kenya

The students were asked to indicate howreligious organizations influence school curriculum in Kenya. The findings are presented on Table 8.

Table 4: The perceptions of the B.Ed students on the ways through which religious organizations influence school curriculum in Kenya

N=198

Aspects	**F**	**%**
Provision of resources	138	69.7
Teacher training	142	71.7
Developing Religious Education curriculum	123	62.1
Provision of guidance and counselling services	101	51.0

3.5 The Perceptions Of The B.Ed Students On The Ways Through Which Their Families Influence School Curriculum In Kenya

The students were asked to indicate howtheir families influence school curriculum in Kenya. The findings are indicated on table 9.

Table 5: The perceptions of the B.Ed students on the ways through which their families influence school curriculum in Kenya

N=198

Aspects	F	%
Payment of school levies	198	100
Provision of resources like books	196	99.0
Motivating learners	109	55.1
Providing the learner's background information	115	58.1

3.6 THE PERCEPTIONS OF THE B.ED STUDENTS ON HOW THE KENYA SCHOOL CURRICULUM HAS FACILITATED THEIR SELF ACTUALIZATION

The students were asked to indicate how the Kenya school curriculum has facilitated their self-actualization.The responses are indicated on Table 10.

Table 6: The perceptions of the B.Ed students on how the Kenya school curriculum has facilitated their self-actualization

N=198

Aspects	Responses				
The learning experiences provided in school:	**SA**	**A**	**U**	**D**	**SD**
Inspire be to perform to the best of my ability	26(13.1)	34(17.2)	12(6.1)	66(33.3)	60(30.3)
Are in line with my needs and interests	49(24.7)	46(23.2)	4(2.0)	45(22.7)	54(27.2)
Encourage me to pursue university education	52(26.3)	51(25.8)	7(3.5)	43(21.7)	45(22.7)
Are within my abilities	46(23.2)	50(25.2)	3(1.5)	45(22.7)	5427.2)

3.7 SUMMARY OF THE FINDINGS

The first research objective investigated the perceptions of the B.Ed students on the extent to which the Kenya school curriculum had prepared them to cope with emerging issues in the society. Majority of the students indicated that the Kenya school curriculum had inadequately preparedthem to cope with most of the emerging issues in the society like HIV/AIDS awareness and prevention, eradication of ethnic violence,coping with unemployment,environmental conservation,poverty reduction,abstinence to drug and substance abuse and gender issues. The only aspects that the students indicated the Kenya school curriculum had helped them in are embracing technology changes andpopulation control.

The second research objective was an investigation of the perceptions of the B.Ed students on the extent to which the Kenya school curriculum had facilitated their understanding and appreciation of their culture. The students were of the feeling that the curriculum had failed to facilitate them in understanding the culture of other communities, to appreciate other peoples' cultures and to understand the challenges affecting the Kenya society. Majority indicated that the Kenya school curriculum had effectively assisted them to understand the economic activities of the people of Kenya, the social groups/communities found in Kenya as well as the political organization in Kenya.In addition, the students felt that the aspects of the curriculum that have greatly facilitated the understanding of the Kenya society were the curriculum objectives, and the content in the subject areas. The aspects that the students found inhibiting in the understanding of the Kenya society were the teaching methods and the methods of evaluation.

The third research objective was an investigation ofthe perceptions of the B.Ed students on how religious organizations influenced school curriculum in Kenya.Majority of the students agreed that the religious organizations greatly influenced school curriculum in Kenya through provision of resources, teacher training, development and implementation of Religious Education curriculum as well as the provision of guidance and counselling services.

The fourth research objective was an investigation of the perceptions of the B.Ed students on how their families influenced school curriculum in Kenya. Majority of the students agreed that their families greatly influenced school curriculum in Kenya through payment of school levies, provision of resources, motivating learners and by providing the learner's background information

The fifth research objective was an investigation of the perceptions of the B.Ed students on how the Kenya school curriculum has facilitated their self-actualization. Majority of the students indicated that the learning experiences provided in school did not inspire them to perform to the best of their abilities, that the learning experiences were not in line with their

needs and interests and that they were not within their abilities. The only aspect that majority of the students agreed on was the fact thatthe learning experiences provided in school encouraged them to pursue university education.

4 CONCLUSIONS AND RECOMMENDATIONS

4.1 CONCLUSIONS

Based on the findings of this study, the following conclusions were arrived at:

i) The Kenya school curriculum fails to adequately prepare learners to cope with most of the emerging issues in the societylike HIV/AIDS awareness and prevention, eradication of ethnic violence, coping with unemployment, environmental conservation, poverty reduction, abstinence to drug and substance abuse and gender issues.
ii) The Kenya school curriculum does not adequately facilitate learners to understand the cultures of other communities in Kenya, to appreciate other peoples' cultures, and to understand the challenges generally affecting the Kenya society. That the teaching methods adopted by teachers and the methods of evaluation used are inadequate in helping the learners to understand and appreciate their culture. This explains why Kenya is lagging behind in economic growth. Our school leavers are ill prepared to cope with the challenges affecting the society.
iii) Religious organizations positively influence school curriculum in Kenya through provision of resources, teacher training, development and implementation of Religious Education curriculum as well as the provision of guidance and counselling services.
iv) Parents positively influence school curriculum in Kenya through payment of school levies, provision of resources like books, motivating learners and by providing the learner's background information.
v) The Kenya school curriculum is inadequate in enhancing the learners self-actualization.

4.2 RECOMMENDATIONS

i) Learners need to be sensitized more on how to cope with the emerging issues in the society. Although the school curriculum in Kenya has been reviewed in favour of these issues, most of the learners indicated that they are not well versed in coping with the challenges. Some of the ways through which this can be done is through talks, seminars, provision of books and other materials on the same. The integrated approach recommended in the teaching of the emerging issues should reviewed as well. In addition, the implementation of Life Skills Education which was enacted in 2002 need to be investigated on. Life Skills Education aims at preparing the learners to cope with the challenges affecting the Kenya society.
ii) Continuous curriculum reviews on national cohesion should be done. Most students indicated that they lacked knowledge on other peoples' culture and appreciation of the same.
iii) Schools should partner with religious organizations more in the curriculum development and implementation process. Most of the students indicated that religious organizations positively influenced the school curriculum in Kenya.
iv) Schools should partner with parents more because parents are very influential in the implementation of the school curriculum.
v) Teachers should be provided with professional development opportunities on teaching methods that are learner centred especially those that facilitate problem solving, discovery learning and self-directed approaches. Such teaching methods allow the exploration of learners' abilities and interests thereby facilitating self-actualization.

REFERENCES

[1] Bishop, G. (1985).Curriculum Development: A text book for students. London: Macmillan.
[2] Central Bureau of statistics (2004). Kenya Demographic and Health survey 2003. Nairobi: Government Printer
[3] Gall, J. P., Gall, M. D., & Borg, W. R. (2005). Applying Educational Research: A practical guide (5th ed.). Boston: Pearson Education Inc.
[4] Glatthorn, A. Boschee F. & Whitehead B.M. (2006). Curriculum leadership, development and implementation. Thousand Oaks: Sage publications.
[5] Jesse, K. (2010). Bridging the unemployment gap in Kenya. Jese Jariuki bgorspot.com. Retrieved on 20 th march 2012
[6] Kibera, L. W. and Kimokoti, A. (2007). Fundamentals of Sociology of Education with reference to Africa. Nairobi: University of Nairobi Press.
[7] Kothari, C. R. (2004). Research Methodology: Methods and techniques (5th Ed.). New Delhi: Wishwa Prakashan.
[8] Ministry of Education (MOE) (July, 2007). Gender Policy in education. Nairobi: Government Printer.
[9] Ornstein, A.C& Hunkins, F.P (1998) Curriculum foundations, principles and issues. Boston: Allyn and Bacon.
[10] Otieno, J. (1st June, 2010). Unemployment in Kenya on www.the eastafrican.co.ke. Retrieved on 26th March 2012.
[11] Otunga, R. N. Odeo, I. I. & Barasa, P. L. (ed) (2011). A hand book of curriculum & Instruction. Eldoret: Moi University Press.
[12] Taba, H.B (1962). Curriculum development: Theory and practice. Newyork : Harcourt Brace and World Inc.
[13] Tyler, R. W(1949).Basic principles of curriculum and instruction. Chicago: University of Chicago press
[14] Scherer, M (1999).The understanding pathway: A conversation with Howard Gardner. Journal of educational leadership 57 (3), 1 – 16.
[15] Shiundu S.J & Omulando J.S (1992). Curriculum: Theory and Practice in Kenya. Nairobi: Oxford university press.

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The Effect of Sentential Load, Semantic Relatedness/Unrelatedness, and Sex on Depth of Lexical-Semantic Processing in L1 and L2 reading

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ABSTRACT: Three experiments based on the text-change paradigm examined the effect of sentential load, semantic relatedness/unrelatedness, and sex on depth of lexical-semantic processing in L1 and L2 reading. Experiment 1 and 2 showed that there is no significant effect of sentential load on depth of lexical-semantic processing in L1 and L2 reading. On the other hand, they confirmed the existence of a significant effect of semantic relatedness/unrelatedness on depth of lexical-semantic processing in L1 and L2 reading. Experiment 3 consolidated the results obtained from experiment 1 and 2 and revealed that load is neither localized at the embedded verb nor at the adverb phrase positions. Finally, sex proved not to have an effect on depth of lexical-semantic processing in L1 and L2 reading. The present study showed that all embedded relative clauses and not just object-extracted relative clauses decrease deep processing.

KEYWORDS: Depth of lexical-semantic processing, shallow, deep, underspecification, sentential load, syntactic complexity, referential load, semantic relatedness/unrelatedness.

1 INTRODUCTION

Most linguistic studies on natural language processing (e.g. Gibson & Pearlmutter, 1998; Altmann, 1998; Tanenhaus et al., 1995; Altmann & Steadman, 1988, cited in Ball, Freiman, Rodgers, and Myers, 2010) have argued that language processing in general and syntactic and lexical-semantic processing in particular are complete, fast, and accurate. That's to say, "syntactic, semantic, and pragmatic processing of a word is done while the eyes are fixated on that word or while that word is being heard" (Rayner & Clifton, 2009, p.1). This view is also adopted by most psycholinguists (e.g. Altman, Kamide & Haywood, 2003; Van Berkum et al., 2005; Staub & Clifton, 2006, cited in Demberg, 2011) who "assume that [lexical-semantic processing] generates complete, detailed, and accurate representations of the linguistic input" (Ferreira, Bailey & Ferraro, 2002, p.11). However, Sanford and Sturt (2002) proved that lexical-semantic processing is not always incremental and it is sometimes incomplete. In other words, lexical-semantic processing is not always uniform as some words' meanings are processed deeper than others are. Consequently, they developed depth of lexical-semantic processing theory.

Prior to getting a deep analysis of depth of lexical-semantic processing theory, it is worth mentioning that the notion of depth of processing has appeared in two domains of research which are memory research in the field of cognitive psychology and language comprehension research in psycholinguistics. Wang, Bastisansen, Yang, and Hagoort (2011) affirm that the meaning of depth of processing is not the same in the aforementioned domains. The present paper is concerned with depth of lexical-semantic processing as defined in the psycholinguistic literature.

2 EVIDENCE FOR DEPTH OF LEXICAL-SEMANTIC PROCESSING THEORY

There are mainly three types of evidence that do emphasize that lexical-semantic processing is not always deep and that do back the phenomenon of shallow processing. These evidence are findings of other fields such as formal semantics, computational linguistics, and human language understanding. They have proved that words are not always processed in an incremental fashion (Sanford & Sturt, 2002).

In fact, studies on formal semantics (e.g. Erickson and Matteson, 1981) affirm that people seem to get the global meaning of the discourse at hand prior to the local meaning of its parts and do not always process each word they read or listen to with the same depth (ibid). Inspired by Erickson and Matteson's (1981) study, Barton and Sanford (1993) investigated the detection of semantic anomalies in language comprehension literature by testing the "survivors' anomaly" (Sanford & Sturt, 2002, p.384). In fact, most of their participants did not notice the anomaly in the following question "after an air crash, where should the survivors be buried?" (Barton & Sanford, 1993, cited in Sturt, Sanford, Stewart, and Dawydiak, 2004, p. 882) and gave an answer like "burry them where their relatives want" (Sanford & Sturt, 2002, p. 384). Therefore, these participants did not detect that survivors are living people and that normally we do not burry living people (Sanford, Sanford, Filik, and Molle, 2005). However, the same anomaly can be detected in a bicycle crash context as the following: "After a bicycle crash context, where should the survivors be buried" (Barton & Sanford, 1993, cited in Sturt et al., 2004, p. 882) because, in this situation, dead people are not frequent and survival is the norm. Accordingly, when the word fits the global context, it can be processed less deeply than when it does not, which gives rise to the occurrence of shallow processing.

Similarly, computational linguists contend that language processing varies in depth depending on the purpose of the processor (Sanford & Sturt, 2002). For instance, while automatic translation requires deep processing, shallow processing can be efficient for the automatic generation of indexes for large texts (ibid). In fact, "the computational system underspecifies initially and fills in information if the details become relevant" (Ferreira & Patson, 2007, p. 73). That's to say, underspecified representations are initially computed, and then in the presence of other information like syntactic preferences, world knowledge topic/focus, deep processing occurs (Ferreira & Patson, 2007). For example, there are two readings for a sentence such as (1): (1) there is one boy and many girls and (2) there are as many boys as girls. Nevertheless, computational systems do not make the distinction between the two readings from the beginning and wait till further contextual cues are provided, which gives rise to shallow parsing. In other occasions, as the one illustrated in (2), it would be unacceptable that one can understand that there is one and only one single bath "at the end of the corridor" (Paterson, 2010, p. 31). Thus, such sentence requires obviously deep processing i.e. "full-sentence parsing" (Palmović, 2007, p. 28) right from the beginning and computational systems should not wait for further contextual cues to make decisions.

(1) A boy hit every girl.

(2) 'Every room has a bath'-while booking a room in a hotel.

(Source: Paterson, 2010, p. 31)

Studies on human language understanding suggest that there are certain circumstances when people resort firstly to shallow processing rather than deep processing; and consequently, form only underspecified representations. Then, when contextual clues are available, they process information more deeply; and therefore, form complete representations. For instance, Frazier, Pacht and Rayner (1999) argue that a sentence like (3) is open to two interpretations: (1) Mary saved 100$ and also John saved 100$; (2) Jane and Mary saved together 100$ (cited in Ferreira & Patson, 2007, p. 73). Nonetheless, people, reading or listening to such sentence, cannot immediately choose one of the previous alternatives till they are provided with further context (ibid) (see 4).

(3) Mary and John saved 100$.

(4) Mary bought a present to her mother by her 100$.

2.1 Focus

Sanford et al. (2005) argue that lexical-semantic processing can be either deep or shallow depending on two main factors which are focus and sentential load. Focus is about highlighting a piece of information through linguistic devices or contextual cues or prosodic features or orthographic devices. Bredart and Modolo (1988) were the first to investigate the relationship between focus and lexical-semantic processing using Erickson and Matteson's (1981) Moses illusion example in the domain of formal semantics (Sturt et al., 2004). They argue that the semantic anomaly was only detected when the Moses illusion sentence was put in a cleft construction (5) (ibid). Sturt et al. (2004) extended the previous study to the domain of discourse comprehension and studied the effect of focus on the extent of lexical-semantic processing by means of text-change paradigm which was designed specifically for this purpose. Their study showed that focus has a direct effect on depth of lexical-semantic processing in a sense that focused pieces of information enhance deep processing.

(5) It was Moses who put two of each kind of animals on the Ark.

(Source: Sanford et al., 2005, p. 379)

2.2 SENTENTIAL LOAD

Sanford et al. (2005) argue that sentential load does affect depth of lexical-semantic processing. Sentential load can be perceived as the sum of syntactic complexity and referential load. More precisely, syntactic complexity is manipulated through contrasting sentences containing subject-extracted relative clauses (6) (i.e. low loaded sentences) and object-extracted relative clauses (7) (i.e. high loaded sentences). Referential load is manipulated through contrasting the use of indexical pronouns (8) (i.e. low loaded) or full NPs (9) (i.e. high loaded) in subject position of object-extracted relative clauses. Sentential load is of particular interest to the current paper as it aims at exploring its effect on the extent of lexical-semantic processing in both L1 and L2 reading.

(6) The reporter who sent the photographer hoped for a story

(7) The reporter who the photographer sent hoped for a story.

(8) The reporter who I sent hoped for a story.

Indexical pronoun

(9) The reporter who the photographer sent hoped for a story.

Full NP

(Source: Sanford et al., 2005, p. 380)

2.2.1 SYNTACTIC COMPLEXITY

Several studies (Chomsky, 1957, 1965; Chomsky & Miller, 1963; Miller & Chomsky, 1963; Miller & Isard, 1964; Yngve, 1960; cited in Warren & Gibson, 2002) have affirmed that "nested (or center-embedded) syntactic structures are more difficult to process than non-nested structures" (Gibson & Warren, 2002, p. 80). In other words, complex sentences, e.g. sentences containing relative clauses are more difficult than simple sentences. However, it has been argued that not all relative clauses are equally difficult to process.

Gibson (1998) affirms that a plethora of measurements such as phoneme monitoring, online decision, reading time, and response accuracy, ERP, etc. proved that object-extracted relative clauses are more difficult to process than subject-extracted relative clauses. Additionally, Mak, Vonk and Schriefers (2002) argue that, according to the relative clause literature, subject-extracted relative clauses are easier to process than object-extracted relative clauses generally in most languages, namely English, French, German, and Dutch. Despite the large body of literature on relative clauses' complexity worldwide, relative clauses' processing, from this perspective, is under explored in Tunisian Arabic. Therefore, it is the aim of the present paper to document Tunisian Arabic as far as processing studies are concerned.

However, Carreirasa, Duñabeitia, Vergara, de la Cruz-Pavía, and Laka (2010), investigating the Basque language, argue that the previous conclusion, which is object-extracted relative clauses are more difficult to process than subject-extracted relative clauses, cannot be always considered as a fact. They showed that "subject relative clauses are not universally easier to process" (p. 1) since they found that subject-extracted relative clauses are harder to process than object-extracted relative clauses in Basque. They explained that Basque differ structurally from other investigated languages such as English, French, Dutch, German, and Spanish in a sense that Basque is an ergative-absolutive language and the others are nominative-accusative languages. In Basque, "relative clauses precede their head nouns" (Carreirasa et al., 2010, p. 83); however, in French, English, Spanish, etc. relative clauses follow the head nouns and are generally introduced by a relative pronoun (ibid). It can be concluded that subject-extracted relative clauses are easier to process than object-extracted relative clauses only for nominative-accusative languages.

As far as this paper is concerned, the effect of syntactic complexity on depth of lexical-semantic processing will be studied regarding two languages which are English and Tunisian Arabic. Concerning English, a plethora of studies (Caplan et al., 2002 ; Ford, 1983 ; Gibson et al., 1994; Gordon et al., 2001; King & Just, 1991 ; King & Kutas, 1995 ; Pickering, 1994; Traxler et al., 2002; Weckerly & Kutas, 1999; Cohen & Mehler, 1996 ; Frauenfelder et al., 1980 and Holmes & O'Regan, 1981, cited in Carreirasa et al., 2010) confirmed that object-extracted relative clauses are harder to process than subject-extracted relative clauses. Therefore, the problematic case seems to be Tunisian Arabic as it is an under explored language. However, one can postulate that Tunisian Arabic rhymes with nominative-accusative languages such as English since, in Tunisian Arabic, relative clauses also follow the head noun and are generally introduced by a relative pronoun "illi" (10). Ultimately, in the present

study, object-extracted relative clauses are presumed to be more difficult to process than subject-extracted relative clauses in Tunisian Arabic.

(10) Haidar šef ir-ražil illi ža

(Source: Ghodbani, 2005, pp .46-47, cited in Arfaoui, 2011, p. 15)

The relationship between syntactic complexity and depth of lexical-semantic processing is evidenced by studies about garden path effects (e.g. Ferreira & Clifton, 1986 and Trueswell et al., 1994; cited in Sanford et al., 2005). Those studies "suggest that when parsing becomes difficult, processing may be shallow" (Sanford, 2002, p. 199). This paper aims at investigating the effect of syntactic complexity on depth of lexical-semantic processing through comparing high loaded sentences i.e. sentences containing object-extracted relative clauses to low loaded sentences i.e. sentences containing subject-extracted relative clauses.

2.2.2 REFERENTIAL LOAD

As stated earlier, object-extracted relative clauses are more difficult to process than subject- extracted relative clauses; however, not all object-extracted relative clauses are believed to be equally hard to process (Sanford et al, 2005). In fact, it is argued that object-extracted relative clauses introduced by indexical pronouns "I" and "you" (11) are easier to process than those introduced by full NPs (12) (ibid). The present study tends to explore the effect of referential load on depth of lexical-semantic processing through comparing high loaded sentences i.e. sentences containing object-extracted relative clauses introduced by a full NP to low loaded sentences i.e. sentences containing object-extracted relative clauses introduced by indexical pronouns.

(11) The professor who I had recently met at a party was famous, but no-one could work out why.

(12) The professor who the student had recently met at a party was famous, but no-one could work out why.

(Source: Sanford et al., 2005, p.381)

Gundel, Hedberg, and Zacharski's (1993) Givenness Hierarchy theory explains why indexical pronouns reduce the processing load of object-extracted relative clauses (cited in Warren & Gibson, 2002). According to this theory, referents are ranked from central to peripheral ones. Central referents are easier to process than peripheral referents. It also states that the accessibility of a referent of an NP in discourse determines its processing load (ibid). In other words, it advocates that central referents such as the referents of indexical pronouns are more accessible than peripheral ones like those of full NPs because indexical pronouns have known referents in each type of discourse while full NPs are either newly introduced or found in long-term memory and thus relatively inaccessible (ibid). To sum up, the Givenness Hierarchy Theory emphasizes the idea that accessing indexical pronouns are low loaded than full NPs since their referents are more easily accessible than those of full NPs.

Both focus and load are related to a third factor which is semantic relatedness/unrelatedness (Sanford et al., 2005). On the one hand, when a piece of information is focused, changes to semantically similar words are more detected than changes to semantically distant words (Sturt, Sanford, Stewart, and Dawydiak, 2004). On the other hand, changes to semantically distant words are more detected than changes to semantically similar ones when a piece of information is under sentential load (Sanford et al., 2005). This issue will also be treated in this paper.

Sanford et al. (2005) argue that difficulty in processing object-extracted relative clauses introduced by full NPs is not spread and it is strictly localized to a certain position. They claim that there is "a well-understood sentential locus [where sentential load is high] and where complexity effects influence processing" (p. 381). In fact, Warren and Gibson (2002) and Sanford et al. (2005) found that sentential load occurs only at the embedded verb and not at adverb or other NPs positions; and do not affect adjacent loci as participants found difficulties only at the integration site of the embedded verb. This issue will be treated in this paper by manipulating changes at the embedded verb position and at the adverb phrase position.

3 LOAD AND LEXICAL REPRESENTATIONS

Focus and sentential load are believed to affect lexical-semantic processing but in a different way. Therefore, we are interested in presenting the three main theories which try to answer the following question: "what does load do to lexical representations?" (Sanford et al., 2005, p.390). These theories are Granularity Theory of Focus, Capacity Theory of Comprehension, and Good Enough Representation Theory.

Sturt et al. (2004) found that granularity theory is sensitive to focus developed by Hobbs (1985). When a word is in focus and changed to another word which is semantically close, the change was easily detected since the word is presented at a more detailed level (Sanford et al., 2005). Conversely, when a word is not in focus, i.e. presented at rougher details, detection rates for semantically similar changes fell (ibid). Thus, focus enhances the detection of close semantic changes rather than the detection of distant semantic changes. However, sentential load is not related to Granularity Theory of focus. The Granularity Theory of focus does not interpret the relationship between load and lexical representation as load is not an active variable in this theory.

In 1992, Just and Carpenter developed the Capacity Theory of Comprehension, a theory about memory resources. They claim that understanding a piece of discourse at hand involves the integration of both syntactic and semantic information, which consumes memory resources (Just & Carpenter, 1992). This theory states that short-term memory is constrained and its storage and computational functions are degraded when the task demands exceed the available resources (Just & Carpenter, 1992). That's why Sanford et al. (2005) argue that when a sentence is complex, it pushes memory resources spent on semantic analysis "to be well compromised" leading to shallow processing of the semantics of that sentence.

The Good Enough Representation theory (2002) assumes that lexical-semantic representations which are often underspecified can be perceived as "just good enough" i.e. sufficient for completing the task at hand (Ferreira et al., 2002). Ferreira et al. (2002) argue that "good enough representations" arise in case of time pressure and mainly resource constraints (e.g. complex sentences, ambiguous sentences).

4 PREVIOUS EMPIRICAL STUDIES

Only few studies have investigated depth of lexical-semantic processing worldwide. Nonetheless, there are some sound empirical studies done to explore this phenomenon and to probe the effects of focus and sentential load on this notion either in reading or listening.

Sturt, Sanford, Steward, and Dawydiak (2004) engaged in a study about the effect of linguistic focus on depth of lexical-semantic processing. Their study revealed that both focus and semantic distance have an effect on detection of changes i.e. change detection rates were high when the word is in focus. Furthermore, they found that focus and semantic similarity/distance interact in a sense that "focus made a significant difference when the change was to [a semantically related] word, but had no effect when the change was to a semantically unrelated word" (Sturt et al., 2004, p.886). Their interpretations of the results were in line with the Granularity Theory of Focus and the Good Enough Representation theory.

Sanford, Molle, Sanford, and Healy (2004) conducted a study about the effects of both focus and referential load on the extent of lexical-semantic processing in the English language Listening (L1). They used Sturt's et al. (2004) text-change detection task using auditory presentations. They manipulated, on the one hand, focus via prior context, and referential load and semantic distance on the other hand. Sanford et al. (2004) found an interaction between focused information and change detection rates with "fewer change detections in unfocused information [were noticed] when the target word was changed to semantically similar words" (p.1). They also found an interaction between focus and semantic relatedness/unrelatedness. The aforementioned results were, therefore, in line with the granularity Theory of focus.

Wang, Bastisansen, Yang, and Hagoort (2011) investigated also the influence of information structure (i.e. both linguistic and prosodic devices of focus) on depth of lexical-semantic processing in listening in Dutch (L1) through ERP experiments. This study revealed that accentuated focused words were processed more deeply compared to other conditions where there was a mismatch between focus and accentuation. Additionally, the researchers noticed sex differences regarding depth of lexical-semantic processing as females tended to engage in more elaborate lexical-semantic processing compared to males. Wang et al. (2011) argue that, except for their study, sex differences in semantic processing is an under-researched issue; and therefore, this issue deserves further investigation. Thus, it is one of the endeavors of the present study to dig into this issue in the Tunisian context.

5 EXPERIMENTAL QUESTIONS AND EXPERIMENTS

To meet its aim, the current paper aspires at answering the following questions: (1) Does sentential load have an effect on depth of lexical-semantic processing in L1 and in L2 reading? (2) Does semantic relatedness/unrelatedness have an effect on depth of lexical-semantic processing in L1 and in L2 reading? (3) Where is the locus of processing load? and lastly (4) Does sex have an effect on depth of lexical-semantic processing?

To find an answer for the research questions stated earlier, three experiments based on the text-change paradigm were used. This task, developed by Sturt et al. (2004), was inspired by the change-blindness paradigm. This paradigm was "used for detecting changes in complex visual scenes, where failures to detect changes have been taken as indicative of inattention" in studies about visual memory (e.g., Hollingworth & Henderson, 2002; Hollingworth et al., 2001; and Simons & Levin, 1997 cited in Sanford et al., 2005, p. 379).

Experiment 1

This experiment aims at exploring the effects of syntactic complexity and semantic relatedness/unrelatedness on depth of lexical-semantic processing in L1 and in L2 reading. Syntactic complexity was manipulated by comparing object-extracted (high load) and subject-extracted (low load) relative clauses. Semantic relatedness/unrelatedness was assessed by changing the embedded verb to either a semantically related or a semantically unrelated word (see Appendix A). The locus of the change was at the level of the embedded verb.

Method

Design and materials

Experiment 1 was composed of two parts: Part (A) was about the English Language and Part (B) was about Tunisian Arabic. The 24 experimental materials used in this experiment were adapted from Sanford et al. (2005). There were 24 experimental items and 48 fillers in the English part and also 24 experimental items and 48 fillers in the Tunisian Arabic part, too. Each experimental item had a core sentence containing an embedded clause that could be either a subject (13) or an object-extracted relative clause (14), an introductory sentence and a concluding sentence (see Appendix A, Table 1). Sanford et al. (2005) themselves adopted the core sentences from Gibson (1998) but added the introductory and the concluding sentences. The fillers used in this experiment were adapted from Spivey-Knowlton, Trueswell, and Tanenhaus (1993), Sturt (2003) and Sanford et al.'s (2005) experimental items of experiment 2. 18 items of fillers matched the experimental items in structure. The other 30 items had different structures at the level of core sentences such as simple sentences but they had also introductory and concluding sentences (15).

(13) There are strict rules about the correct form of behavior at a royal court. The suitors who amused the king wanted to see the princess. Many people seek professional guidance before they appear at a royal event.

(14) The workmen had all worked together on previous projects. The carpenter who the plumber hit yelled at the painter. Usually, they were a good team but this time it seemed to be going badly.

(15) A patient and her son were waiting for their doctor to introduce them to the team of specialists. The doctor presented the patient to them but not the son. The patient felt embarrassed for getting all the attention.

There were four versions of the materials presented in each part. Each version contains high loaded semantically distant items (HLSD), high loaded semantically similar items (HLSS), low loaded semantically distant items (LLSD) and low loaded semantically similar items (LLSS). Finally, to avoid length problems and the occurrence of the same item in both languages, each version is divided into three subversions provided that Item 1 in English in the first subversion is in Tunisian Arabic in the second subversion. Each subversion includes eight experimental items and 16 fillers in the English part and also eight experimental items and 16 fillers in the Tunisian Arabic part. Concerning the fillers, while 6 fillers matched the experimental items in structures, the other ten had other structures at the level of core sentences. Moreover, the fillers that matched the experimental items in structure didn't include any change. As far as the other fillers are concerned, some of them included changes and others did not. Ultimately, there were 14 changed materials (both experimental items and fillers) and 10 unchanged ones (fillers) in each part of a subversion.

Participants

Twenty-four Tunisian students of English who were enrolled at Master classes were the subjects of this study. All subjects' native language was Tunisian Arabic and their L2 were both French and English. 47 were females and 25 were males. Their ages ranged from 22 to 25.

Procedure

The materials of the experiments were presented on a portable computer using Microsoft PowerPoint. The first presentation of each pair of materials was in black, in Time New Roman size 32, on a white background. The second presentation was also in black but in Ariel size 32, on a white background. Using two different fonts was meant to disable participants from recognizing the loci of changes right from the appearance of the materials. After the appearance of the two presentations of the materials, a blank screen would appear.

Before starting the experiments, participants were orally instructed that they were going to read texts composed of three sentences. Each piece of text would appear twice, and the students' task was to inform the experimenter if they noticed any change between the first and the second presentation. Students read the texts at their own pace and are told to read the texts as naturally as possible to imitate natural conditions of reading and were also instructed not to re-read a text once they had passed through it. When they pressed the return key, the first piece of text appeared. Once they had read the text, they pressed the return key again and they read the second presentation of the text. When they finished reading the two presentations, they pressed the return key again, the blank screen appeared and they were instructed to report any change noticed. If they noticed any change, they were asked to say as precisely as possible what the change had been, and if not to say 'no change'. This procedure was repeated till the end of the whole set of presentations.

Results and discussion

It has been firstly hypothesized that increased syntactic complexity decreases detection of word changes in reading in English and in Tunisian Arabic. To test these hypotheses, 2 (syntactic complexity: High load vs. Low load) x 2 (semantic relatedness/unrelatedness: semantically similar vs. semantically distant) Repeated Measure ANOVA on the number of detected changes was performed by participants (*F1*) and by materials (*F2*) for both languages. Regarding English, the means of detection of word changes under high load condition were not significantly different from the means of detection of word changes under low load condition as *F1* (1, 22) = 1. 905, p > .05 and *F2* (1, 23) = 3.538, p > .05 (see Appendix C, Tables 1 and 2). Concerning Tunisian Arabic, there was not a significant difference in means between high load condition and low load condition as *F1* (1, 22) = 1. 100, p > .05 and *F2* (1, 23) = .657, p > .05 (see Tables 1 and 2). Thus, this result assumes that syntactic complexity has no effect on detection of word changes in both languages.

Table 1. The Effect of Syntactic Complexity on Depth of Lexical-Semantic Processing in L1 and L2 Reading: Subject Analysis

Tests of Within-Subjects Effects

Languages		**English**			**Tunisian Arabic**		
Source		df	F	Sig.	Df	F	Sig.
Syncomp	Sphericity Assumed	1	**1.905**	**.181**	1	**1.100**	**.306**
	Greenhouse-Geisser	1.000	**1.905**	**.181**	1.000	**1.100**	**.306**
	Huynh-Feldt	1.000	**1.905**	**.181**	1.000	**1.100**	**.306**
	Lower-bound	1.000	**1.905**	**.181**	1.000	**1.100**	**.306**
Error(syncomp)	Sphericity Assumed	22			22		
	Greenhouse-Geisser	22.000			22.000		
	Huynh-Feldt	22.000			22.000		
	Lower-bound	22.000			22.000		

Table 2. The Effect of Syntactic Complexity on Depth of Lexical-Semantic Processing in L1 and L2 Reading: Item Analysis

Tests of Within-Subjects Effects

Measure: depthlex

Languages		**English**			**Tunisian Arabic**		
Source		df	F	Sig.	df	F	Sig.
Syncomp	Sphericity Assumed	1	3.538	**.073**	1	.657	**.426**
	Greenhouse-Geisser	1.000	3.538	**.073**	1.000	.657	**.426**
	Huynh-Feldt	1.000	3.538	**.073**	1.000	.657	**.426**
	Lower-bound	1.000	3.538	**.073**	1.000	.657	**.426**
Error(syncomp)	Sphericity Assumed	23			23		
	Greenhouse-Geisser	23.000			23.000		
	Huynh-Feldt	23.000			23.000		
	Lower-bound	23.000			23.000		

The analyses of variance previously carried out showed there was no effect of semantic relatedness/unrelatedness on the change detection rate in English, with *F1* (1, 22) = 1.520, p>.05 and *F2* (1, 23) = 1.501, p>.05 (see Tables 3 and 4). Concerning

Tunisian Arabic, although analyses of variance revealed no effect of semantic relatedness/unrelatedness on the number of changes detected in item analysis (*F2* (1, 23) = 3.038, p>.05), such effect appeared in subject analysis (*F1* (1, 22) = 5.577, p<.05) where the means difference revealed that changes to semantically distant words were more detected than changes to semantically similar ones (see Tables 3 and 4).

Table 3. The Effect of Semantic Relatedness/Unrelatedness on Depth of Lexical-Semantic Processing in L1 and L2 Reading (EXP1): Subject Analysis

Within-Subjects Effects

Measure: depthlex

Languages		**English**			**Tunisian Arabic**		
Source		Df	F	Sig.	df	F	Sig.
semrel (EXP 1)	Sphericity Assumed	1	**1.520**	**.231**	1	**5.577**	**.027**
	Greenhouse-Geisser	1.000	**1.520**	**.231**	1.000	**5.577**	**.027**
	Huynh-Feldt	1.000	**1.520**	**.231**	1.000	**5.577**	**.027**
	Lower-bound	1.000	**1.520**	**.231**	1.000	**5.577**	**.027**
Error(semrel)	Sphericity Assumed	22			22		
	Greenhouse-Geisser	22.000			22.000		
	Huynh-Feldt	22.000			22.000		
	Lower-bound	22.000			22.000		

Table 4. The Effect of Semantic Relatedness/Unrelatedness on Depth of Lexical-Semantic Processing in L1 and L2 Reading (EXP1): Item Analysis

Within-Subjects Effects

Measure: depthlex

Languages		**English**			**Tunisian Arabic**		
Source		df	F	Sig.	df	F	Sig.
semrel (EXP 1)	Sphericity Assumed	1	**1.501**	**.233**	1	**3.038**	**.095**
	Greenhouse-Geisser	1.000	**1.501**	**.233**	1.000	**3.038**	**.095**
	Huynh-Feldt	1.000	**1.501**	**.233**	1.000	**3.038**	**.095**
	Lower-bound	1.000	**1.501**	**.233**	1.000	**3.038**	**.095**
Error(semrel)	Sphericity Assumed	23			23		
	Greenhouse-Geisser	23.000			23.000		
	Huynh-Feldt	23.000			23.000		
	Lower-bound	23.000			23.000		

On the basis of the aforementioned results, the existence of an effect of syntactic complexity on depth of lexical-semantic processing in English and Tunisian Arabic is rejected. Therefore, the present results do not endorse Sanford et al.'s (2005) results. In fact, they may be mainly due to the fact that this result is particular to the Tunisian context, and more precisely to the participants of the present study. Those participants told the researcher that all embedded relative clauses –not only object-extracted relative clauses- inhibit them from concentrating and detecting changes. Moreover, they were more able to detect changes that occur in simple sentences (fillers) rather than the ones that occurred at the level of subject-extracted relative clauses or object-extracted relative clauses. Therefore, subject-extracted relative clauses were not low loaded than object-extracted relative clauses for the participants as these former clauses did not help them detect changes. Ultimately, syntactic complexity may be further investigated but with a different operational definition i.e. through comparing complex sentences (i.e. containing embedded relative clauses) to simple sentences.

Additionally, the present results confirmed the fact that changes are more detected when words are changed to semantically distant words rather than when changed to semantically similar ones. These results are consonant with other studies (e.g. Sanford et al., 2005 and Sanford et al., 2004) which found that depth of lexical-semantic processing is also affected by semantic relatedness/unrelatedness. However, the present results cannot be generalized due to the existence of some inconsistencies. Put differently, the effect of semantic relatedness/unrelatedness on depth of lexical semantic

processing is not significant in Tunisian Arabic in case of item analysis and in English in case of subject analysis. Thus, this result cannot be generalized to all subjects experiencing the same condition and to all items having the same structure. Finally, these results are not in line with Sturt et al. (2004) who argued that semantically similar changes were more detected than semantically distant words when they were in focus. Thus, it can be concluded that load and focus work in a different way.

Experiment two

This experiment aims at exploring the effects of referential complexity and semantic similarity/distance on depth of lexical-semantic processing in L1 and in L2 reading. Referential complexity was manipulated by comparing object-extracted relative clauses introduced by Full NPs (high load) to object-extracted relative clauses introduced by indexical pronouns (low load). Semantic relatedness/unrelatedness was assessed by changing the embedded verb to either a semantically related or a semantically unrelated word (see Appendix B). The locus of the change was at the level of the embedded verb.

Method

Design and Materials

Experiment 2 was composed of two parts: Part (A) was about the English Language and Part (B) was about Tunisian Arabic. There were 24 experimental items and 48 fillers in the English part and also 24 experimental items and 48 fillers in the Tunisian Arabic part, too. The 24 experimental materials used in this experiment were adapted from Sanford et al. (2005). Each experimental item had a core sentence containing an object-extracted relative clause introduced either by a Full NP (16) or an indexical pronoun (17) and an introductory sentence (see Appendix A, Table 2). Sanford et al. (2005) themselves adopted the core sentences from Gibson & Warren (2002) but added the introductory sentences. The fillers used in this experiment were also adapted from Spivey-Knowlton, Trueswell, and Tanenhaus (1993), Sturt (2003) and Sanford et al.'s (2005) experimental items of experiment one. Concerning the fillers, while 18 items matched the experimental items in structure, the other 30 items had different structures at the level of core sentences such as simple sentences but they had also introductory (18).

(16) Learning a new language is easier if you hear it being spoken. The student who the family had willingly accommodated during the summer was friendly and her English really improved during her stay.

(17) The music scene is usually livelier at the weekend. The singer who you have regularly adored over the years is coming to town for a concert to promote her new record.

(18) A senator and a lawyer were debating on TV about international law. The next day, the news reporter criticized the senator but not the lawyer.

There were four versions of the materials presented in each part in Experiment 2 as the first experiment.

Participants

They had the same criteria as Experiment 1. They did not include anyone who participated in the piloting phase or in experiment 1.

Procedure

The procedure was identical to that used in experiment 1 except that students were going to read only two sentences (not three as in experiment1).

Results and discussion

It has been hypothesized earlier in this paper that increased referential load decreases detection of word changes in reading in English and in Tunisian Arabic respectively. A 2 (referential load: High load vs. Low load) x 2 (semantic relatedness/unrelatedness: semantically similar vs. semantically distant) Repeated Measure ANOVA on the number of detected changes was applied by participants (*F1*) and by materials (*F2*) on the data obtained regarding English and Tunisian Arabic. There were not reliably higher rates of change detection under low load condition compared to high load condition as *F1* (1, 22) = 1. 185, $p > .05$ and *F2* (1, 23) = .806, $p > .05$ (see Tables 5 and 6).

Table 5. The Effect of Referential Load on Depth of Lexical-Semantic Processing in L1 and L2 Reading: Subject Analysis

Tests of Within-Subjects Effects

Measure: depthlex

Languages		English			Tunisian Arabic		
Source		df	F	Sig.	df	F	Sig.
refload	Sphericity Assumed	1	**1.185**	**.288**	1	**.252**	**.621**
	Greenhouse-Geisser	1.000	**1.185**	**.288**	1.000	**.252**	**.621**
	Huynh-Feldt	1.000	**1.185**	**.288**	1.000	**.252**	**.621**
	Lower-bound	1.000	**1.185**	**.288**	1.000	**.252**	**.621**
Error(refload)	Sphericity Assumed	22			22		
	Greenhouse-Geisser	22.000			22.000		
	Huynh-Feldt	22.000			22.000		
	Lower-bound	22.000			22.000		

Table 6. The Effect of Referential Load on Depth of Lexical-Semantic Processing in L1 and L2 Reading: Item Analysis

Tests of Within-Subjects Effects

Measure: depthlex

Languages		English			Tunisian Arabic		
Source		df	F	Sig.	df	F	Sig.
refload	Sphericity Assumed	1	**.062**	**.806**	1	**.138**	**.714**
	Greenhouse-Geisser	1.000	**.062**	**.806**	1.000	**.138**	**.714**
	Huynh-Feldt	1.000	**.062**	**.806**	1.000	**.138**	**.714**
	Lower-bound	1.000	**.062**	**.806**	1.000	**.138**	**.714**
Error(refload)	Sphericity Assumed	23			23		
	Greenhouse-Geisser	23.000			23.000		
	Huynh-Feldt	23.000			23.000		
	Lower-bound	23.000			23.000		

Concerning Tunisian Arabic, the results were similar to those found in English. The means of number of detected changes did not differ significantly enough between high load condition and low load condition to assume that referential load had an effect on detection of word changes in Tunisian Arabic as *F1* (1, 22) = .252, p > .05 and *F2* (1, 23) = .138, p > .05 (see Tables 5 and 6). Moreover, experiment 2 revealed that detection of word changes increases when words are changed to semantically distant ones in English and in Tunisian Arabic as the analyses of variance showed the existence of such difference and leveled it as significant in order in English and Tunisian Arabic (*F1* (1, 22) = 5.199, p<.05; *F2* (1, 23) = 4.965, p<.05; and *F1* (1, 22) = 7.314, p<.05) (see Tables 7 and 8). However, this difference was not significant in Tunisian Arabic when analysis were carried out by items (see Tables 7 and 8). Thus, while experiment 2 revealed that referential load has no effect on depth of lexical-semantic processing in both languages, it confirmed the effect of semantic relatedness/unrelatedness on depth of lexical-semantic processing in both English and Tunisian Arabic.

Table 7. The Effect of Semantic Relatedness/Unrelatedness on Depth of Lexical-Semantic Processing in L1 and L2 Reading (EXP 2): Subject Analysis

Within-Subjects Effects

Measure: depthlex

Languages		English			Tunisian Arabic		
Source		df	F	Sig.	df	F	Sig.
emrel (EXP 2)	Sphericity Assumed	1	**5.199**	**.033**	1	**7.314**	**.013**
	Greenhouse-Geisser	1.000	**5.199**	**.033**	1.000	**7.314**	**.013**
	Huynh-Feldt	1.000	**5.199**	**.033**	1.000	**7.314**	**.013**
	Lower-bound	1.000	**5.199**	**.033**	1.000	**7.314**	**.013**
Error(semrel)	Sphericity Assumed	22			22		
	Greenhouse-Geisser	22.000			22.000		
	Huynh-Feldt	22.000			22.000		
	Lower-bound	22.000			22.000		

Those results also do neither consolidate Sanford et al.'s (2004) findings about the effect of referential load on depth of in L1 listening nor Sanford et al.'s (2005) results about the effect of referential load on depth of in L1 reading. However, they do back up the interpretation stated earlier. Put differently, these results enhance the idea that embedded relative clauses were the problem for the participants of the present study since they did not detect more changes in case of indexical pronouns than in case of Full NPs. Ultimately, one can conclude that the difficultly caused by embedded relative clauses is not considerably attenuated when introduced by indexical pronouns.

As far as semantic relatedness/unrelatedness is concerned, these results are consonant with other studies (e.g. Sanford et al., 2005 and Sanford et al., 2004) which found that depth of lexical-semantic processing is also affected by semantic relatedness/unrelatedness. However, the present results cannot be generalized due to the existence of some inconsistencies. Put differently, the effect of semantic relatedness/unrelatedness on depth of lexical semantic processing is not significant in Tunisian Arabic in case of item analysis and in English in case of subject analysis. Thus, this result cannot be generalized to all subjects experiencing the same condition and to all items having the same structure. Finally, these results are not in line with Sturt et al. (2004) who argued that semantically similar changes were more detected than semantically distant words when they were in focus. Thus, it can be concluded that load and focus work in a different way.

Experiment three

This experiment aims at checking whether the load effect is localized or whether it is spread due simply to a more general difficulty associated with the high referential complexity sentences. The materials were essentially the same as those used in Experiment two, except that the locus of the change was at the level of the adverb phrase and not at the level of the embedded verb (see Appendix A, Table 3).

Method

Participants

They had the same criteria as those in Experiment 1 and 2. They did not include anyone who participated in the piloting phase or in experiment 1 or 2.

Procedure

The procedure was identical to that used in experiment 1 except that students were going to read only two sentences (not three as experiment1).

Results and Discussion

Processing load has been, previously, theorized to occur at a well-specified locus which is the embedded verb position. However, this hypothesis is rejected mainly for two reasons. First, analyses of variance carried out by participants (*F*1) and by materials (*F*2) on the data obtained from experiment 3 showed that there were no reliably higher rates of detection at adverb positions under the low load condition (indexical pronouns) than under the high load condition (Full NP) with *F1* (1,

22) = .034, p>.05 and *F2* (1, 23) = .000, p>.05 in English and *F1* (1, 22) = .407, p> .05 and *F2* (1, 23) = .031 , p>.05 in Tunisian Arabic (see Tables 9 and 10). Second, results of the first questions, stated earlier, assert that there was no reliably higher rates of detection at embedded verb position under the low-loaded condition (subject-extracted relative clause (Experiment one), indexical pronouns (Experiment two)) than under the high-loaded condition (object-extracted relative clauses (Experiment one), Full NP (Experiment two)) in both English and Tunisian Arabic. Therefore, load is neither localized at the embedded verb locus nor at the adverb phrase locus.

Table 8. The Effect of Referential Load on Depth of Lexical-Semantic Processing in L1 and L2 Reading (EXP3): Subject Analysis

Tests of Within-Subjects Effects

Measure: depthlex

Languages		**English**			**Tunisian Arabic**		
Source		df	F	Sig.	df	F	Sig.
Refload (EXP 3)	Sphericity Assumed	1	**.034**	**.855**	1	**.407**	**.530**
	Greenhouse-Geisser	1.000	**.034**	**.855**	1.000	**.407**	**.530**
	Huynh-Feldt	1.000	**.034**	**.855**	1.000	**.407**	**.530**
	Lower-bound	1.000	**.034**	**.855**	1.000	**.407**	**.530**
Error (Refload Exp 3)	Sphericity Assumed	22			22		
	Greenhouse-Geisser	22.000			22.000		
	Huynh-Feldt	22.000			22.000		
	Lower-bound	22.000			22.000		

Table 9. The Effect of Referential Load on Depth of Lexical-Semantic Processing in L1 and L2 Reading (EXP3): Item Analysis

Tests of Within-Subjects Effects

Measure: depthlex

Languages		**English**			**Tunisian Arabic**		
Source		df	F	Sig.	df	F	Sig.
Refload (EXP 3)	Sphericity Assumed	1	**.000**	**1.000**	1	**.031**	**.862**
	Greenhouse-Geisser	1.000	**.000**	**1.000**	1.000	**.031**	**.862**
	Huynh-Feldt	1.000	**.000**	**1.000**	1.000	**.031**	**.862**
	Lower-bound	1.000	**.000**	**1.000**	1.000	**.031**	**.862**
Error (Refload Exp 3)	Sphericity Assumed	23			23		
	Greenhouse-Geisser	23.000			23.000		
	Huynh-Feldt	23.000			23.000		
	Lower-bound	23.000			23.000		

The hypothesis, which stated that load is localized at the embedded verb position, is refuted, which contrasts with Sanford et al.'s (2004) and Sanford et al.'s (2005) studies. Still, their results partially agree with the current results since all of them found that processing load is not situated at adverb positions. But, Sanford et al. (2004) and Sanford et al. (2005) found that load is situated at the embedded verb position as they found a particular effect of sentential load at that position, which is in a sharp contrast with the results of the present study. Consequently, load is neither situated at the embedded verbs nor situated at the adverb positions.

The present paper was also about the effect of sex on depth of lexical-semantic processing in both languages. In fact, female students were suggested to process lexical-semantics more deeply than their male counterparts do in both English and Tunisian Arabic. Analyses of variance were performed for both languages and for with sex as a between-subject factor. These analyses, performed on the three experiments, showed that the mean differences between males and females were not significant enough to assume that females are better processors of lexical-semantics than males (see Table 11).

Table 10. The Effect of Sex on Depth of Lexical-Semantic Processing in L1 and L2 Reading

Tests of Between-Subjects Effects

Measure: depthlex

	English				Tunisian Arabic			
	Source	df	F	Sig.	Source	df	F	Sig.
EXP 1	Intercept	1	**93,278**	**,000**	Intercept	1	**113,841**	**,000**
	SEX	1	**2,069**	**,164**	SEX	1	**,359**	**,555**
	Error	22			Error	22		
EXP 2	Intercept	1	**105,960**	**,000**	Intercept	1	**131,133**	**,000**
	SEX	1	**,168**	**,686**	SEX	1	**3,319**	**,082**
	Error	22			Error	22		
EXP 3	Intercept	1	**79,926**	**,000**	Intercept	1	**118,047**	**,000**
	SEX	1	**1,778**	**,196**	SEX	1	**4,704**	**,061**
	Error	22			Error	22		

This result does not confirm the hypothesis that females process lexical-semantics more deeply than males do in both English and Tunisian Arabic. Additionally, it is counter to Wang et al.'s (2011) finding which revealed that females are better performers in cognitive tasks. The present result may be due to the fact that the size of males was smaller than the size of females or to the fact that depth of processing is not related to sex. Instead, it can be related to other factors such as the students' levels of attention devoted to the task at hand and the students' memory capacity. In fact, the researcher noticed that some female students were less attentive than their male counterparts and that some male students were more careful and concentrating than their female counterparts. Thus, this issue should be more explored in further research ensuring equal sizes of female and male students.

6 GENERAL DISCUSSIONS

Table 12 showed that there is a difference between the number of existing changes and the number of detected changes. More precisely, the number of detected changes is inferior to the number of existing changes. This observation enhances the claim stated earlier that there is an effect of complexity load on depth of lexical-semantic processing in L1 and L2 reading. But, this complexity load is not similar to that previously operationally defined in the present study.

Table 11. Number of Detected Changes vs. Number of Existing Changes

Experiments	Number of detected changes		Number of existing changes per language
	English	Tunisian Arabic	
Experiment one	104	106	192
Experiment two	109	112	192
Experiment three	107	112	192

It is rather hypothesized that syntactic complexity is caused by embedded relative clauses in general and not just object-extracted relative clauses. However, this claim remains a theoretical one and future investigations can be conducted either to prove it or refute it. Therefore, it can be concluded that the present results are in line with Capacity Theory of comprehension. According to this theory, complex syntactic structures (e.g. complex sentences) consume memory resources and limit considerably memory resources spent on semantic analysis (Just & Carpenter, 1992). This "well-compromised" memory resources lead to shallow processing of the semantics of words and consequently to a failure of change detection (Sanford et al., 2005).

The present results refute the claim that shallow processing is a characteristic of L2 processing. They support some studies about shallow processing such as Ferreira et al. (2002), Sanford et al. (2005), and Wang et al. (2011) which found that shallow processing exists in L1, too. Table 12 (Appendix C) suggested that the participants opt for shallow processing in some occasions in both their L1 and L2 languages. Therefore, shallow processing can be considered as a universal characteristic of language processing regardless of one's proficiency in that language.

This paper cannot decide whether there is a relationship between load and semantic relatedness/unrelatedness or not since load as it has been operationally defined in this study proves to have no effect on depth of lexical-semantic processing. Thus, it cannot fully decide whether these results are in line with Granularity Theory of focus. Nevertheless, it reveals that there is an effect of semantic distance on depth of lexical-semantic processing as changes to semantically distant words were more detected than changes to semantically similar words, which contradicts with one basic premise of the Granularity Theory of Focus. This premise declares that critical words whether in focus or in loaded positions when changed to semantically similar words are more detected than when changed to semantically distant words (Sanford et al., 2005). Thus, it can be concluded that the current results partially disapprove with one of the main assumptions of the Granularity Theory Hypothesis.

The hypotheses tested and the procedure followed cannot fully decide if the present results are in line with Good Enough Theory. This theory asserts that people usually are satisfied with the minimum processing that meets their needs; therefore, people are inclined naturally to shallow processing (Ferreira et al., 2002). Deep processing; consequently, occurs occasionally when the task at hand requires more attention. While conducting this study, the participants did affirm that they get the gist of the piece of discourse they read; however, this observation alone still not enough to ensure that the present results consolidate this theory or not. Thus, this issue should be further empirically investigated.

Finally, the analysis the participants' data reveals the presence of many false positives among the participants' answers. In experiment 1, there were 90 false positives in English and 45 in Tunisian Arabic. Only 11 out of 90 occurred at the level of embedded verbs in English and only 5 of them occurred at the level of embedded verbs in Tunisian Arabic. In Experiment 2, there were 72 false positives, 12 of them were at the embedded verb positions in English. In Tunisian Arabic, only four out of 31 were at the embedded verbs positions. The third experiment shows that only six out of 78 and only one out of 52 false positives fell at the adverb position in English and in Tunisian Arabic respectively. These observations demonstrate that the participants failed to detect the loci of changes (embedded verbs in experiments 1 and 2 and adverbs in experiment 3). Consequently, their responses were not due to their recognition of the loci of changes, which increases the reliability of the results obtained.

7 MAJOR CONTRIBUTIONS

The present paper has a number of contributions on different domains. First, it can be insightful for computational linguistics since computational linguists argue that complex sentences, mainly those containing embedded relative clauses, hinder the quality of machine translation (Poornima, Dhanalakshmi, Anand, & Soma, 2011). Therefore, they resort to developing simplification programs to obtain two simple sentences out of the complex one. The present study empirically backed up the aforementioned claim since it found that embedded relative clauses hinder depth of processing of meanings of words i.e. the central units of messages. Hence, it is recommended that translators simplify by themselves texts containing such structures before entering them into translation softwares to guarantee an effective translation without changing the meaning.

Moreover, the importance of this study lies in the insights it can provide into the process of teaching reading for both L2 beginners and L2 advanced learners. In the light of the present findings, L2 instructors should avoid texts loaded with embedded relative clauses when teaching L2 beginners because such structures disrupt their reading fluency and hinder their deep processing in reading. Besides, if such structures do exist in texts, teachers should avoid asking those beginners to find synonyms of words found within embedded clauses. Instead, teachers can ask about antonyms since the present results affirm that semantically distant words trigger deep processing more than semantically close words do in the presence of embedded relative clauses. Finally, when those beginners gain reading competency and become somehow advanced readers, it is recommended that their teachers raise their awareness to the effect embedded relative clauses have on their deep processing of reading that they can pay more attention on their processing of words' meanings while facing such structures.

Finally, this paper contributed to the domain of discourse processing not only through investigating the most researched language which is English, but also through exploring an under-researched language which is Tunisian Arabic. In fact, it pioneered in "documenting Tunisian Arabic" as far as research on depth of lexical-semantic processing is concerned. It is recommended that researchers on language processing in the Tunisian context be inspired by this study and dig into their own language to get a better understanding of how it is processed syntactically and semantically speaking. Finally, Tunisian writers or corpus linguists should also be encouraged to write Tunisian Arabic corpuses to facilitate the work of researchers on language processing by providing them with authentic database.

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REFERENCES

[1] Arfaoui, D. (2011). *L1 and L2 ambiguity resolution of relative clauses*. Unpublished MA. Dissertation, Institut Supérieur de langues vivantes at Tunis, Tunisia.

[2] Ball, J., Freiman, M., Rodgers, S., & Myers, C. (2010). *Toward a Functional Model of Human Language Processing*. Poster presented at the 32nd Annual Conference of the Cognitive Science Society, Portland. Retrieved October 20, 2011 from, *act-r.psy.cmu.edu/papers/963/paper0413.pdf*

[3] Bohan J., Sanford A.J., Glen, Clark & Martin. (2008). *Focus and emphasis devices modulate depth of processing as reflected in semantic anomaly detection*. Retrieved September 13, 2011 from http://www.psy.gla.ac.uk/docs/download.php?type=PUBLS&id=1540

[4] Carreiras, M., Duñabeitia, J.A., Vergara, M., de la Cruz-Pavía, I., Laka, I. (2010). Subject relative clauses are not universally easier to process: Evidence from Basque. [Electronic Source]. *Cognition*, 115, 79–92.

[5] Demberg,V. (2011). Incrementality: Evidence for / against incrementality from psycholinguistic research and incremental algorithms in NLP. Retrieved February 27, 2012, from http://www.coli.uni-saarland.de/~vera/Intro.pdf

[6] Ferreira, F., Ferraro, V., & Bailey, K. G. D. (2002). Good-enough representations in language comprehension. *Current Directions in Psychological Science*, 11, 11-15. Retrieved September 14,2011, From ftp://grey.colorado.edu/pub/oreilly/teach/prosem_lang/FerreiraBaileyFerraro02.pdf

[7] Ferreira, F. & Patson, N.D. (2007). The 'good enough' approach to language comprehension. *Language and Linguistics Compass 1* (1-2), 71–83. Retrieved September 14, 2011, from http://www.psy.ed.ac.uk/people/fferreir/Fernanda/Ferreira_Patson_LLC_2007.pdf

[8] Gibson, E. (1998). Linguistic complexity: Locality of syntactic dependencies. [Electronic source]. *Cognition*, 68, 1–76.

[9] Mak, W.M., Vonk, W. and Schriefers, H. (2002). The influence of animacy on relative clause processing. [Electronic source]. *Journal of Memory and Language, 47*, pp. 50–68.

[10] Marinis, T. (2003). Psycholinguistic techniques in second language acquisition research. *Second Language Research* 19 (2), 144-161. Retrieved September 22, 2011 http://www.personal.rdg.ac.uk/~lls05tm/papers/marinis13.pdf

[11] Palmovic, M. (2007). *Electrophysiological Evidence for Sentence Comprehension: A Comparison of Adult, Normal Developing Children and Children with Specific Language Impairment*. Published Ph D. dissertation University of Zagreb, Croatia. Retrieved September 14, 2011, from http://wings.buffalo.edu/linguistics/people/faculty/vanvalin/rrg/Palmovic_diss.pdf

[12] Paterson, K. (2010). *Quantifier processing: Quantifier scope ambiguity*. Retrieved September 13, 2011 from http://www2.le.ac.uk/departments/psychology/ppl/kbp3/pdf/ESSLLI-4.pdf

[13] Poornima, C., Dhanalakshmi, V., Anand, K. M., & Soma, K. P. (2011). Rule based sentence simplification for English to Tamil machine translation system. *International Journal of Computer Applications 25*(8), 38-42. Retrieved May 17, 2012 from http://www.ijcaonline.org/volume25/number8/pxc3874147.pdf

[14] Rayner, K., & Clifton, C., Jr. (2009). Language processing in reading and speech perception is fast and incremental: Implications for event potential related research. *Biological Psychology, 80*, 4-9 doi:10.1016/j.biopsycho.2008.05.002 PMid:18565638. Retrieved October 12, 2011 from http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2649675/?tool=pubmed

[15] Sanford, A. J. (2002). Context, attention and depth of processing during interpretation. [Electronic source]. *Mind & Language, 17*, 199-206.

[16] Sanford, A. J. S., Molle, J., Sanford, A. J., & Healy, N. (2004, September 18). *Shallow semantic processing of spoken utterances*. Poster presented at the Architectures and Mechanisms of Language Processing conference, university of Aix-en-Provence. Retrieved May 11, 2011, from http://aune.lpl.univ-aix.fr/~fulltext/2037.pdf

[17] Sanford, A.J.S, Sanford, A.J., Filik, R. and Molle, J. (2005). Depth of lexical-semantic processing and sentential load. [Electronic source]. *Journal of Memory and Language, 53*, 378-396.

[18] Sanford, A.J. & Sturt, P. (2002). Depth of processing in language comprehension: not noticing the evidence. [Electronic source]. *Trends in Cognitive Sciences, 6*, 382-386.

[19] Seliger, W. & Shohamy, E. (1989). *Second language research methods*. Oxford: Oxford University Press.

[20] Spivey-Knowlton, M.J., Trueswell, J.C. & Tanenhaus, M.K. (1993). Context effects in syntactic ambiguity resolution: Effects of discourse and semantic context in parsing reduced relative clauses. *Canadian Journal of Psychology, 47*, 276-309. Retrieved October 10, 2011, from *www.ircs.upenn.edu/.../trueswell.../Context_effect...*

[21] Sturt, P., Sanford, A.J., Stewart, A.J., & Dawydiak, E. (2004). Linguistic focus and good-enough representations: an application of the change-detection paradigm. *Psychonomic Bulletin and Review, 11*, pp 882-888. Retrieved May 11, 2011 from http://web.me.com/andrewjstewart/Site/Download_Papers_files/Sturt%20et%20al%202004.pdf

[22] Traxler, M.J., Morris, R.K. and R.E. Seely. (2002). Processing subject and object relative clauses: Evidence from eye movements. *Journal of Memory and Language, 47*, pp. 69–90.

[23] Wang, L., Bastiaansen, M. C. M., Yang, Y., & Hagoort, P. (2011). The influence of information structure on the depth of semantic processing: How focus and pitch accent determine the size of the N400 effect. *Neuropsychologia, 49*, 813-820. doi:10.1016/j.neuropsychologia.2010.12.035. Retrieved September 16, 2009, http://pubman.mpdl.mpg.de/pubman/item/escidoc:408411:12/component/escidoc:852547/Wang_The%20influence%20of%20information%20structure_Neuropsychologia_2011.pdf

[24] Warren, T. & Gibson, E. (2002). The influence of referential processing on sentence complexity. [Electronic source]. *Cognition, 85*, 79-112.

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APPENDIXES

APPENDIX A

Table 1

Experimental items for Experiment one

The high load version of each material appears first, followed by the second sentence which carries the low load condition, and then how the word changed from the original to the close and distant related words.

The English Version	**The Tunisian Arabic Version**
1. The man was selected from the identity parade by the witness. The burglar who the police **negotiated** with had frightened the dog. The dog involved was a Jack Russell and unharmed. The burglar who ***negotiated*** with the police had frightened the dog. **Change:** negotiated⟶bargained/ disagreed	**1.** الرّاجل طلّعوه من بين المشتبه فيهم بفضل الشاهد. السّارق اللّي البوليس **تفاوض معاه** خوّف الكلب. الكلب من نوع جاك روسال و ما صارلو شي. السّارق اللّي **تفاوض مع** البوليس خوّف الكلب. **Change : تفاوض ⟵ ما تفاهمش /تساوم**
2. The workman had all worked together on previous projects. The carpenter who the plumber **hit** yelled at the painter. Usually, they were a good team but this time it seemed to be going badly. The carpenter who **hit** the plumber yelled at the painter . **Change: hit⟶ struck/hired**	**2.** الخدّامة الكلّ خدموا مع بعضهم في مشاريع أخرى قبل. النجّار اللّي البلومبي **ضربو** صاح على الدهّان. في العادة كانوا عاملين إيكيب باهية أما المرّة هاذي اللأ مور مامشاتش بلڤدا. النجّار اللّي **ضرب** البلومبي صاح على الدهّان. **change: ضربو ⟵ خدّمو/ تتعارك معاه**
3. A well-run company is founded on a happy work force. The accountant who the engineer **advised** spoke to the secretary. All the employees were respected for their knowledge and skill. The accountant who **advised** the engineer spoke to the secretary **Change: advised ⟶instructed/ disliked**	**3.** أساس أيّ شريكة ناجحة ڤروب متاع موظّفين متفاهمين. المحاسب اللّي المهند س **نصحو** كلّم السّكرتيرة. الموظّفين لكلّ محترمين على خاطر معرفتهم و إتقانهم لخدمتهم. المحاسب اللّي **نصحو** المهند س كلّم السّكرتيرة. **Change : نصحو ⟵ ما حبّوش/علّمو**
4. Good research is conducted in an environment encouraging inquiry and scholarly application. The student who the professor **trusted** met with the head of the administration. Learning advances through good teamwork. **Change: trusted ⟶ believed/ ignored**	**4.** البحث العلمي باش ينجح لازم يتعمل في محيط يشجّع على البحث و التّطبيق العلمي. الطّالب اللّي البروفسور **وثق فيه** قابل المسؤول في الإدارة. التّعليم يتحسّن كيف يبدا فمّا ڤروب متاع خدمة باهي. الطّالب اللّي **وثق في** البروفسور قابل المسؤول في الإدارة. **Change :وثق فيه ⟵ حقرو/صدّقو**

5. Criminal organizations have been the subject of many popular films and TV programs. The mobster who the media **criticized** kidnapped the spy. The relationship of the Mafia with government agencies has often been a compelling theme. The mobster who **criticized** the media kidnapped the spy **Change: criticized ⟶ attacked/admired**	**5.** المؤسّسات الإجراميّة ولاّت موضوع برشا أفلام مشهورة و برامج تلفزيّة. المجرم اللّي وسائل الإعلام **إنتقدتو** خطف الجاسوس. العلاقة بين المافيا و مؤسّسا ت الدّولة ولاّ موضوع يشدّ الإنتباه المجرم اللّي **إنتقدت** وسائل الإعلام خطف الجاسوس. **Change: إنتقدتّو ⟵ عجبها/هاجمتّو**
6. Film stars are under intense pressure to produce international hits. The actress who the starlet **angered** disregarded the leading man. The atmosphere on set can often be unstable. The actress who **angered** the starlet disregarded the leading man. Change: angered: **annoyed ⟶ appeased**	**6.** نجوم الأفلام ديما يعيشوا تحت الضّغط باش يطلّعوا إنتاجات عالميّة ناجحة. الممثّلة اللّي النّجمة الصّغيرة **غشّتها** حقرت البطل. الأجواء في البلاتو ساعات تولّي متقلّبة. الممثّلة اللّي **غشّتت** النّجمة الصّغيرة حقرت البطل. **Change: غشّتتها ⟵ رضّاتها/قلّقتها**
7. There are strict rules about the correct form of behavior at a royal court. The suitors who the king **entertained** wanted to see the princess. Many people seek professional guidance before they appear at a royal event. The suitors who **entertained** the king wanted to see the princess. **Change: entertained⟶ amused/despised**	**7.** فمّا قواعد ستريكت تنظّم تصرّفات العباد في القصور الملكيّة. الخطّاب اللّي الملك **فرهدهم** حبّوا يشوفوا الأميرة. برشا عباد يلوّجوا على توجيهات بروفسيونال قبل ما يمشيوا للقصور الملكيّة. الخطّاب اللّي **فرهدو** الملك حبّوا يشوفوا الأميرة. **Change : فرهدهم ⟵ حقرهم /عمللهم جوّ**
8. Finding a suitable marriage partner is taken very seriously by many people. The bachelor who the socialite liked the millionaire. Rich people are often viewed as more attractive. The bachelor who the socialite **pursued** liked the millionaire **Change: pursued⟶ chased/rejected**	8. إنّو الواحد يلقا شريك حياتو المناسب موضوع ياخذوه برشا عباد بجديّة كبيرة. العازب اللّي المرا الغنيّة **تتبّع فيه** يحبّ لمليونار. النّاس الغنية يبداو العباد يلوّجوا علاهم. العازب اللّي **يتبّع في** المرا الغنيّة يحبّ لمليونار. **Change : تتبّع فيه ⟵ رفضو/ يجري وراه**
9. There are many popular quiz shows on TV. The contestant who the judges **joked** with turned toward the cameraman. Being able to see the reaction of the contestants is very important. The contestant who the judges **joked** with turned toward the cameraman **Change: joked ⟶ laughed/fought**	**9.** فمّا برشا برامج مسابقات مشهورة تتعدّى على التّلفزة. المتسابق اللّي الحكّام **فذلكوا معاه** دار للمصوّر. مهمّ برشا إنّوالواحد ينجّم يشوف الرّيياكسيون متاع المتسابق**.** المتسابق اللّي **فذلك مع** الحكّام دار للمصوّر. **Change : فذلكوا ⟵ تعاركوا /ضحكو**

10. There is an increasing demand for therapists and councilors in many areas of modern life. The child who the psychologist **talked** to had hurt the woman. It is important that all victims should receive a high standard of emotional support. The child who **talked** to the psychologist had hurt the woman **Change: talk ⟶ spoke/listened**	**10.** ولاّ فمّا طلب كبير عالمعالجين و الأخصيّين النّفسيين في برشا مجالات في الحياة العصريّة. الطّفل اللّي البسيكولوق **تحدّث معاه** جرح المرا. حاجة مهمّة إنّو الضّحايا الكلّ يتحصّلوا على مستوى عالي مالدّعم النّفسي. الطّفل اللّي **تحدّث معاه** البسيكولوق جرح المرا. **Change : سمعو/تكلّم معاه⟵تحدّث معاه**
11. In many countries, government officials are directly accountable for their own behavior. The diplomat who the Prime Minister **insulted** angered the dictator. In other countries, however, leaders have total power and have not such responsibility for their actions. The diplomat who **insulted** the Prime Minister angered the dictator **Change: insulted ⟶ abused/ praised**	**11.** في برشا دول،لازم المسؤولين في الحكومة يحاسبوهم شخصيّا على تصرّفاتهم. الدّيبلوماسي اللّي الوزير لول **سبّو** غشش الدّيكتاتور. فدول أخرى، بالعكس، الحكّام عندهم الحريّة المطلقة و ما يتحمّلوش مسؤوليّة أفعالهم. الدّيبلوماسي اللّي **سبّ** الوزير لول غشّش الدّيكتاتور. **Change : مدحو /عنّفو⟵سبّو**
12. Tourism is essential to the economy of many countries. The tourists who the guide **walked** with waved at the nuns. While sightseeing, holidaymakers are advised to guard their belongings. The tourists who **walked** with the guide waved at the nuns **Change: walked ⟶ strolled/joked**	**12.** السّياحة ضروريّة لإقصاد برشا بلدان. السّياح اللّي القيد **مشى معاهم** بيباو عالرّاهبات. ننصحو الخلايعيّة باش يردّوا بالهم على حوايجهم وقتلّي يحوّسوا في الشّارع. السّياح اللّي **مشاو مع** القيد بيباو عالرّاهبات. **Change : فذلك/حوّس⟵مشى**
13. There are many cases of extra-terrestrial sightings in quiet rural communities. The farmer who the aliens had **communicated** with phoned the newspaper. It is the role of free press to report accurate information. The farmer who had **communicated** with the aliens phoned the newspaper. **Change: communicated⟶ conversed/Struggled**	**13.** فمّا برشا حالات متاع ناس شافت كائنات فضائيّة في المناطق الرّيفيّة الهادية. الفلاّح اللّي الكائنات الفضائيّة **تكلّمت معاه** عمل تلفون للجريدة. دور وسائل الإعلام الحرّة هو باش تنقل الخبر الصّحيح. ح الفلاّح اللّي **تكلّم مع** الكائنات الفضائيّة عمل تلفون للجريدة. **Change : تصارعت/ تحدّثت⟵تكلّمت**
14. American politicians rarely agree on contentious issues. The official who the governor **argued** with avoided the mayor. They must represent the views of their voters. The official who the governor **argued** with avoided the mayor **Change: argued ⟶ quarreled/agreed**	**14.** السّياسيين الأمريكان قليل ما يتفاهموا على الأمور المثيرة للجدل. المسؤول اللّي الوالي **تجادل** معاه تجنّب العمدة. لازم السّياسيين يمثّلوا أفكار النّاخبين متاعهم. المسؤول اللّي **تجادل** مع الوالي تجنّب العمدة **Change : إتّفق/ تعارك⟵تجادل**

15. There are many examples of personal disputers amongst rock groups. The guitarist who the band **played** with rejected the agent. Music can earn successful groups and others a lot of money. The guitarist who **played** with the band rejected the agent. **Change: played ⟶ performed/argued**	**15.** فمّا برشا أمثلة للخلافات الشّخصيّة وسط ڤروبات الرّوك. الڤيتاريست اللّي الفرقة **عزفت** معاه رفض الموزّع. الموسيقى تنجّم تربّح برشا فلوس للڤروبات النّاجحة و لبرشا ناس أخرين زادة. الڤيتاريست اللّي **عزف** مع الفرقة رفض الموزّع. **Change: تعاركت/ أدّات⟵عزفت**
16. The quality of National Health Service care is a major electoral issue. The medical student who the doctor **worked** with scolded the patient. The government, public and media all closely scrutinize the effectiveness of hospitals The medical student who **worked** with the doctor scolded the patient. **Change: Worked ⟶ operated/trained**	**16.** موضوع جودة الخدمات في الصحّة العموميّة مهمّ برشا في البرامج الإنتخابيّة. طالب الطبّ اللّي الطّبيب **خدم معاه** صاح على المريض. الحكومة، النّاس، و وسائل الإعلام كلّهم يراقبوا عن قرب الجودة في السبيطارات. طالب الطبّ اللّي **خدم مع** الطّبيب صاح على المريض. **Change : تحدّث/ درّبو/عمل العمليّة⟵خدم**
17. Pet animals should always be kept on a leash when walking in the countryside. The dog which the cat **chased** scratched the baby cats. This is especially important when they are not well trained. The dog which **chased** the cat scratched the baby cats. **Change: chased ⟶ hunted/annoyed**	**17.** الحيوانات الأليفة لازم تتربط كيف يبدا الواحد يحوّس في الرّيف. الكلب اللّي القطّوسة **جرات وراه** خبّش القطاطس الصّغار. الحاجة هاذي مهمّة خاصّة كيف يبداو ماهمش مربّين بلڤدا. الكلب اللّي **جرى وراء** القطّوسة خبّش القطاطس الصّغار. **Change : قلّقت/ حسّرت⟵جرات وراه**
18. Forest animals have come under increasing protection from new legislation. The rabbit which the fox bit ran from the wolf. However, there is little protection for normal species behavior. The fox which **bit** the rabbit ran from the wolf. **Change: bit ⟶ nipped/sniffed**	**18.** فمّ قوانين جديدة تعطي أكثر حماية لحيوانات الغابة. الأرنب اللّي الثّعلب عضّها هربت مالذّيب. تبقى فمّا شويّة حماية لتّصرّفات الطّبيعيّة متاع الحيوانات. الأرنب اللّي عضّت الثّعلب هربت مالذّيب. **Change : شمّو/ قرصو⟵عضّ**
19. The media play an important role in monitoring political activity. The reporter who the senator **attacked** questioned the president. In a powerful country like America the government needs to be closely scrutinized. The reporter who **attacked** the senator questioned the president. **Change: attacked⟶ assaulted/protected**	**19.** وسائل الإعلام تلعب دور كبير في مراقبة النّشاط السّياسي. الصّحافي اللّي عضو مجلس النّواب **هاجمو** سئل الرّئيس. في دولة قويّة كيما أمريكا، الحكومة لازم ديما تتراقب بدقّة. الصّحافي اللّي **هاجم** عضو مجلس النّواب سئل الرّئيس. **Change : حماه/ هاجمو⟵ضربو**

20. Several international companies have been devastated due to heavy financial losses. The banker who the chairman **suspected** fired the broker. Nick Leason's trading brought about the collapse of Bearings bank. The banker who **suspected** the chairman fired the broker. **Change: suspected ⟶ distrusted/praised**	**20.** عدد كبير مششركات العالميّة تدمّرت بسبب الخساير الماليّة الكبيرة. البنكاجي اللّي رئيس مجلس الإدارة شكّ فيه طرّد السمسار. تصرّفات NICK LEASON في البورصة كانت السّبب في فلسان بنك ال .Bearings البنكاجي اللّي شكّ في رئيس مجلس الإدارة طرّد السمسار. **Change: شكّ فيه ⟵ شكرو/ ما يثق فيه**
21. Nannies often provide high quality care for young infants and children. The babysitter who the parents **phoned** cooked a meal for the child. Nannies often spend a significant amount of time with the infant. The babysitter who **phoned** the parents cooked a meal for the child. **Change: phoned ⟶ called/insulted**	**21.** المروّضات يتلهاو بلبّيبيّات و بالصّغار بلڤدا. المروّضة اللّي الوالدين عملولها تلفون حضّرت فطور للطّفل. المروّضات ساعات يعدّيوا برشا وقت مع الصّغار. المروّضة اللّي عملت تلفون للوالدين حضّرت فطور للطّفل. **Change : عملت تلفون ⟵ سبّوها /كلّموها**
22. The standards in many retail outlets have greatly increased over the years. The shop assistant who the manager **suspected** helped the customer. Many stores spend a lot of money ensuring the environment is comfortable. **Change: suspected ⟶ distrusted/trusted**.	**22.** جودة المعاملات في برشا بوتيكات ماشيا و تتحسّن السّنيين هاذوما. البيّاعة اللّي مولى البوتيك **شكّ فيها** عاونت الكليونت. برشا حوانت تصرف في برشا فلوس باش تحسّن الجوّ في داخلها. البيّاعة اللّي **شكّت في** مولى البوتيك عاونت الكليونت. **Change : شكّ فيها ⟵ ياثق فيها /ما يا ثقش فيها**
23. Classical music is a popular form of entertainment. The violinist who the sponsors **publicized** respected the singer. Talented performers are often highly paid for their skill. The violinist who **publicized** the sponsors respected the singer. **Change: publicized⟶ advertized/criticized**	**23.** الموسيقى الكلاسيكيّة شكل مشهور من أشكال التفرهيد. عازف الكمنجة اللّي المموّلين **قدّموه لجّمهور** إحترم المغنّي. الفنّانين الموهوبين يخلصوا بلڤدا على خاطر موهبتهم. عازف الكمنجة اللّي المموّلين **قدّموه لجّمهور** إحترم المغنّي **Change: قدّموه لجّمهور ⟵ إنتقدوه /شهروه**
24. The lives of the rich and famous hold a fascination for many of us. The model who the artist **mimicked** was questioned by the reporter. Glamorous and beautiful people are idolized by many. **Change: mimicked⟶ imitated/disliked**	**24.** عيشة النّاس الغنية و المشهورين تجلب برشا عباد. العارضة اللّي الفنّان قلّدها سألها الصّحافي. برشا عباد تموت على النّاس المشهورين و المزيانين. العارضة اللّي قلّدت الفنّان سألها الصّحافي **Change: قلّدَ ⟵ كرهها/ تصرّف كيفها**

Table 2

Experimental items for Experiment Two

The high load version of each material appears first, followed by the second sentence which carries the low load condition, and then how the word changed from the original to the close and distant related words.

The English Version	**The Tunisian Arabic Version**
1. The college frequently held social functions for visiting academics. The professor who the student **had** recently **met** at the party was famous, but no one could figure out why. The professor who I **had** recently **met** at the party was famous, but no one could figure out why. **Change: met ⟶ seen/missed**	**1.** الجامعة ديما تنظّم في حفلات إجتماعيّة للأساتذة الجامعيّين الضّياف. البروفسور اللّي الطّالب مازال كيف **قابلو** مشهور، أما ما فمّا حدّ يعرف علاش. البروفسور اللّي أنا مازالت كيف **قابلتو** مشهور، أما ما فمّا حدّ يعرف علاش. **Change: نساه /شافو ⟵قابلو**
2. Take-overs of organizations are increasingly common and require careful negotiation. The chairman who the consultant **had** previously **interviewed** about the company was knowledgeable, but very resistant to changes in the structure of his company. The chairman who I **had** previously **interviewed** about the company was knowledgeable, but very resistant to changes in the structure of his company. **Change: interviewed ⟶questioned/checked**	**2.** شريان أسهم الشركات ماشي و يولّي شي عادّي و لازمو مفاوضات مدروسة. رئيس مجلس الإدارة اللّي المستشار **حاورو** قبل على الشريكة راجل يفهم، أما يعارض برشا أيّ تغيير في هيكلة مؤسّستو. رئيس مجلس الإدارة اللّي أنا **حاورتو** قبل على الشريكة راجل يفهم، أما يعارض برشا أيّ تغيير في هيكلة مؤسّستو. **Change: حقّق معاه /سألو⟵حاورو**
3. Learning a new language is easier if you hear it being spoken. The student who the family **had** willingly **accommodated** during the summer was friendly and her English really improved during her stay. The student who you **had** willingly **accommodated** during the summer was friendly and her English really improved during her stay. **Change: accommodated⟶ hosted/employed**	**3.** الواحد باش يتعلّم لغة جديدة بسهولة لازم يسمعها تتحكى. الطّالبة اللّي العايلة **سكنّتها** عندها بكيفها في الصّيف كانت بحبوحة و الأنڤليزيّة متاعها تحسّنت بلڤدا معاهم. الطّالبة اللّي العايلة **سكنّتها** عندها بكيفها في الصّيف كانت بحبوحة و الأنڤليزيّة متاعها تحسّنت بلڤدا معاهم. **Change: خدّمتها/ضيّفتها ⟵سكنّتها**
4. It is rare to find people who are really good at motivating others to learn. The teacher who the child **had** really **admired** after the lesson was talented, because she could explain very technical ideas in a simple way. The teacher who I **had** really **admired** after the lesson was talented, because she could explain very technical ideas in a simple way. **Change: admired ⟶ respected/astonished**	**4.** قليل باش تلقى عباد يعرفوا بلحق كيفاش يشجّعوا النّاس باش يتعلّموا. الأستاذة اللّي الطّفلة بلحق **حبّبتها** بعد الدّرس موهوبة، خاطر تنجّم تفسّر الأفكار التّقنيّة بسهولة. الأستاذة اللّي أنا بلحق **حبّيتها** بعد الدّرس موهوبة، خاطر تنجّم تفسّر الأفكار التّقنيّة بسهولة. **Change: إستغربت منها /إحترمتها⟵ حبّبتها**

5. Not considering other people and vehicles when playing in the road can be dangerous. The policeman who the bicyclist **had disobeyed** on the street was friendly and only issued a warning instead of a fine. The policeman who I **had disobeyed** on the street was friendly and only issued a warning instead of a fine. **Change: disobeyed ⟶ disregarded/ignored**	**5.** تنجّم تكون حاجة خطيرة كيف الواحد ما يعبّرش النّاس لوخرين و الكراهب وقتلّي يلعب في الطّريق. البوليس اللّي الرّاجل على البيسيكلات **ما سمعش كلامو** في الطّريق كان ناس ملاح و نبّه عليه أكهوفي عوض ما يعطيه مخالفة. البوليس اللّي أنا **ما سمعتش كلامو** في الطّريق كان ناس ملاح و نبّه عليّ أكهوفي عوض ما يعطيني مخالفة. **Change: حقّرو/ تجاهلو⟵ ما سمعش كلامو**
6. The quality of teaching at the college was legendary. The advisor who the students **have** always **appreciated** for her clear thinking is excited because she recently won a teaching award. The advisor who you **have** always **appreciated** for her clear thinking is excited because she recently won a teaching award. **Change: appreciated ⟶respected/disliked**	**6.** الكالتيه متاع التّعليم في الأنستيتو ممتازة. المرشدة اللّي الطّلبة **يقدّروها** ديما على خاطرأفكارها الواضحة فرحانة برشا خاطر مازالت كيف ربحت جايزة التّعليم. المرشدة اللّي إنت **تقدّرها** ديما على خاطر خاطرأفكارها الواضحة فرحانة برشا خاطر مازالت كيف ربحت جايزة التّعليم. **Change: يكرهوها/ يحترموها ⟵يقدّروها**
7. Working for counseling service for children and teenagers can be a very rewarding work. The counselor who the teenager had previously **called** on the phone was helpful since she really cared about his problems. The counselor who I had previously **called** on the phone was helpful since she really cared about his problems. **Change: called ⟶ spoken to/shouted at**	**7.** خدمة مرشدين لصّغار و الشّباب تنّجم تكون خدمة مفيدة برشا. المرشدة اللّي المراهق **كلّمها** في تلفون قبل كانت متعاونة خاطرها تهتمّ بالحقّ بمشاكل النّاس. المرشدة اللّي أنا **كلّمتها** في تلفون قبل كانت متعاونة خاطرها تهتمّ بلحقّ بمشاكل النّاس. **Change: صاح علاها/ حكا معاها⟵ كلّمها**
8. Awareness of risk in medicine is becoming ever more important. The doctor who the patient had always **depended upon** for his health needs was skilful, but it was a dangerous procedure so everyone was worried. The doctor who you had always **depended upon** for his health needs was skilful, but it was a dangerous procedure so everyone was worried. **Change: depended upon ⟶ relied upon/called**.	**8.** الوعي بالأخطار الطبيّة ماشي وزيد أهميّة. الطّبيب اللّي المريض **يعتل عليه** ديما باش يداويه طبيب ممتاز، أما العمليّة خطيرة على ذاك النّاس الكلّ كانوا متقلقين. الطّبيب اللّي إنت **تعتل عليه** ديما باش يداويه طبيب ممتاز، أما العمليّة خطيرة على ذاك النّاس الكلّ كانوا متقلقين. **Change: كلّمو/ يعتمد عليه ⟵ يعتل عليه**
9. The music scene is usually livelier at the weekend. The singer who the fan **has** regularly **adored** over the years is coming to town for a concert to promote her new record. The singer who you **has** regularly **adored** over the years is coming to town for a concert to promote her new record **Change: adored ⟶ admired/ignored**	**9.** السّاحة الفنيّة ديما تكون حيّة أكثر في الويك آند. المغنّية اللّي المعجب **يعشقها** ديما عندو سنين باش تجي للمدينة و تعمل حفلة إطلاق ألبومها الجديد. المغنّية اللّي إنت **تعشقها** ديما عندو سنين باش تجي للمدينة و تعمل حفلة إطلاق ألبومها الجديد. **Change: يعشقها / يحبّها ⟵ يعشقها**

10. Buying clothes in the January sales can be very frustrating. The assistant who the shopper **had been irritated** by from the beginning was unhelpful and refused to look for a bigger size. The assistant who I **had been irritated** by from the beginning was unhelpful and refused to look for a bigger size. **Change: irritated⟶ annoyed/ignored**	**10.** شريان الحوايج في الصّولد متاع جانفي ينجّم يكون حاجة تنرفز. اللبيّاعة اللّي الكليونت **تنرفزت منها** ملول ماكانتش متعاونة و ما حبّتش تشوفلها طاي أكبر. اللبيّاعة اللّي أنا **تنرفزت منها** ملول ماكانتش متعاونة و ما حبّتش تشوفلي طاي أكبر. **Change: تحقرت/ تقلّقت ⟵تنرفزت**
11. Gangs of youths are frequently a nuisance before and after football matches. The woman who the boy had accidentally **pushed** got upset and decided to report the incident to the policeman standing nearby. The woman who you had accidentally **pushed** got upset and decided to report the incident to the policeman standing nearby. **Change: pushed ⟶ knocked/crowded**	**11.** جمهور الكورة الشّباب يتسبّبوا في المضرّة قبل و بعد ماتشوات كورة القدم. المرا اللّي الطّفل **دزّها** مين غير ما يقصد تغشّشت و قرّرت باش تشكي بيه للبوليس الواقف قريب. المرا اللّي إنت **دزّيتها** مين غير ما تقصد تغشّشت و قرّرت باش تشكي بيه للبوليس الواقف قريب. **Change: لصقها/ طيّحها⟵ دزّها**
12. Managing court cases can be a difficult business. The judge who the lawyer **had** really **respected** by the end of the trial was brilliant, but he had difficulty keeping the court in order. The judge who I **had** really **respected** by the end of the trial was brilliant, but he had difficulty keeping the court in order. **Change: respected⟶ trusted/envied**	**12.**ممكن تكون حاجة صعيبة إنّو الواحد ينجّم يتحكّم في قاعات المحكمة. القاضي اللّي المحامي **إحترمو** في نهاية الجلسة كان ذكيّ برشا، أما ما نجمّش يحافظ على الهدوء وقت الجلسة. القاضي اللّي أنا **إحترمتو** في نهاية الجلسة كان ذكيّ برشا أما ما نجمّش يحافظ على الهدوء وقت الجلسة. **Change: حسدو /وثق فيه ⟵إحترمو**
13. There is a lot of money to be made from Art and Literature. The author who the editor **had talked to** late into the night was young but very talented. The author who I **had talked to** late into the night was young but very talented. **Change: talked ⟶ chatted to/planned with**	**13.** الواحد كيف يخدم في دومان الفنّ و الأدب ينجّم يربح برشا فلوس. الكاتب اللّي رئيس التّحرير **تحدّث معاه** ممخّر في اللّيل كان صغير أما موهوب برشا الكاتب اللّي رئيس التّحرير **تحدّث معاه** ممخّر في اللّيل كان صغير أما موهوب برشا **Change: خطّط /دردش⟵ تحدّث**
14. Much of politics depends upon steady effort. The candidate who the Conservative **had** consistently **helped** during the campaign was liberal and wanted to increase welfare. The candidate who I **had** consistently **helped** during the campaign was liberal and wanted to increase welfare. **Change: helped⟶ aided/blocked**	**14.** دومان السّياسة يحبّ مجهود متواصل. المترشّح اللّي واحد من حزب المحافظين **عاونو** وقت حملتو الإنتخابيّة كان ليبيرالي و يحبّ يحسّن في الخدمة الإجتماعيّة. المترشّح اللّي واحد من أنا **عاونتو** وقت حملتو الإنتخابيّة كان ليبيرالي و يحبّ يحسّن في الخدمة الإجتماعيّة. **Change:منعو/ وقف معاه ⟵عاونو**

15. It can be difficult to find dependable workmen in a hurry. The plumber who the landlord had already **hired** for the job was incompetent but there was nothing to do because the contract had already been signed. The plumber who I had already **hired** for the job was incompetent but there was nothing to do because the contract had already been signed. **Change: hired ⟶ got/suggested**	**15.** صعيب ساعات إنّو الواحد يلقى بزربة صناعيّة باهين. البلومبيّ اللّي مولى الدّار **خدّمو** موش كومبيتون أما ما ينجّم يعملّوشي على خاطر الكونترا ما بيناتهم تصحّح ديجا. البلومبيّ اللّي أنا **خدّمتو** موش كومبيتون أما ما ننجّم نعملّو شي على خاطر الكونترا ما بيناتهم تصحّح ديجا. **Change: خدّمو ⟵ إقترحو /عطاه الخدمة**
16. At university, a supportive environment can make all the difference. The new student who the volunteer **had** willingly **tutored** on a daily basis was bright, but he had difficulty in concentrating. The new student who I **had** willingly **tutored** on a daily basis was bright, but he had difficulty in concentrating. **Change: tutored ⟶ taught/trained**	**16.** في الجامعة، المحيط كيف يبدا باهي ينجّم يصنع الفرق. الطّالب الجديد اللّي الطّالب المتطوّع **عطاه** يوميّا **دروس زايدة** بكيفو ذكيّ أما عندو صعوبة في التّركيز. الطّالب الجديد اللّي أنا **عطيتو** يوميّا **دروس زايدة** بكيفي ذكيّ أما عندو صعوبة في التّركيز. **Change: عطاه دروس زايدة ⟵ درّبو/قرّاه**
17. One could say that people get what they deserve. The comedian who the teenager **had** really **hated** during the talent show is staying and will do another show at the club tonight. The comedian who you **had** really **hated** during the talent show is staying and will do another show at the club tonight. **Change: hated ⟶ disliked/enjoyed**	**17.**الواحد ينجّم يقول إنّو النّاس ياخذو على قدّ قلوبهم الفنّان الكوميدي اللّي المراهق بالحق **كرهو** في برنامج المواهب باش يبقى و باش يعمل عرض آخر في النّادي اللّيلة. الفنّان الكوميدي اللّي إنت بلحق **كرهتو** في برنامج المواهب باش يبقى و باش يعمل عرض آخر في النّادي اللّيلة. **Change: كرهو ⟵ حبّو/ ماحبّوش**
18. Respect for people's property is very important. The landlord who the tenant **had** previously **spoken to** at a friend's house is pleased to have someone responsible in the apartment. The landlord who you **had** previously **spoken to** at a friend's house is pleased to have someone responsible in the apartment. **Change: spoken to ⟶ talked to/listened to**	مولات الدّار اللّي الكاري **18.**مهمّ برشا إنّو الواحد يحترم ممتلكات الغير. **تكلّم معاها** قبل في داروحد من أصحابهم فرحانة خاطرلقات واحد راسبونسابل في الأبرتمن. مولات الدّار اللّي إنت **تكلّمت معاها** قبل في داروحد من أصحابكم فرحانة خاطرلقات واحد راسبونسابل في الأبرتمن. **Change: تكلّم معاها ⟵ سمعها/تحدّث معاها**

19. Growing old generally means an increase in dependency on others. The neighbor who the volunteered girl **had** regularly **brought** groceries to at the sheltered housing was old and sick and needed help making her dinner. The neighbor who I **had** regularly **brought** groceries to at the sheltered housing was old and sick and needed help making her dinner. **Change: brought ⟶ delivered/sent**	**19.** الواحد كلّ ما يكبرفي العمر تزيد حاجتو لنّاس . الجارة اللّي الطّفلة المتطوّعة **تجيبلها** ديما في قضياتها لدار المسنّين مرا كبيرة في العمر و مريضة و تحتاج شكون يعاونها في تحضير عشاها الجارة اللّي أنا **نجيبلها** ديما في قضياتها لدار المسنّين مرا كبيرة في العمر و مريضة و تحتاج شكون يعاونها في تحضير عشاها. **Change:تجيبلها ⟶ تبعثلها/تهزلّها**
20. Sometimes people have a great time when they expect not to. The visitor who the host **had** belatedly **invited** to the party was shy but ended up having a fantastic time. The visitor who you **had** belatedly **invited** to the party was shy but ended up having a fantastic time. **Change: invited⟶ asked/driven**	**20.** ساعات النّاس يعدّيو وقيّت حلو مع إنّهم ما يتوقّعوش هذا. الضيفة اللّي مولات الدّار **إستدعاتها** ممخّر للحفلة كانت حاشمة أما مبعد عملت جوّ. الضيفة اللّي إنت **إستدعيتها** ممخّر للحفلة كانت حاشمة أما مبعد عملت جوّ. **Change:إستدعاتها ⟶ جبتها/طلبتها باش تجي**
21. Getting used to going to nursery school can be difficult. The child who the play leader **had** repeatedly **comforted** in the playground eventually settled down and played in the sandy playground. The child who I **had** repeatedly **comforted** in the playground eventually settled down and played in the sandy playground. **Change: comforted ⟶calmed/disregarded**	**21.**ساعات الصّغار يتعوّدوا على المشيان لرّوضة بالسّيف. الطّفل اللّي المروّضة ديما **ترضّي فيه** في الكور ركح في لخّر و مشا يلعب في الملعب الرّملي. الطّفل اللّي أنا ديما **نرضّي فيه** في الكور ركح في لخّر و مشا يلعب في الملعب الرّملي. **Change:ترضّي ⟶ تحقر/تهدّي**
22. Some people can be very inconsiderate of others. The novice skier who the snowboarder had repeatedly **harassed** on the nursery slopes was fed up being knocked over and complained to the skiing instructor. The novice skier who you had repeatedly **harassed** on the nursery slopes was fed up being knocked over and complained to the skiing instructor. **Change: harassed ⟶ bothered/struck**	**22.** ساعات، فمّا ناس ما يعطيوش قيمة لمشاعر العباد. المتزلّج الجديد اللّي اللمتزلّج المحترف ديما **يضايق فيه** في البيستة السّاهلة فدّ من عمايلو و شكا بيه للمدرّب. المتزلّج الجديد اللّي اللمتزلّج المحترف ديما **يضايق فيه** في البيستة السّاهلة فدّ من عمايلو و شكا بيه للمدرّب. **Change:يضايق ⟶ يضرب /يقلّق**
23. Finding medical staff with experience in complex surgical techniques is difficult. The surgeon who the nurse frequently **assisted** during difficult operations was difficult to understand, as he had a very heavy foreign accent The surgeon who I frequently **assisted** during difficult operations was difficult to understand, as he had a very heavy foreign accent **Change: assisted⟶helped/talked to**	**23.** حاجة صعيبة باش تلقى كوادر طبيّة عندهم خبرة في العمليّات الجراحيّة المعقّدة. الجرّاح اللّي الفرمليّة **تساعد فيه** ديما في العمليّات الصّعيبة يتفهم بالسّيف على خاطر عندو أكسون ماهيش مفهومة. الجرّاح اللّي أنا **نساعد فيه** ديما في العمليّات الصّعيبة يتفهم بالسّيف على خاطر عندو أكسون ماهيش مفهومة **Change:تساعد ⟶ تتحدّث معاه/تعاون**

24. Musicians frequently use shopping centers as a way of capturing audiences. The guitarist who the pedestrian really **liked** because he played a lot of modern music was playing music in the shopping mall. The guitarist who you really **liked** because he played a lot of modern music was playing music in the shopping mall. **Change: liked ⟶ loved/hated**	**24.** الفنّانين يستعملو ديما في الفضاءات التجاريّة باش يجلبوا الجمهور. الڤيتاريست اللّي الرّاجل المتعدّي **يحبّو** بلحق خاطر يعزف في الموسيقى العصريّة قاعد يعزف في السونتر كومارسيال الڤيتاريست اللّي إنت **تحبّو** بلحق خاطر يعزف في الموسيقى العصريّة قاعد يعزف في السونتر كومارسيال **Change: يحبّو ⟵ يعشقو / يكرهو**

Table 3

Experiment three

Experimental items in Experiment three are the same as Experiment two, but changes are made to adverb phrases rather than embedded verbs.

The English Version	**The Tunisian Arabic version**
1. Luckily → fortunately/unfortunately.	من سوء حظّو / من حسن حظّو → بالزّهر
2. Previously → formerly/subsequently.	من بعد /بكري→قبل
3. Willingly → happily/unwillingly.	بالسّيف/بفرحة→بكيفها
4. Fanatically → obsessively/casually.	نص نص /بهوس →برشا برشا
5. Foolishly → stupidly/wisely.	بذكاء/ببهامة →مين غيرما يخمّم
6. Always → constantly/rarely.	شويّة/على طول → ديما
7. Tentatively → shyly/boldly.	برقعة /و أنا حاشم → و أنا متردّد
8. Sensibly → prudently/irrationally.	مين غير ما تخمّم /و إنت محطاط→و إنت رادّ بالك
9. Thoroughly → totally/mildly.	شويّة/برشا برشا→علّخر
10. Fairly → slightly/extremely.	برشا/موش برشا→شويّة
11. Accidentally → mistakenly/deliberately.	بلعاني /بلغلط →مين غير ما يقصد
12. Really → truly/slightly.	شويّة/بلحق→برشا
13. Regularly → frequently/occasionally.	ساعات/برشا مرّات→ديما
14. Consistently → steadily/infrequently.	شويّة/على طول→باستمرار
15. Cautiously → carefully/rashly.	بزربة /و هو محطاط→وهو رادّ بالو
16. Anxiously → nervously/calmly.	وهو هادي /وهو منرفز →وهو على أعصابو
17. Obviously → clearly/secretly.	مين غير ما يظهّر /بوضوح →بشكل واضح
18. Briefly → momentarily/extensively.	برشا /لحظات →شويّة
19.Thoughtfully →considerately/carelessly.	فوق من قلبي/بكيفي→بمحبّة
20. Cheerfully → gladly/reluctantly.	بالسّيف /بكلّ فرحة →بمحبّة
21. Repeatedly → repetitively/occasionally.	ساعات/برشا مرّات→ديما
22. Frequently → often/seldom.	موش ديما/برشا مرّات→ديما
23. Eagerly → enthusiastically/unwillingly	فوق من قلبي /بكلّ حماس →بمحبّة
24. Usually → generally/sometimes.	ساعات/ديما →في العادة

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LA TEORIA DE LA FUNCION

[THEORY OF THE FUNCTION]

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ABSTRACT: Exposes the idea of a new universe based on the convertibility, one in another, a couple of fundamental concepts simultaneously, basic components of any function. Exposes a structure of thought unique and authentic made-to-measure of reality. Exposes an integral vision heuristics and dogmatic of the world. Through the theory of the function the reader will find the wealth of a thinkable construction that will allow you to deepen in the immense mystery of the universe seen from the perspective of their different realities, all of them made of the same essence, the same act. The mystery of the coexistence in addition to a couple of forms and as happens on the process of the convertibility of both, one in the other, to the interior of this function, is the core of this theory. By this theory we will try to find a construction is thinkable, unique and sustainable that try to describe and explain in a comprehensive manner the wonderful universe of which we are a part. I have tried to achieve through the intellectual effort, a thinkable solid construction and orderly sufficiently able to cope with in a consistent manner to the reality even to the point of view and confused also conform with the unreal. This theory is closely associated with the progress of human knowledge and seeks only consolidate a comprehensive view of the world in which we exist.

KEYWORDS: Convertibility, Complementation, Interaction, Holistic, System.

RESUMEN: Expone la convertibilidad, uno en otro, de manera simultánea de los dos componentes fundamentales de toda función. Expone una estructura de pensamiento única y autentica hecha a la medida de la realidad. Expone una visión integral heurística y dogmática del mundo. A través de la Teoría de la Función el lector encontrara la riqueza de una construcción pensable que le permitirá profundizar en el misterio inmenso del Universo visto desde la perspectiva de sus diferentes realidades, todas ellas hechas de una misma esencia, de una misma ley. El misterio de la coexistencia en complemento de un par de formas y de como sucede el proceso de la convertibilidad de ambos, uno en otro, al interior de esta función, es la parte medular de este trabajo de investigación. Es imposible poder precisar las conclusiones a las que se puede arribar con esta teoría, pues cada investigador, cada pensador, desde su perspectiva, según su propósito, según su objetivo, puede obtener muy diferentes conclusiones, evidentemente a partir de la aplicación teórico y practica que pueda derivar de la interpretación individual o colectiva que se haga de la teoría. Esta teoría se encuentra asociada íntimamente al progreso del conocimiento humano y busca solamente consolidar una visión completa del mundo en el que existimos.

PALABRAS CLAVE: Convertibilidad, Complementación, Interacción, Holístico, Sistema.

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1 INTRODUCTION

Todo lo que existe en nuestro Universo, visto de manera individual o visto de manera asociada cumple un propósito, tiene un objetivo, es decir posee una función.

De manera categórica, puedo sostener que el concepto función, desde mi punto de vista, es la composición de **un origen y una estructura;** de manera simple es el complemento de ambos.

Pero ¿Qué es el origen?, por separado y ¿Qué es la estructura?, también por separado.

El origen es el comienzo o el principio de las cosas. En el origen los elementos integrantes de cualquier estructura se encuentran dispersos. De manera posterior los elementos integrantes de la estructura a través de fuerzas mecánicas, factores y/o actividades se asocian dando como resultado una estructura.

La estructura es la manera sistemática y coherente como las partes que conforman un todo se asocian al interior de dicho todo. Desde esta perspectiva diremos que los elementos integrantes o componentes de la estructura se encuentran concentrados.

En definitiva toda forma de estructura existente se encuentra unida de modo complementario a un origen.

Pero esta forma segmentada de evaluar por separado los componentes de una función cualquiera no se corresponde o no se encuentra asociada en exacto a la realidad.

2 LA FUNCIÓN ES HOLÍSTICA

Por definición sabemos que las propiedades y características del todo no pueden ser explicadas por las partes que componen o forman ese todo. En tal sentido cualquier función es un sistema integral que posee propiedades y características muy diferentes a lo que es el origen por separado, y lo que es la estructura por separado. La Función es algo completamente nuevo y diferente. La Función es lo que realmente existe, pues el origen por separado es algo distinto y diferente de lo que representa o es la Función, de igual modo la estructura resulta también, ser algo completamente diferente de la Función. Puedo afirmar que la Función empieza a poseer vida. El Origen y la Estructura vistos cada uno de modo separado carecen de sentido. En nuestro Universo concebirlos de manera separada es imposible, simplemente NO EXISTEN.

3 LA FUNCIÓN ES UNA UNIDAD DE MEDIDA

Una Función cualquiera, es una magnitud estandarizada, que toma su valor a partir de suponer cuantas veces dicha magnitud se encuentra contenida en otra. No olvidemos que por definición una magnitud es todo aquello que puede ser medido con cierto grado de exactitud.

4 LA FUNCIÓN COMO PROPORCIÓN, RAZÓN, RELATIVO

Toda Función puede ser expresada de manera básica o fundamental como una proporción, o como una sencilla relación x:y, de la cual podemos afirmar que “x” es una parte de la razón o proporción y por su parte “y” es la otra parte o ingrediente de la razón, pero que de un modo armónico se sostienen e interactúan en la proporción, pues una parte es relativa a la otra. Podemos encontrar que cualquier Función se encuentra conformada de partes en una relación uno a uno como también en una relación de uno a múltiple.

5 LA FUNCIÓN ES INERCIAL

Cualquier función es inercial. En efecto, para que la función pueda cumplir con su propósito es necesaria la intervención de fuerzas mecánicas y/o actividades tendientes a permitir el logro de dicho propósito. La función de esta manera debe romper su inercia para cumplir con su propósito. Las fuerzas mecánicas y/o actividades son los agentes intervinientes, que hacen posible que la función cumpla de manera plena con su propósito. Debo indicar que existen además fuerza mecánicas y/o actividades inversas tendientes a lograr la extinción de la función y de su propósito.

Existe por lo tanto **una primera forma**: en relación a la cual existen fuerzas mecánicas y/o actividades que son directamente proporcionales y tendientes al logro o formación o concentración de la función, es decir intervienen de manera directa para que la función cumpla con su propósito, en otras palabras y de modo simplificado podemos decir: del origen a la estructura

Por otro lado existe también **una segunda forma** en relación de la cual podemos afirmar que existen fuerzas mecánicas y/o actividades inversamente proporcionales al logro o formación o concentración de la función, es decir buscan poder extinguir la función y su propósito, dispersarla, en otras palabras y también de modo simplificado podemos afirmar que esto ocurre: de la estructura al origen.

Afirmo y sostengo que ambas formas, tanto la primera como la segunda, descritas en los acápites anteriores existen de manera integrada, de manera complementada y de manera simultánea, es decir mientras se sucede la primera forma, a su vez y de manera simultánea, también está sucediendo la segunda forma. Esta es una de las afirmaciones básicas en las que se sostiene esta teoría y que desarrollare de modo amplio más adelante.

6 UNA NUEVA FUNCIÓN HOLÍSTICA EN CONVERSIÓN

Como se acaba de exponer, esta es una **nueva** Función Holística y la podemos expresar de un modo gráfico para una mejor comprensión y rápido entendimiento de la manera siguiente:

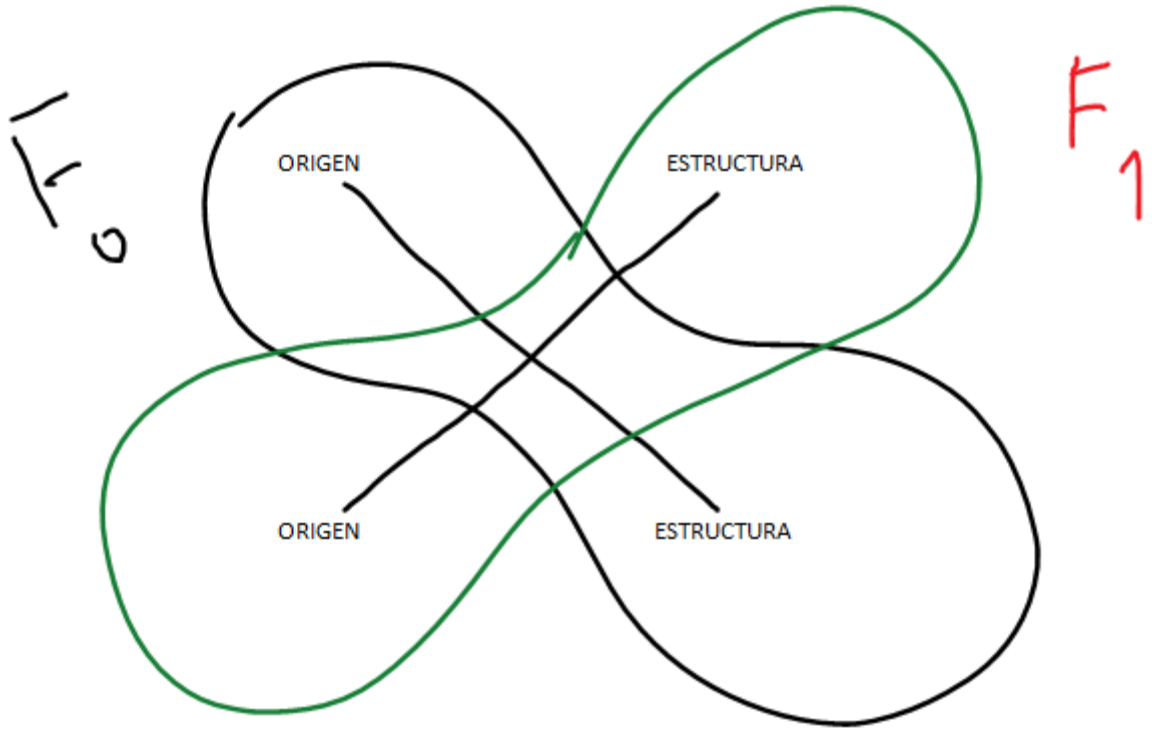


Fig. 1.

En la figura 1 muestra que F0 es la primera forma de la Función o lo que llamaremos primer segmento del sistema: **de ORIGEN A ESTRUCTURA** (Estoy afirmando que el origen **se convierte** en la estructura, interviniendo para ello fuerzas mecánicas y/o actividades directamente proporcionales a la concentración de la función). A este proceso lo he denominado **CONFORMAR.** Conformación de la Función. Figura 2

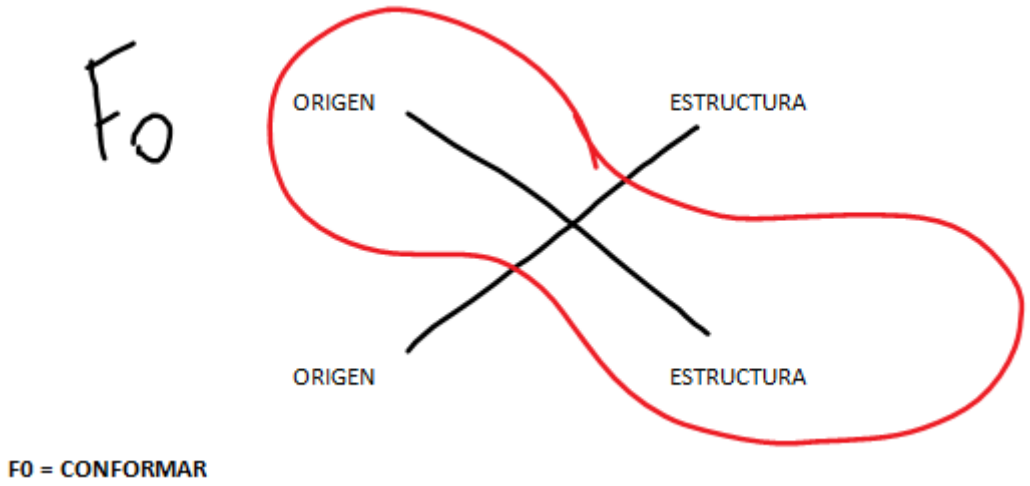


Fig. 2.

En la Figura 3, F1 es la segunda forma de la Función o lo que llamaremos el segundo segmento del sistema: de **ESTRUTURA A ORIGEN** (Estoy afirmando aquí que la estructura **se convierte** en el origen, interviniendo para ello fuerzas mecánicas y/o actividades inversamente proporcionales a la concentración de la función). A este proceso lo he denominado **ADAPTAR.** Adaptación de la Función.

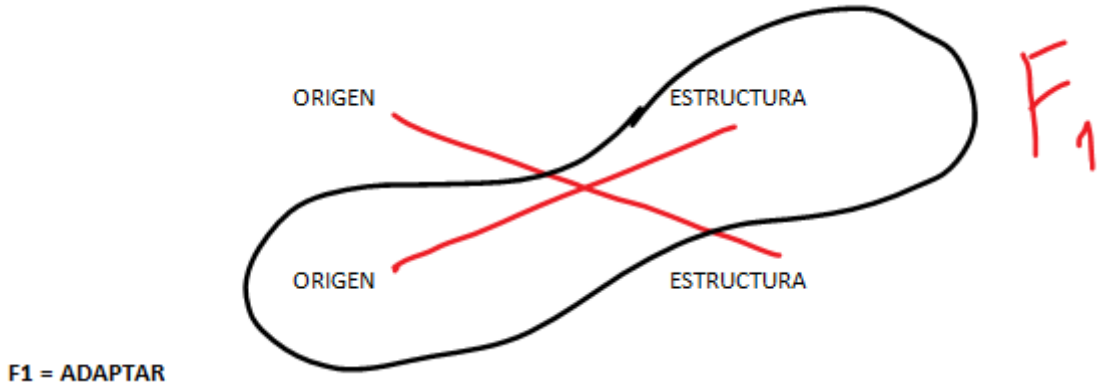


Fig. 3.

De manera resumida el sistema de interacción quedaría como sigue:

F0 de Origen a estructura: CONFORMAR

F1 de Estructura a origen: ADAPTAR

Adaptar y Conformar son los dos elementos, partes o segmentos intervinientes en la composición de algo extraño, existentes en su interior, en permanente proceso de cambio, complemento y conversión en simultáneo. Un nuevo concepto, un neologismo, más exacto y mas hecho a la medida de la realidad. Es algo como dijimos en líneas anteriores: Holístico.

Cuando pensamos en lo que es **el Origen y la Estructura** por separado, concebimos racionalmente que ambos puedan existir complementados, dando como resultado de dicho complemento algo nuevo, representado por la Función. Pero el concepto complemento NO ES SUFICIENTE en nuestra teoría, pues debemos atender a la existencia de un concepto fundamental, que impregne de verdadero sentido a las cosas y al mundo físico real, en lo Microscópico y en lo Macroscópico: **LA CONVERTIBILIDAD.**

Al hablar de estas dos formas: a) Del origen a estructura y b) de la estructura al origen, nuestro concepto Función ha evolucionado, pues existen dos procesos interactuantes en los que se sucede la CONVERTIBILIDAD, al punto de PERCIBIR E

INTUIR la existencia de la "Función y de la Anti función", integrados en **"una figura holística superior"** a la que también deberemos encontrarle un concepto o definición.

A esta nueva Función también le corresponde la aplicación del principio de unidad de medida y también le corresponde el principio de relación, razón, relativo, vistos en líneas anteriores.

7 F0 Y F1 SIMULTÁNEOS

En esta nueva forma donde se integran e interactúan tanto F0 Y F1, se le añade otra propiedad fundamental, la SIMULTANEIDAD, es decir que en ambas formas, tanto F0 como F1 se encuentran en proceso de conversión y complementación, pero de modo simultáneo; sucede por tanto **de ORIGEN A ESTRUCTURA**, pero también sucede y de modo simultáneo **de ESTRUCTURA A ORIGEN**.

8 CONFORMAR Y ADAPTAR

CONFORMAR, es el proceso de dar forma a algo, es el concepto que he asociado al proceso de conversión de ORIGEN A ESTRUCTURA. Por tanto podemos decir que es la primera forma de Función, según los parámetros expuestos anteriormente. ADAPTAR, que es el proceso de modificar o ajustar algo, es el otro concepto que he asociado al proceso de conversión de ESTRUCTURA A ORIGEN, por tanto podemos decir que es la segunda forma de Función (o Anti función); esta segunda forma se comporta de manera inversa, contraria y proporcional a la anterior. Reitero que Conformar y Adaptar poseen las mismas propiedades y características descritas hasta este momento para la Función, es decir también se encuentran en un proceso de complemento, de interacción, de simultáneo y de Conversión. En la Figura 4 gráficamente tenemos, lo siguiente:

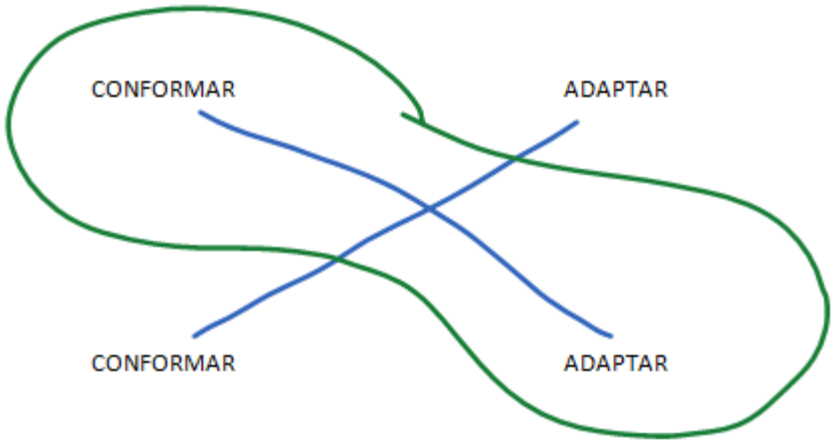


Fig. 4.

Expuesto en términos sencillos, la conversión, la interacción, el complemento y la simultaneidad ocurren de **ADAPTAR A CONFORMAR**, pero también de **CONFORMAR A ADAPTAR**.

9 LA FUNCIÓN EN EL TIEMPO

El proceso que se ha descrito hasta este punto de la teoría de la Función, se inicia en algún momento en el tiempo, diré mejor que se inicia en el infinito pero también va hacia el infinito. Existe una primera etapa, o T1, vamos a llamarlo así, donde se aprecia la forma del binomio, donde el PRIMER par de conceptos, se encuentran simplemente en interacción, COMPLEMENTADOS, sin mostrar aun indicios de CONVERTIBILIDAD. Este tiempo T1, visto de manera individual desde la perspectiva de la existencia de cada una de las infinitas funciones existentes en nuestro Universo, puede ser tan efímero, o tan pequeño, como también puede ser tan colosal e inconmensurable, que nuestros sentidos no imaginarían, ni soñarían jamás en la posibilidad de la **CONVERTIBILIDAD del binomio (Uno en Otro)**. Tal vez pueda suceder también que el binomio complementario existente en el tiempo T1 que apreciamos, sea el resultado posterior a un proceso de CONVERTIBILIDAD ya presentado con anterioridad. Este proceso en el Universo se repite de manera incesante. La CONVERTIBILIDAD propiamente, del Origen y de la Estructura, uno en otro, en términos de rapidez y velocidad, puede ser un proceso tan sorprendentemente veloz, como también puede ser un proceso sorprendentemente retardado y lento.

10 NEOLOGISMOS

Inicialmente había podido apreciar que, existe significante y significado para el primer concepto integrante del binomio en complemento, existe también significante y significado para el segundo concepto integrante del binomio en complemento, pero me encontraba muchas veces con la dificultad siguiente : el binomio en complemento propiamente era el significante nuevo, verdadero, único, autentico y holístico, al cual simplemente NO podía asociarle un significado, debido a que la palabra o signo lingüístico que expresa este significado, simplemente no existía o no existe. Por ello y ante la necesidad imperiosa de contar con este concepto NUEVO, es que es necesario recurrir a su creación. Lo que si es necesario enfatizar, es que este concepto Nuevo, verdadero, único, autentico y holístico, **es lo que realmente existe**, los otros dos conceptos (Representados en mi teoría como el Origen y la Estructura), que poseen también significado y significante, como tal, **NO EXISTEN**, han perdido sentido frente a esta NUEVA forma EN COMPLEMENTO (Representada en mi teoría como La Función).

Cuando empezamos a hablar de la propiedad de la Convertibilidad, es decir que los integrantes del binomio en complemento se convierten uno en otro, por la aparición de fuerzas mecánicas, factores, actividades, o fuerzas de cambio, vemos como nuestro concepto nuevo, único, verdadero, autentico y holísticos, se rompe, mejor diré que se perfecciona, se hace autentico y único. Por eso pienso que el significante y el significado que se atribuye a este concepto nuevo, único, verdadero, autentico, y holístico mientras existe durante el tiempo T1 como resultado del complemento de los otros dos anteriores, permanece como un concepto estático, pero en el Universo todo es dinámico, por tanto, y vuelvo a insistir en ello, es imperfecto.

La convertibilidad es la propiedad que perfecciona la complementación, pero también perfecciona el concepto, la definición. Para la teoría de la Función el primer segmento de Convertibilidad esta dado de la Estructura hacia el Origen Este segmento como tal, debe poseer un significante y un significado, es decir un concepto que hable de modo integral y exprese la naturaleza en conversión existente en este primer segmento .También dentro de la Teoría de la Función el segundo segmento expone la convertibilidad del Origen en Estructura, por tanto y del mismo modo debe existir un significante y un significado que defina y exprese de modo integral la naturaleza en conversión de uno en otro en este segundo segmento. Sucede además que ambos segmentos son interactuantes y complementarios bajo una nueva forma de “Función” que también necesita un significante y un significado, el cual dentro de esta forma integral representa también algo nuevo, único, verdadero, autentico y holístico, esta forma es en definitiva **lo que realmente existe**. Este proceso se repite desde el infinito y va hacia el infinito de modo constante e ininterrumpido.

11 UNOS EJEMPLOS DEMOSTRATIVOS

Vamos a imaginar una singular pista de atletismo que posee solamente dos carriles, a uno de ellos vamos a llamarlo A y al otro vamos a llamarlo B. Tenemos también un solo atleta que se encuentra ubicado en el carril A. Una vez que todo se encuentra listo, damos la partida y nuestro corredor sale muy veloz por el carril A; para ello clarificamos el escenario con la Figura 5:

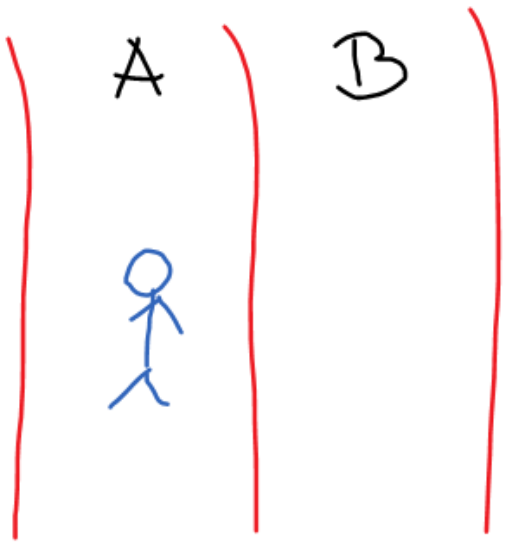


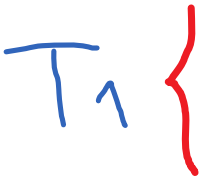
Fig. 5.

Tenemos dos conclusiones:

El corredor está DENTRO del carril A, pero a su vez y de modo simultaneo

El corredor está FUERA del carril B

Utilizando el modo gráfico de nuestra teoría, podemos tener por tanto lo siguiente:



DENTRO FUERA

A B

Aquí nos encontramos con **la primera forma** de complemento que ocurre en un determinado momento de tiempo, al cual hemos denominado T1.

A partir de este punto es precisamente donde hacen su aparición e intervienen lo que he denominado **fuerzas mecánicas, actividades, factores de cambio o acciones de cambio.** Estas fuerzas mecánicas son las que hacen posible que se produzca la CONVERTIBILIDAD es decir uno en otro, de los componentes complementarios de **la primera forma** vista en el párrafo anterior. Por tanto y volviendo a nuestro ejemplo y a nuestro corredor, vamos a hacer que aparezcan para nuestro ejemplo, las acciones de cambio que posibilitan el principio de CONVERSION indicado:

Nuestro corredor discurre muy veloz por la pista de atletismo, cuando de pronto ocurre la ACCION DE CAMBIO: Da un salto y pasa a ubicarse al carril B.

Tenemos entonces:

Una ACCION DE CAMBIO de A hacia B, y

Una ACCION DE CAMBIO de B hacia A: Gráficamente lo podemos expresar en la Figura 6:

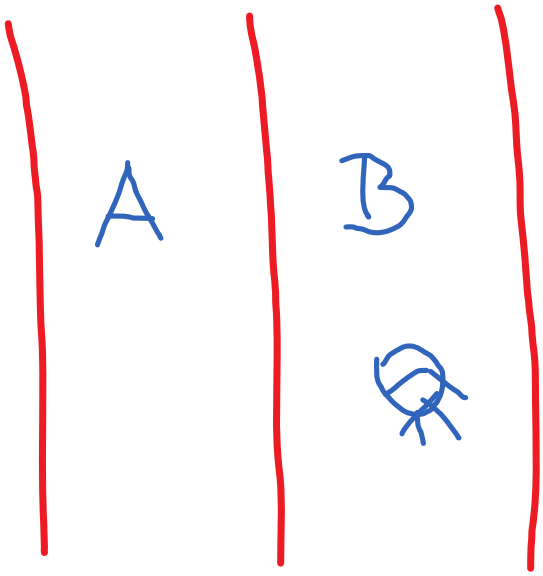


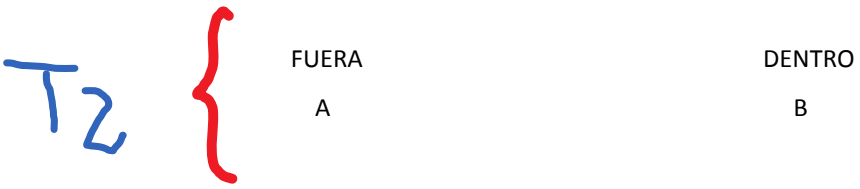
Fig. 6.

Volvemos a tener dos conclusiones:

El corredor está FUERA del carril A, pero a su vez y de modo simultaneo

El corredor está DENTRO del carril B

Si volvemos a utilizar el modo gráfico de nuestra teoría tenemos lo siguiente:



Aquí nos encontramos con **la segunda forma** de complemento que ocurre en otro momento determinado de tiempo, que denominaremos T2.

Ahora hagamos un resumen de todo el razonamiento de modo completo, en la Figura 7:

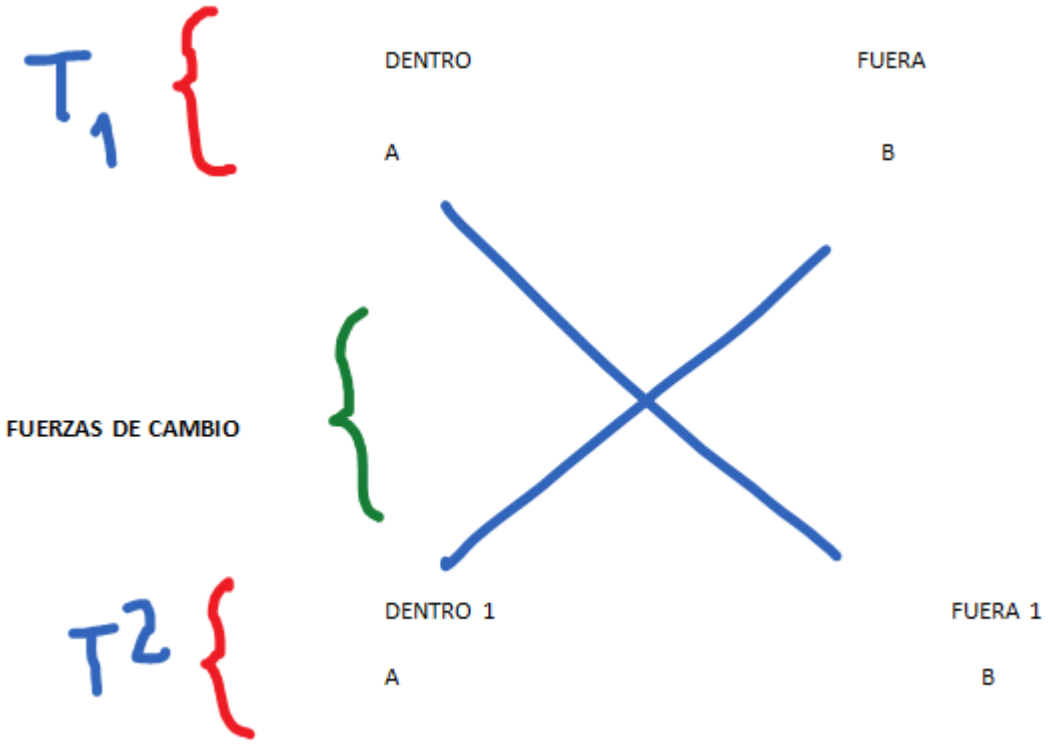


Fig. 7.

Es recomendable no perder ni por un instante la imagen de la pista de atletismo

Esta es la forma como pienso que se encuentra construido el universo en el cual existimos.

Cuando de manera sucesiva figuras geométricas se cortan por su punto medio exacto obtenemos lo siguiente:

Cuando una figura de un punto corta a una figura de dos puntos exactamente por su mitad, la razón seria ½

Cuando una figura de dos puntos corta a una figura de tres puntos exactamente por su mitad, la razón seria 2/3

Cuando una figura de tres puntos corta a una figura de cuatro puntos exactamente por su mitad, la razón seria ¾. Así de manera sucesiva. El problema está en la primera relación 0/1 y en la última relación infinito/infinito+1, el Punto y el Campo. Complementarios y en conversión simultánea. Tal vez estas figuras geométricas en algún punto de la sucesión de cortes dejen de ser estáticas para convertirse en dinámicas.

Ver la Figura 8:

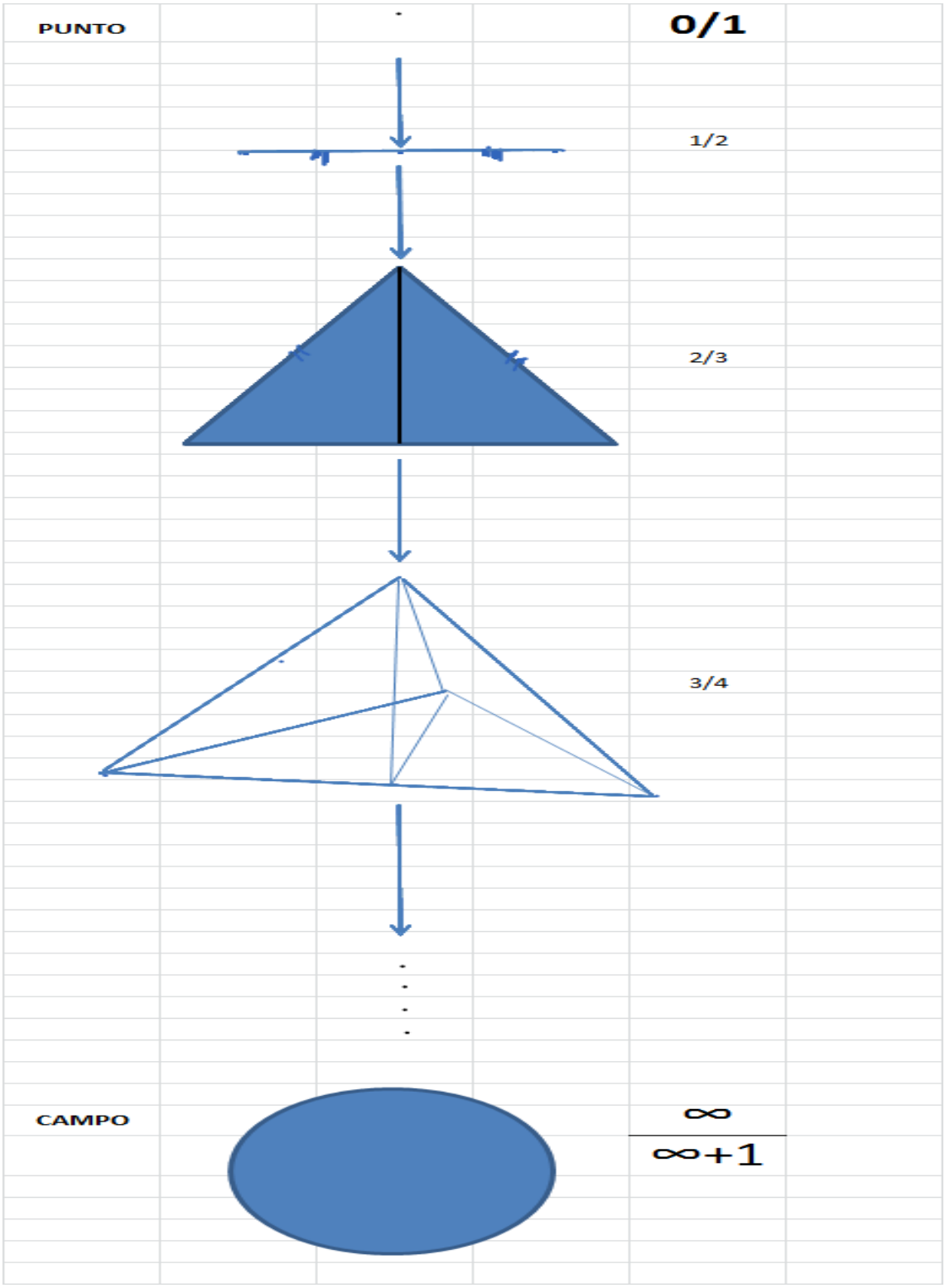


Fig. 8.

12 LA TEORÍA DE LA FUNCIÓN Y LA SEMIÓTICA

La Semiótica definida por los estudiosos es la ciencia orientada a estudiar cómo funciona el pensamiento para explicar las maneras de interpretación del entorno y de creación y de difusión del conocimiento que tienen las personas. En tal sentido la teoría de la función debe contribuir a entender y comprender de una manera más racional y coherente nuestro entorno,

tratándolo de hacer más a nuestra medida, que es medida de la verdad. Por ello la Función representa el elemento integrador, holístico, y unidad de medida a través del cual podemos comprender mejor los procesos en el mundo social y en el Universo. La teoría de la Función busca concentrar el mundo en el que vivimos y existimos en una única forma de construcción pensable. ….El Universo esta hecho a la medida de la inteligencia del hombre.

13 LA TEORÍA DE LA FUNCIÓN Y EL COMPORTAMIENTO DEL TIEMPO EN EL MUNDO MACROSCÓPICO Y MICROSCÓPICO

La forma progresiva e **irreversible** como acontecen los hechos en la realidad desde el pasado hasta el futuro, pasando por el presente, nos indica una cierta dirección como el tiempo discurre, en un universo relativo de cuatro dimensiones. Con frecuencia nos hemos preguntado porque los hechos en la realidad suceden de esta manera y no suceden de otra, pero, lo extraordinario es que los hechos se consuman en la realidad, de modo que discurren desde el momento de tiempo en el que suceden hacia adelante en el tiempo sin detenerse, **son irreversibles**. En conclusión nos estamos refiriendo a que todos los hechos de la realidad suceden en el tiempo de un modo **UNIDIRECCIONAL**.

Esto resulta válido y aplicable para el mundo Macroscópico - Relativo. Otra es la historia cuando nos referimos al mundo Microscópico - Cuántico, pues aquí es posible aceptar que existen fenómenos que son reversibles en el tiempo, en tal sentido el modo UNIDIRECCIONAL como el tiempo discurre en el mundo Macroscópico - Relativo, no se cumple en el mundo de lo Microscópico - Cuántico. Nos preguntamos por tanto ¿Si no es Unidireccional la forma como discurre el tiempo en el mundo Microscópico – Cuántico, entonces la respuesta debe ser que el tiempo en el mundo de lo Microscópico – Cuántico discurre de modo **ANTIDIRECCIONAL**.

No debemos olvidar que el tiempo no existe de manera separada del espacio, ambos coexisten en una estructura de complemento holística superior que es el espacio – tiempo.

En la Figura 9 trataremos de expresar lo anterior:

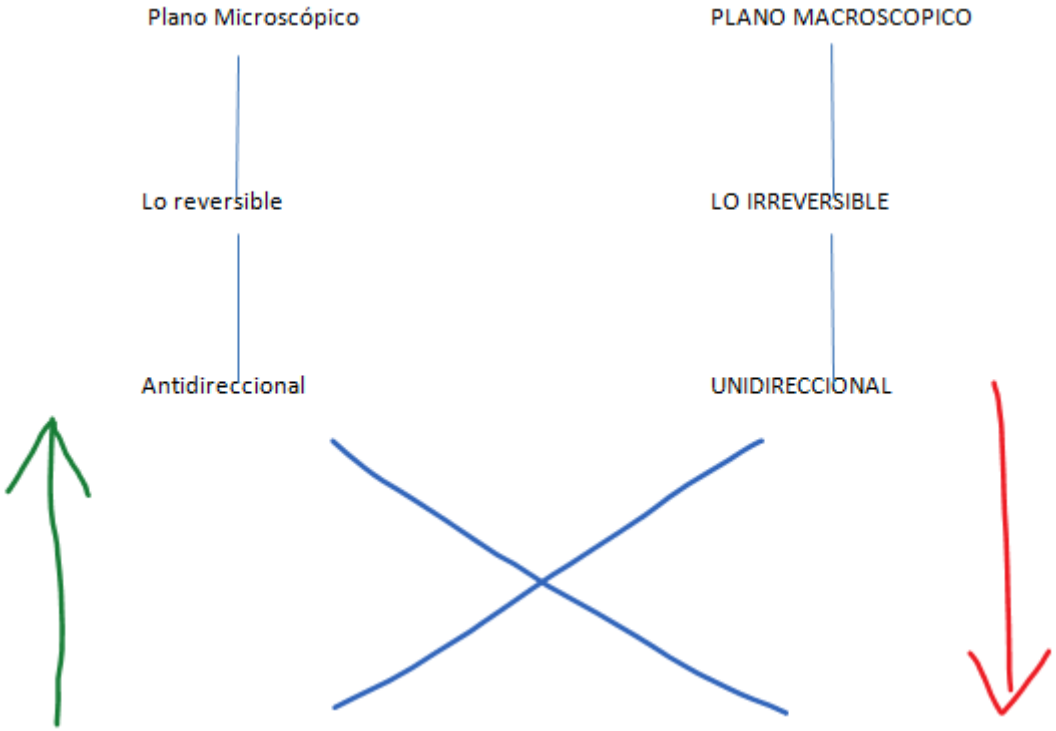


Fig. 9.

En la Teoría de La Función la flecha roja está de acuerdo con lo irreversible de los hechos, indica además que la CONVERTIBILIDAD discurre en esa dirección. La flecha de tiempo verde indica que el Proceso de Convertibilidad discurre de modo inverso al discurrir de los hechos indicados por la flecha roja, indica por tanto, que la CONVERTIBILIDAD, discurre de modo contrario a los hechos indicados por la flecha roja.

14 UNO TIENE ALGO DEL OTRO

De lo dicho hasta ahora se desprende que La teoría de la Función sostiene que existe un par de conceptos que se encuentran complementados, son interactuantes, son simultáneos y se encuentran además convirtiéndose uno en otro y que bajo esta idea fundamental la arquitectura del Universo se encuentra sostenida. Ahora además a esta idea, debemos añadir otra propiedad fundamental: **Uno tiene algo del Otro**, esto quiere decir que el primer concepto integrante del binomio posee propiedades y características propias del segundo concepto y a su vez el segundo concepto posee propiedades y características propias del primer concepto. El todo posee propiedades de la parte y a su vez la parte posee propiedades del todo. El creador posee algo de su obra y a su vez la obra posee algo de su creador. Lo concreto posee propiedades de lo abstracto y a su vez lo abstracto posee propiedades de lo concreto. Alguno posee propiedades de ninguno y a su vez ninguno posee propiedades de alguno. En la Teoría de la Función esta propiedad se sostiene en el resultado obtenido luego de la convertibilidad, como se muestra en la Figura 10:

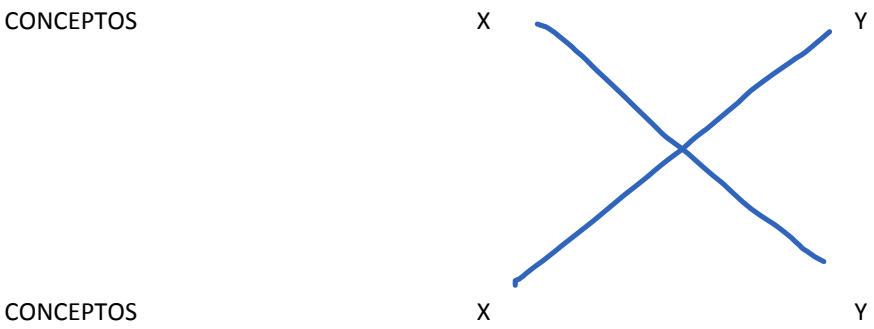


Fig. 10.

Cuando se produce la CONVERTIBILIDAD de X en Y, sucede que Y conserva características propiedades de X, y a su vez cuando se produce la CONVERTIBILIDAD de Y en X, sucede que X conserva propiedades y características de Y. Como habíamos indicado anteriormente de X a Y es un segmento y de Y a X es otro segmento. Tampoco no debemos olvidar que el proceso de CONVERTIBILIDAD no deja de suceder y viene desde el infinito y va hacia el infinito.

15 RESULTANTE DE LA CONVERTIBILIDAD

Para explicar esta propiedad, vamos a empezar haciendo un gráfico de Convertibilidad en la Figura 11:

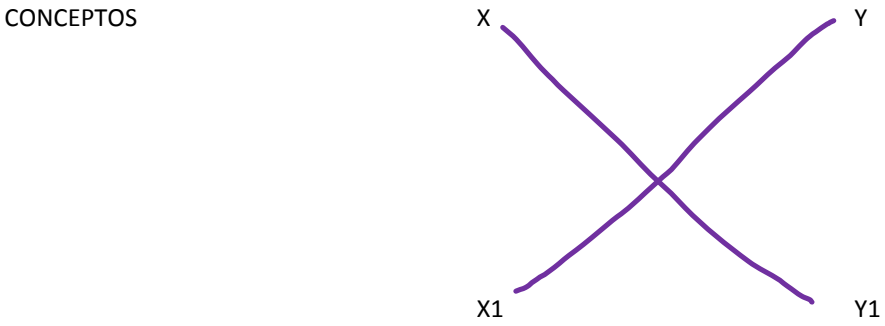


Fig. 11.

Cuando se produce la CONVERTIBILIDAD generada por una ACCION DE CAMBIO, vamos a encontrar que la resultante de Convertibilidad de X es Y1 y que la resultante de Convertibilidad de Y es X1. Esta propiedad nos indica que **X1 como resultante** NO es X, es parecida a X pero no igual, de igual modo **Y1 como resultante** NO es Y, es parecida a Y pero no igual. En la física cuántica existe lo que se llama corpúsculo y existe lo que se llama onda. Tenemos entonces Figura 12:

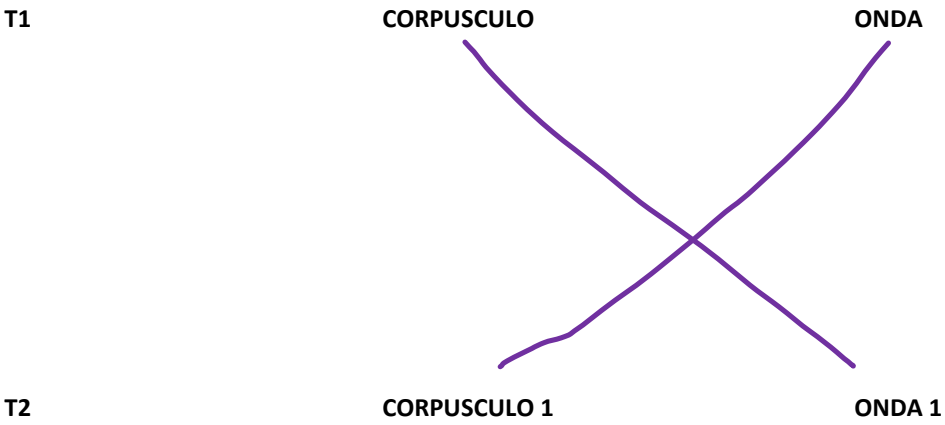


Fig. 12.

Cuando se produce la CONVERTIBILIDAD, el Corpúsculo se convierte en Onda 1 y a su vez de modo simultáneo la Onda se convierte en Corpúsculo 1, por aplicación de esta propiedad el Corpúsculo es distinto de Corpúsculo 1, son parecidos, pero NO iguales, como también la Onda es diferente de Onda 1, son parecidos, pero NO iguales.

16 CONCLUSIÓN

La teoría de la Función es una visión Heurística y Dogmática integral del mundo, por tanto es posible aplicarla a todo lo amplio del saber y del pensamiento humano.

REFERENCIAS

[1] Landáu, Lev y Rumer, Yuri, "¿Qué es la Teoría de la Relatividad?," vol. 13, Ediciones Akal, 1995.
[2] Einstein, Albert, "Mi Visión del Mundo", Editorial Tusquets Editores, 1995.
[3] Hawking, Sthepen, "Historia del Tiempo. Del Big Bang a los Agujeros Negros. Alianza. Madrid, 1998.
[4] Prigogine, Ilya y Stengers, Isabelle, "Entre el Tiempo y la Eternidad", Alianza Madrid, 1990.
[5] Vidalez González, Carlos, **"***Semiótica y teoría de la comunicación". Tomo II***.,** CECYTE, N.L.-CAEIP, 2010.

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Levenberg-Marquardt and Conjugate Gradient Training Algorithms of Neural Network for Parameter Determination of Solar Cell

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ABSTRACT: This present paper deals with the parameter determination of solar cell under different values of irradiance and temperature by using an artificial neural network. This latter is trained by an optimization algorithm based on gradient descent. In this work we used two distinguished algorithms from different order of gradient descent: Levenberg-Marquardt and conjugate gradient. The use of these two algorithms is to conduct a comparative study on their performances. The results revealed that the Levenberg-Marquardt algorithm presents the best potential in providing accurate electrical parameters values compared to conjugate gradient algorithm. Moreover, the trends of electrical parameters according to irradiance and temperature show the effect of each of these two meteorological factors on the values of the intrinsic parameters of solar cell.

KEYWORDS: Artificial neural network, Conjugate gradient, Electrical parameters, Levenberg-Marquardt, Solar cell.

1 INTRODUCTION

The continuous exhibition to irradiance (G), temperature (T) and aging leads to prevent the photovoltaic (PV) module to achieve its optimal performances. In order to study the impact of these handicapping factors on the produced electrical energy, we therefore need to know the behavior of the smallest unit of a PV module which is the solar cell, and thus by determining its intrinsic electrical parameters.

Under the lack of a direct mathematical equation between [G, T] and the electrical parameters, the Artificial Neural Network (ANN) seems to be an adequate method to model this implicit non-linear relationship. The feature of this method is presented in its ability to predict result from exploitation of the acquired data. Hence, the information is carried by weights, representing the connections values between neurons. The functioning of ANN requires her learning by a training algorithm, ensuring the minimization of the error generated at the network output.

In this study we used two gradient descent optimization algorithms that allow separately the training of ANN: Conjugate gradient of first order of gradient and the Levenberg-Marquardt of second order. We firstly determined the electrical parameters values of solar cell according to different values of G and T, then we compared between the potentials of the two algorithms opted for training of ANN. In addition, plotted curves of the electrical parameters values are provided in order to show the impact of G and T on these parameters during the production of the electrical energy by a solar cell.

2 SOLAR CELL MODEL

2.1 SINGLE DIODE EQUIVALENT MODEL

The solar cell that produces I_{PV} is modelled by a single diode electrical model [1-3].

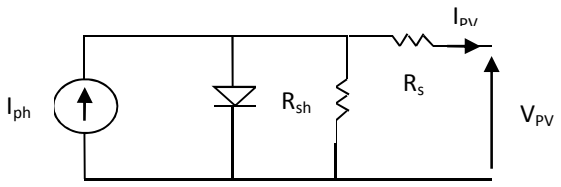

Fig. 1. Equivalent electrical circuit of solar cell

The mathematical equation deducted from the circuit of the figure 1 is expressed as follows:

$$I_{PV} = I_{ph} - I_s\left[\exp\left(\frac{V_{PV} + R_s I_{PV}}{n\, V_{th}}\right) - 1\right] - \frac{V_{PV} + R_s I_{PV}}{R_{sh}} \quad (1)$$

Where:

R_s: Series resistance representing the losses due to various contacts and connections.
R_{sh}: Shunt resistance characterizing the leak currents of the diode junction.
I_{ph}: Photocurrent. I_s: Diode saturation current. n: Diode ideality factor.
V_{th}: Thermal voltage $[AT/q]$.
A: Boltzmann constant $[1.3806503 .10^{-23} J/K]$. q: Charge of the electron $[1.60217646.10^{-19} C]$.
T: Temperature of solar cell by Kelvin.

2.2 DEPENDENCE OF ELECTRICAL PARAMETERS TO IRRADIANCE AND TEMPERATURE:

An illuminated solar cell generates an I_{PV} (V_{PV}) characteristic for a definite value of G and T. Indeed, according to the equation (1), the solar cell is characterized by five internal electrical parameters R_s, R_{sh}, I_{ph}, I_s and n, which lead to the production of current I_{PV} and change their values according to the value of two geometrical factors G and T, like it is the case with I_{ph} and I_s following these two equations:

$$I_{ph} = \frac{G}{G_{ref}}[I_{ph,ref} + b_{Isc}(T - T_{ref})] \quad (2)$$

$$I_s = I_{s,ref}\left(\frac{T}{T_{ref}}\right)^3 \exp\left[\frac{qE_g}{An}\left(\frac{1}{T} - \frac{1}{T_{ref}}\right)\right] \quad (3)$$

Where:

ref: Index indicating the reference value.
b_{Isc}: Temperature coefficient of the short circuit current.
Eg: Energy of band gap of the solar cell material.

The current I_{ph} varies according to the irradiance (equation (2)) and the current I_s varies according to the temperature (equation (3)) while the both resistances R_s and R_{sh} change according to the both meteorological factors [4]. The cell handled in this study is a commercial cell characterized by the following parameters at T_{ref} = 33°C and G_{ref} =1000W/m²:

Maximum power - P_{mp}(W)	0.3107
Open circuit voltage - V_{oc}(V)	0.5728
Short circuit current - I_{sc}(A)	0.7603
Operating voltage at maximum power - V_{mp}(V)	0.4507
Operating current at maximum power - I_{mp}(A)	0.6894

In order to train our network, we therefore needed several values of the five parameters and theirs according values of [G, T]. Hence, we determined, before we begin the training process, the necessary amount of the parameters values from

several characteristics $I_{PV}(V_{PV})$. We considered different characteristics for a margin of solar irradiance values between 100W/m² and 1000W/m² and for a cellular temperature values going from 15°C to 45°C. These $I_{PV}(V_{PV})$ are obtained from the schematization of a simulation model of the solar cell under MATLAB/SIMULINK software.

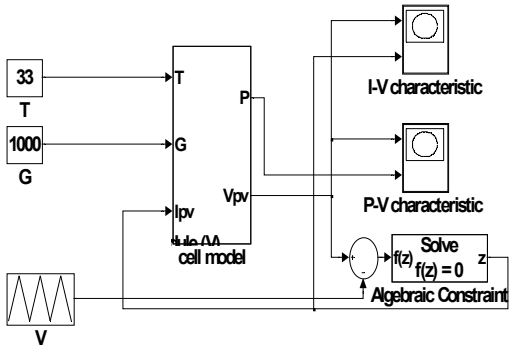

Fig. 2. Solar cell model

The block "*cell model*" of Fig. 2 includes a subsystem, modeling the mathematical equation (1).

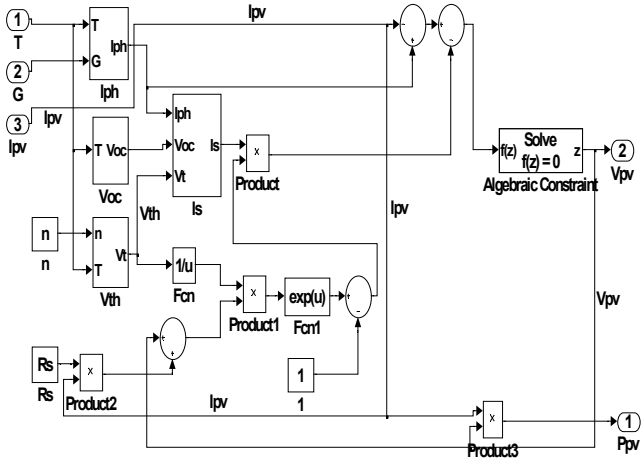

Fig. 3. Internal cell structure inside the block "Solar cell model"

The block of I_{ph} in figure 3 models the equation (2), while the block of V_{oc} and I_s in the same figure models successively the both following equations for current I_{pv}= 0 :

$$V_{oc} = \frac{G}{G_{ref}}[V_{oc,ref} + b_{voc}(T - T_{ref})] \qquad (4)$$

$$I_s = \frac{I_{ph}}{\exp\left(\frac{V_{oc}}{V_{th}}\right) - 1} V_{oc} \qquad (5)$$

b_{voc}: Temperature coefficient of the open circuit voltage.

3 THE USED ARTIFICIAL NEURAL NETWORK

The determination of the five internal electrical parameters of solar cell for various values of T and G are ensured by an ANN made in [4]. The architecture includes an entrance layer, a hidden layer and an output layer as shown below:

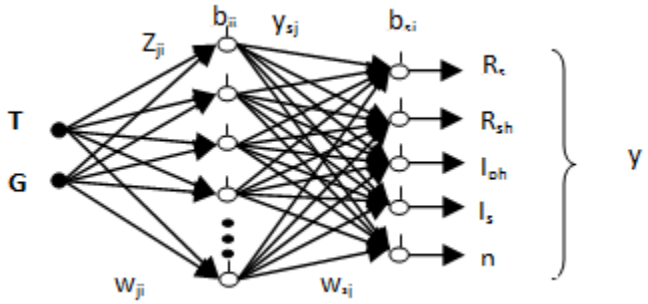

Fig. 4. The used topology of ANN

The entrance layer contains two inputs [T, G], the hidden layer contains twenty hidden neurons and that of the output includes five neurons of output corresponding to the five parameters [R_s, R_{sh}, I_{ph}, I_s, n] whose we want to predict the values. The entrance and the output of the network are connected by the following equations:

f_j^h Activation function « hyperbolic tangent » of the hidden neurons, f_s^o Activation function « linear » of the output neurons.

Equations of input **Equations of output**

$$z_{ji} = \sum_{i=1}^{2} x_i w_{ji} + b_{ji} \quad (6) \qquad y_{sj} = f_j^h(z_{ji}) \quad (7)$$

$$z_{sj} = \sum_{j=1}^{20} y_{sj} w_{sj} + b_{sj} \quad (8) \qquad y = f_s^o(z_{sj}) \quad (9)$$

4 TRAINING ALGORITHMS OF THE NETWORK

The training of the ANN is characterized by three stages: learning, validation and test. In order to obtain a good training, the error generated by the output of ANN during the learning stage must be minimized. This error is known under the name of "Mean Squared Error" $F_{mean\,(learning\,)}$, which is expressed by the following equation:

$$F_{mean\,(learning\,)} = \frac{1}{p}\sum_{t=1}^{p}\sum_{m=1}^{v}\left[S_{learning}\,(t,m) - y_{learning}\,(t,m)\right]^2 \quad (10)$$

Where:
p: Number of examples {input, output}.
v: Number of network output.
S: Desired values of the network output.
t: Index pointing out the number of examples.
m: Index pointing out the number of output.
y: Matrix values of the network output y = [R_s, R_{sh}, I_{ph}, I_s, n].

The minimization of the error $F_{mean\,(learning\,)}$ is ensured by the adjustment of the ANN's weights (w), using one optimization algorithm among the both: Levenberg-Marquardt or conjugate gradient.

4.1 LEVENBERG-MARQUARDT ALGORITHM

Levenberg-Marquardt algorithm (LM) is well known for its combination between the steepest descent method and Gauss-Newton method, which explain its low sensitivity toward initial points and its fast convergence around the optimum [5]. The LM algorithm adjusts the weights (w) of the network by following the expression:

$$w_{k+1} = w_k - \frac{J_k e_k}{J_k^{'} J_k + \lambda I} \quad (11)$$

Where:
J: Jacobian matrix of the error function $F_{mean\,(learning\,)}$.
e: Error between the desired and calculated network output.
k: Number of iterations.
I: Matrix identity.

Regulation strategy of the damping factor λ of Levenberg-Marquardt algorithm is made according to the following principle:

If the calculated error $F_{mean\,(learning\,)}$ for $w_{k+1,}$ decreases then:

$$\lambda = \lambda / 10$$

Else $\lambda = \lambda * 10$ and $w_{k+1} = w_k$

4.2 CONJUGATE GRADIENT ALGORITHM

Conjugate gradient algorithm (CG) is of the same family as the steepest descent algorithm, but it is more efficient. At the first iteration, the direction of gradient descent "d" is defined as follows:

$$d_{old} = -2 J_k^{'} e_k$$

From the second iteration

$$\beta = \frac{d_{old}^{'} d_{old}}{(J_k^{'} e_k)^{'} J_k^{'} e_k} \quad \text{and} \quad d_{new} = -2 J_k^{'} e_k + \beta d_{old}$$

$$w_{k+1} = w_k + \alpha d_{new} \quad (12)$$

5 RESULTS

Training of the network is made with 130 inputs-outputs examples distributed in three sets (learning, validation and test).

5.1 MEAN SQUARED ERROR

LM algorithm allows a good training of the ANN compared with CG algorithm; the latter converges slowly as it is shown in figure 5.

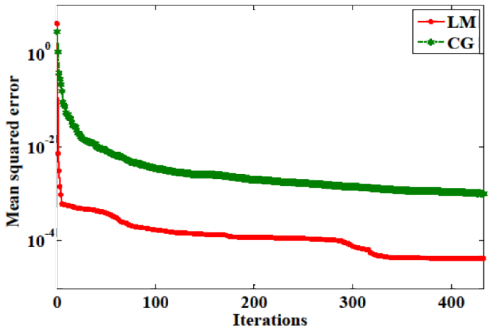

Fig. 5. Evolution of the mean squared error at learning stage of the ANN trained by LM and CG

5.2 EVOLUTION OF ELECTRICAL PARAMETERS ACCORDING TO TEMPERATURE

Electrical parameters values of solar cell are determined in margin of T = [15°C, 45°C]. In order to well observe their evolution, we have chosen to present their curves for two values of G (150W/m² and 350W/m²) (figures 6, 10).

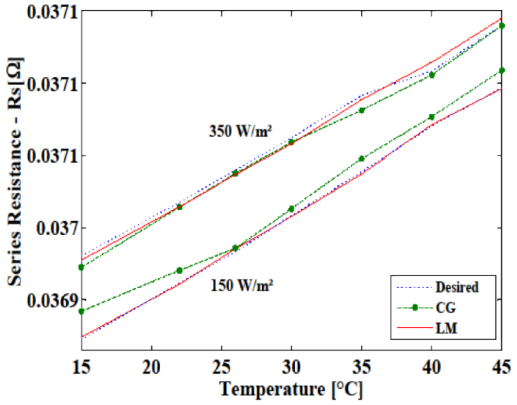

Fig. 6. Series resistance R_s according to temperature

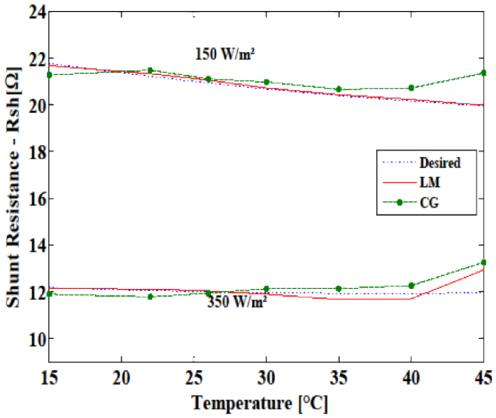

Fig. 7. Shunt resistance R_{sh} according to temperature

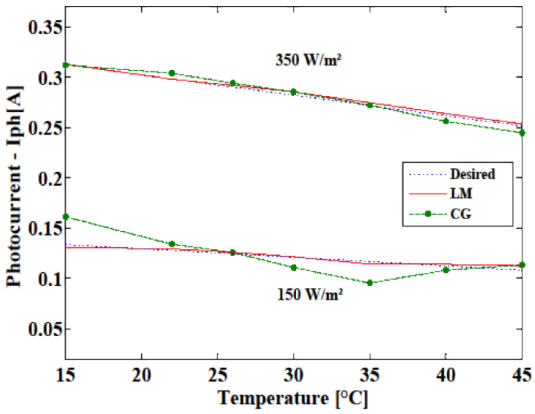

Fig. 8. Photocurrent I_{ph} according to temperature

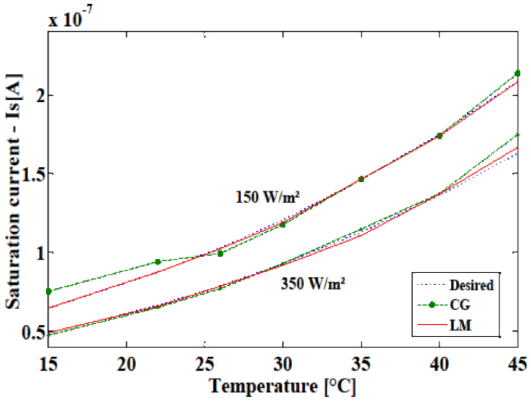

Fig. 9. Saturation current I_s according to temperature

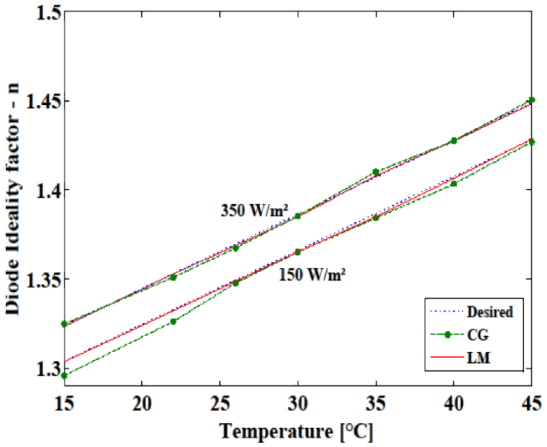

Fig. 10. Diode ideality factor n according to temperature

5.3 EVOLUTION OF ELECTRICAL PARAMETERS ACCORDING TO IRRADIANCE

Electrical parameters values of solar cell are determined in margin of G = [100W/m², 1000W/m²]. Since the curves are crowded, we have chosen two values of T (15°C and 35°C) to observe well the evolution of these parameters (figures 11,15).

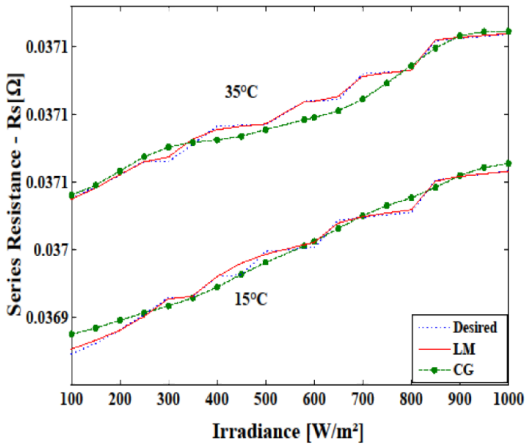

Fig. 11. Series resistance R_s according to irradiance

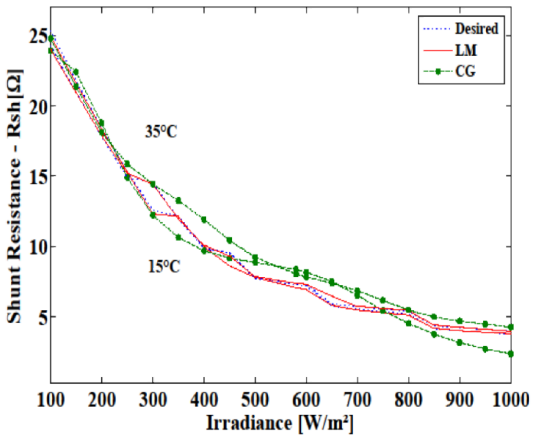

Fig. 12. Shunt resistance R_{sh} according to irradiance

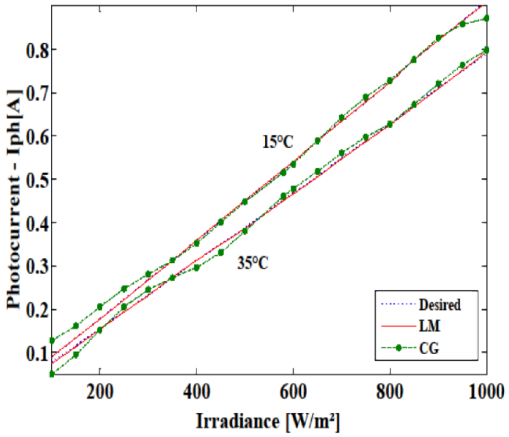

Fig. 13. Photocurrent I_{ph} according to irradiance

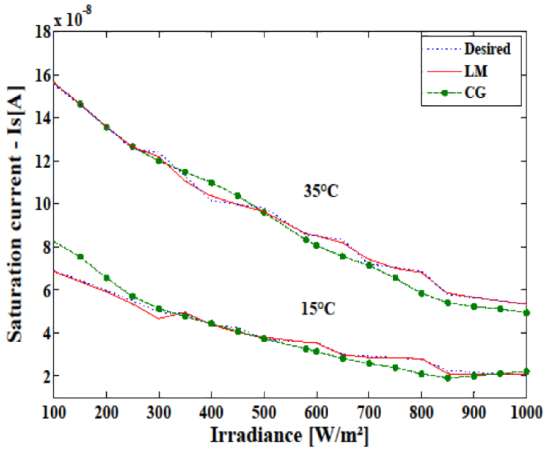

Fig. 14. Saturation current I_s according to irradiance

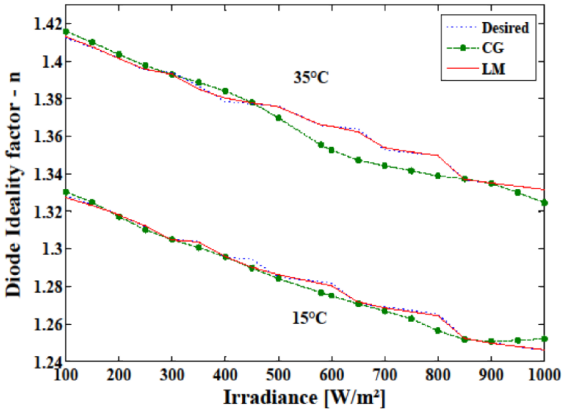

Fig. 15. Diode ideality factor n according to irradiance

6 DISCUSSIONS

As it is shown in fig. 5, the LM algorithm converges quickly and presents a minimal value of $F_{mean\,(learning\,)}$ compared to the error generated by the CG algorithm. This ability of LM to reach lower value of the mean squared error better than CG is explained by the features that LM inherits from Gauss-Newton. This algorithm becomes fast and effective when the network weights are well refined by the steepest descent algorithm. In other hand the CG which behaves like steepest descent, it had a slow convergence around the optimal network weighs, which explain the behavior of the algorithm that does not achieve a minimal error like it is the case with LM.

The obtained curves of the electrical parameters of the solar cell according to temperature and irradiance (fig. 6 to fig. 15), shows clearly that the network trained by LM gives values near to desired values than those obtained by ANN trained by CG. The temperature and the irradiance apply different effects on the five parameters R_s, R_{sh}, I_{ph}, I_s and n. As it is clearly seen in fig. 6 and in fig. 11, the values of R_s increase when T and/or G increase too, while in the two fig. 7 and fig. 12, the values of R_{sh} decrease with the variation of G, then they remain almost the same although the variation of T. The photocurrent I_{ph} as its name indicates, it is more affected by the change of G than by T, so this is obvious in fig. 8 and fig. 13. The values of I_s decrease with G and increase with T (fig. 9 and fig. 14), this evolution is also observed in the values of the diode ideality factor n (fig. 10 and fig. 15).

Table 1. Percentage of error of electrical parameters obtained par the ANN trained par LM and CG algorithms.

Meteorological Conditions		Conventional model [6]					Proposed ANN trained by LM					Proposed ANN trained by CG				
G [W/m²]	T [°C]	Rs [%]	Rsh [%]	Iph [%]	Is [%]	n [%]	Rs [%]	Rsh [%]	Iph [%]	Is [%]	n [%]	Rs [%]	Rsh [%]	Iph [%]	Is [%]	n [%]
200	15	0.0336	0.0115	0.0005	1.9764	0.0171	0.0000	0.0007	0.0005	0.0112	0.0000	0.0002	0.0222	0.1556	0.0965	0.0007
400		0.0292	0.0077	0.0006	0.4265	0.0237	0.0002	0.0001	0.0005	0.0124	0.0000	0.0002	0.0891	0.0194	0.0202	0.0001
600		0.0270	0.0059	0.0005	0.5636	0.0288	0.0000	0.0034	0.0005	0.0036	0.0012	0.0003	0.0556	0.0083	0.1163	0.0054
800		0.0248	0.0041	0.0004	0.7100	0.0339	0.0001	0.0013	0.0004	0.0144	0.0000	0.0062	0.1898	0.0071	0.2419	0.0070
1000		0.0246	0.0012	0.0002	0.0488	0.0251	0.0000	0.0011	0.0002	0.0267	0.0003	0.0003	0.1594	0.0445	0.0816	0.0049
200	45	0.0337	0.0104	0.0006	0.8324	0.0168	0.0000	0.0005	0.0006	0.0004	0.0001	0.0002	0.0034	0.0193	0.0023	0.0015
400		0.0294	0.0065	0.0006	0.8639	0.0219	0.0002	0.0053	0.0006	0.0891	0.0033	0.0003	0.1660	0.0506	0.0831	0.0041
600		0.0271	0.0050	0.0004	0.8541	0.0312	0.0000	0.0021	0.0004	0.0419	0.0034	0.0005	0.0121	0.0207	0.0512	0.0093
800		0.0024	0.0030	0.0003	0.0002	0.0304	0.0000	0.0027	0.0000	0.0002	0.0000	0.0001	0.0643	0.0011	0.1795	0.0079
1000		0.0011	0.0029	0.0002	0.0011	0.0361	0.0000	0.0018	0.0002	0.0162	0.0005	0.0001	0.1831	0.0111	0.0778	0.0052

In a previous work [6], we identified the electrical parameters of the mathematical model equation (1) by a conventional method. We therefore adjusted numerically the sum of squared error in order to determine these parameters by using one characteristic I_{PV} (V_{PV}). This characteristic is taken for a determined value of T and G. The determination of the corresponding values of the electrical parameters makes the identification issue a little bit slow and heavy to implement. Consequently the ANN method resolves this problem and presents an adapted determination platform, which establish a relationship between [T, G] and [R_s, R_{sh}, I_{ph}, I_s, n].

As it is shown in Table 1, we observe that the ANN trained by LM and CG presents the error percentages of electrical parameters minimum compared to that supplied by the conventional method, except for the percentages of error concerning the parameters R_{sh} et I_{ph} supplied by the CG algorithm which had important values compared to those presented by the conventional method. When we compare between ANN trained by LM and that trained by CG, we noteworthy that the first one presents the most minimal errors.

7 CONCLUSIONS

Levenberg-Marquardt algorithm provides the best performances in the training of the artificial neural network compared to the conjugate gradient algorithm. The determined values of the five electrical parameters of solar cell obtained by the network trained by the Levenberg-Marquardt algorithm are so close to the desired values, due to the ability of this algorithm to combine between the characteristics of steepest descent algorithm and the Gauss-Newton algorithm which ensure a maximal minimization of the mean squared error.

REFERENCES

[1] A. Jain, A. Kapoor, "Exact analytical solutions of the parameters of real solar cells using Lambert W-function", *Solar Energy Materials & Solar Cells*, vol. 81, pp. 269-277, 2004.

[2] H. Qin, J. W. Kimball, "Parameter Determination of Photovoltaic Cells from Field Testing Data using Particle Swarm Optimization", *IEEE*, 2011.

[3] T. Ikegami, T. Maezono, F. Nakanishi, Y. Yamagata, K. Ebihara, "Estimation of equivalent circuit parameters of PV module and its application to optimal operation of PV system", *Solar Energy Materials & Solar Cells*, vol. 67 pp. 389-395, 2011.

[4] E. Karatepe, M. Boztepe, M. Colak, "Neural network based solar cell model", *Energy Conversion and Management*, vol. 47, pp. 1159-1178, 2006.

[5] B. G. Kermani, S. S. Schiffmanb, H. T. Nagle, "Performance of the Levenberg–Marquardt neural network training method in electronic nose applications", *Sensors and Actuators*, vol. 110, pp. 13–22, 2005.

[6] B. Oukarfi, F. Dkhichi, A. Fakkar, "Parametric identification by minimizing the squared residuals (Application to a photovoltaic cell)", Proc. 1th IEEE Conf. on Renewable and sustainable energy conference, Ouarzazate, *IEEE Explore*, (March 7-9 2013).

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Synthesis and Characterization of Visco-Elastic (VE) Polyurethane Foam

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ABSTRACT: One of the important applications of polyurethanes is polyurethane foam. Flexible type of polyurethane foam is divided into many types and one of them is visco-elastic foam. Visco-elastic foam is unique foam showing both viscous and elastic behavior at same time. Visco-elastic foam covers major applications of flexible polyurethane foam. Visco-elastic foam samples were synthesized on lab scale by cup foaming. All samples were characterized by finding density of each sample. Cream time, gel time and rise time were also estimated for each sample. The chemical compositions of all polyurethane foam samples were characterized by FTIR analysis.

KEYWORDS: Polyurethanes, Visco-elastic Polyurethane foam, Cup Foaming, FTIR.

1 INTRODUCTION

Polyurethanes are broad class of materials used widely in many applications. Polyurethanes are also written as PUR. Polyurethanes also called as urethanes are characterized by urethane linkage -NH- C (=O) - O - . This linkage is formed due to the reaction of isocyanate group with hydroxyl group [1-3].

The total annual production of urethanes in the world is estimated to be 8 million tons per year and is increasing 4-5 % yearly. Polyurethane foams can be classified in to the two major groups depending on their physical properties. Flexible and rigid foams are low density foams and semi rigid foams have medium density [4-8].

The structure of polyurethane foam is formed due to the foaming system in which all the constituents are mixed and they rise to form an elongated structure having closed or open cells [9-11]. Polymeric (Visco-elastic) foams are used in many applications due to their low weight, and sound- and shock-absorbing properties. Polyurethane foam is a complex engineering material. Material Properties also depend on temperature and humidity and one of the important behaviors of foaming products is visco-elastic behavior [12-14].

Visco-elastic foam technology lead to the new innovation in the field of flexible polyurethane foams. Due to unique characteristics of visco-elastic VE foam it has captured the major applications of flexible polyurethane foam. Visco-elastic memory foam was first developed by NASA in 1970s to help relieve the astronauts from intense lift off. NASA developed a pressure relieving foam that was temperature sensitive and it evenly distributed body weight. NASA released this material in public in 1980s and originally it is proved unstable for commercial use then after a long research and development on visco-elastic VE foam by NASA they succeeded in developing a proper formulation and proper process for manufacture of visco-elastic foam that is commercially a viable product. Visco- elastic foam is also called memory foam and it is due to the reason that it remembers the shape of the object which is placed on it and when the object is removed from it the shape mark of the object is placed on the foam surface [15-18].

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2 MATERIALS & METHOD

2.1 MATERIALS

Chemicals used for the experimentation include Modified MDI (Methylene diphenyl di-isocyanate) which is the blend of toluene diisocyantae (TDI) and MDI, Polyether Polyol, additive (Benzyl Alcohol), filler ($CaCO_3$), catalyst (Stannous octoate). All chemicals are of commercial grade and are used without any further treatment. Calcium carbonate would be used as filler for density load build and residue reduction [15]. Instead of using conventional polyether polyol now different new types of polyols can also be used in synthesis of polyurethane foam like soya bean polyol, palm oil polyol, and sugar cane bagasse polyol [19-21].

2.2 METHOD

Visco-elastic foam was prepared using a standard hand mix procedure or cup foaming. Equipment used was Electric Mixer, Paper/ Plastic cups, Stirrer, Stop watch and Weight Balance. Foaming systems and environment was kept at constant temperature. Measured quantity of polyol was weighed in a plastic or paper cup by using electronic weight balance. Catalyst, water, blowing agent and surfactant (if used) were added in it with gentle stirring with spatula. Polyisocyanate component was weighed in a separate cup. Polyisocyanate was poured into the cup containing polyol and was thoroughly mixed for five seconds. Foaming mixture was allowed to expand and rise in the same cup. Foam block was cured at room temperature overnight. Foam samples were cut for testing from upper parts of the foam cured. Different batches were prepared by changing the quantity of chemicals used and also by changing the type of chemicals. One industrial sample of visco-elastic foam was also taken to compare results of lab scale synthesized foam with it. Five samples of visco-elasatic foam were synthesized with different type of chemicals and by varying the quantities of chemicals used. Complete formulation details for synthesis of visco-elastic foam with varying the percentages and type of chemicals are indicated in tabulated form in Table 1.

Table 1. Experimental data for synthesis of visco-elastic foam

Batch No.	Modified MDI (Blend of TDI & MDI)	Polyether Polyol	Water (Drops)	Additive (Benzyl Alcohol)	Filler ($CaCO_3$)	Catalyst (Stannous octoate)	Results
1	7 gram	12 gram	3-4	Nil	Nil	Nil	Soft VE foam
2	7 gram	12 gram	Nil	2-3 drops	Nil	Nil	Soft and fine VE foam
3	7 gram	12 gram	Nil	Nil	0.15 gram	Nil	VE foam with rigid surface
4	7 gram	12 gram	2-3	2 drops	Nil	Nil	Soft and fine VE foam
5	7 gram	12 gram	2-3	2 drops	Nil	0.1 gram	VE foam with rapid rise

3 CHARACTERIZATION

3.1 CALCULATION OF DENSITY

Density is a structural property and it is defined as mass per unit volume. Different physical properties of foamed polyurethanes are found through apparent density. For simple shaped samples density can be calculated by weighing it and then by finding its volume through linear dimensions but in the case of complex shaped materials especially polyurethane foams and elastomers the method used for calculating density is described in DIN 53479.

In this method the sample is first weighed when it is dry then it is again weighed after dipping it into the test liquid. In this case test liquid taken is water. Density can be calculated by using the formula described in DIN 53479 which is [2]:

$$\boldsymbol{Q_{PK} = \frac{m_1 Q_v}{m_2 - m_1}}$$

Whereas,

Q_{PK} = Density of test sample, Q_v = Density of test liquid, m_1= weight of dry specimen, m_2= weight of wet specimen.

Calculated density values of all batches of visco-elastic foam are shown in table 2.

Table 2. Density values of visco-elastic foam samples.

Batch Number	m_1 (gram)	m_2 (gram)	Q_v (g/cm^3)	Q_{PK} (g/cm^3)
1. Visco-elastic foam with full formulation	0.110	0.856	1	0.147
2 .Visco-elastic foam with catalyst	0.332	2.023	1	0.19
3. Visco-elastic foam with blowing agent	0.206	1.291	1	0.189
4. Visco-elastic foam with additive	0.278	0.907	1	0.44
5. Visco-elastic foam with filler	0.268	1.229	1	0.278

3.2 ESTIMATION OF CREAM TIME, GEL TIME AND RISE TIME

Cream time is the time interval at which mixture turns creamy and starts to expand. It is the bench time of mixing and usually measured in seconds. It is measured by using a stopwatch and it shows time periods in which mixture of all reactants turns creamy. Gel time is the time interval at which mixture turns into the foam of a gel and it is due to the cross linking reactions occurring in the mixture. To test for gel touch the foaming mixture with spatula, a thread will form between spatula and foam. It is also measured in seconds. Gel time is normally more than the cream time. Rise Time is the time interval at which mixture starts to rise up. It can be in minutes or seconds depending upon the type of foam synthesized. It is very important in foam synthesis because it shows time at which reaction gets completed and process of formation of foam starts. Rise time is greater than both cream time and gel time [1].

3.3 FOURIER TRANSFORM INFRARED SPECTROSCOPY (FTIR) ANALYSIS

FTIR analysis of all the samples of foam was done by using Shimadzu IR Prestige-21/DRS-8000 with a resolution of 4 cm^{-1} with number of scans 50 and the instrument was run at transmittance mode. The data interval provided by the instrument for a resolution of 4 cm^{-1} is 1 cm^{-1}. The software used was IR Solution. All spectra were recorded from 4000 to 800 cm^{-1}. Spectra of all foam samples were obtained which indicates the various functional groups present in those samples.

4 RESULTS AND DISCUSSIONS

4.1 DENSITY MEASUREMENTS

There is a little variation in density values of all the samples of viscoelastic foam and this is due to the reason that all the ingredients are almost same in every batch of viscoelastic foam with very little variation in quantities of different reactants. In case of samples of VE foam with additive and filler the density value is 0.44 g/ cm^3 and 0.278 g/ cm^3 respectively. The density values of these two samples slightly differ from the density of other samples of visco-elastic foam; because when additive is used, density value becomes higher. Density values of all VE foam samples are almost same.

4.2 CREAM, GEL AND RISE TIME FOR VISCO-ELASTIC FOAM SAMPLES

Cream, gel and rise time of all samples of visco-elastic foam is measured. In first batch soft visco-elastic foam is formed in which cream time, gel time and rise time are 4 s, 6 s and 10 s respectively. Water is used as a blowing agent in this batch that's why mixture rises rapidly in a very less time. In second batch Cream time, gel time and rise time are 5 s, 6 s and 11 s respectively. In this batch there is a slight difference in the rise time as compared to the first batch and this is due to the reason that no blowing agent is used here and mixture starts to rise after the complete reaction of reactants.

In third batch Cream time, gel time and rise time are 7 s, 9 s and 17 s respectively. Now in this case there is a major difference in gel time and rise time as compared to other batches. This difference is due to the addition of filler as filler is added and also no blowing agent is used so mixing is required for more time and the ingredients will react with each other as the mixing continues. There is no rapid rise because the reaction will take time to complete due to the addition of filler and even it is observed that when the mixture take the form of gel then rise will not start at once but rise started after some seconds. In fourth batch Cream time, gel time and rise time are 3 s, 5 s and 10 s respectively. In this batch rise is rapid due to the use of water as physical blowing agent. In fifth batch Cream time, gel time and rise time are 2 s, 3 s and 7 s respectively. In this batch a rapid and fast rise is observed and this is due to the catalyst action, as catalyst enhances the rate of reaction without being the part of reaction so due to the addition of catalyst the rise time is very small and reaction gets completed in a very short time and after taking the form of gel mixture at once rise resulting in a fine and soft visco-elastic foam.

Measured values of cream time, gel time and rise time for all the samples of visco-elastic foam are represented graphically in figure 1, 2 and 3 respectively.

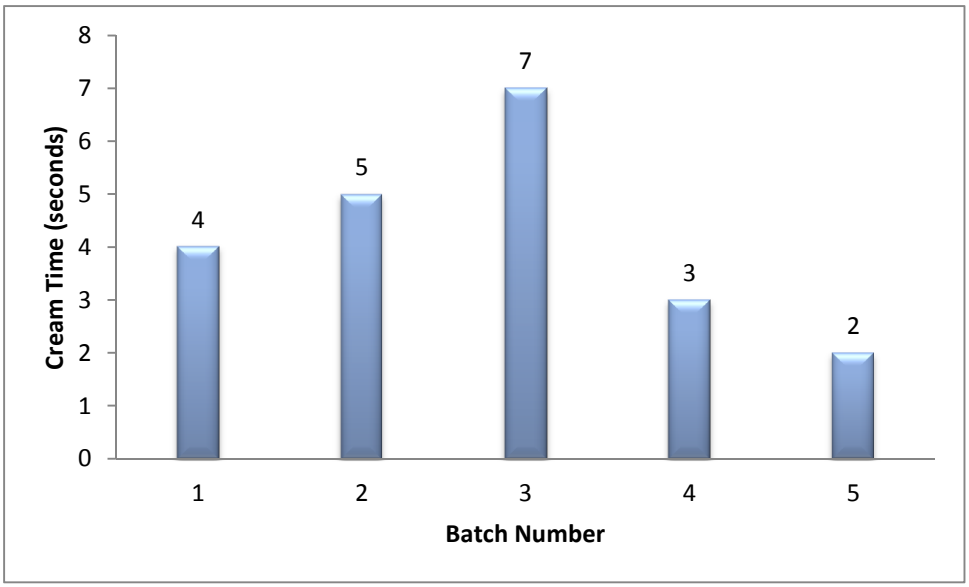

Fig. 1. Variation in cream time with batch number for visco-elastic foam samples.

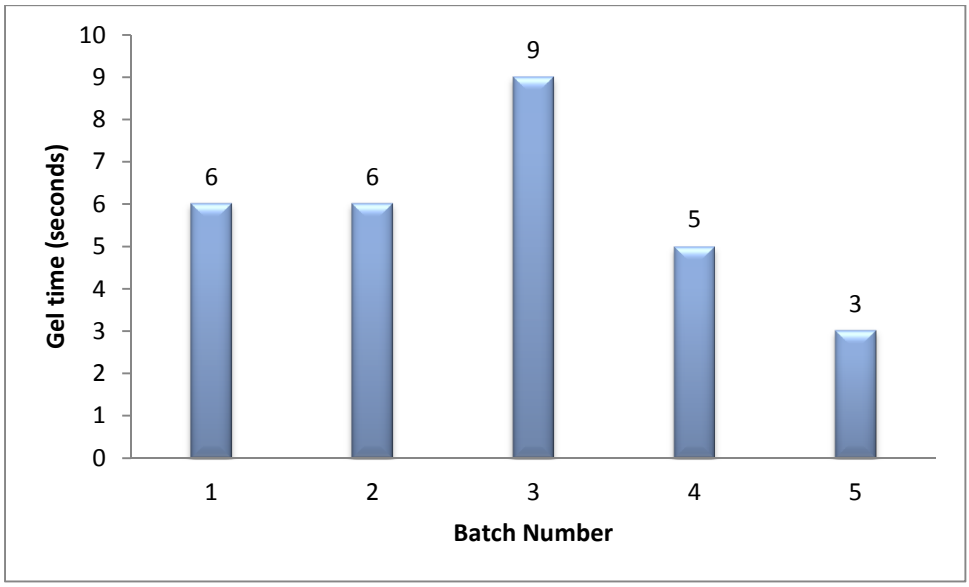

Fig. 2. Variation in gel time with batch number for visco-elastic foam

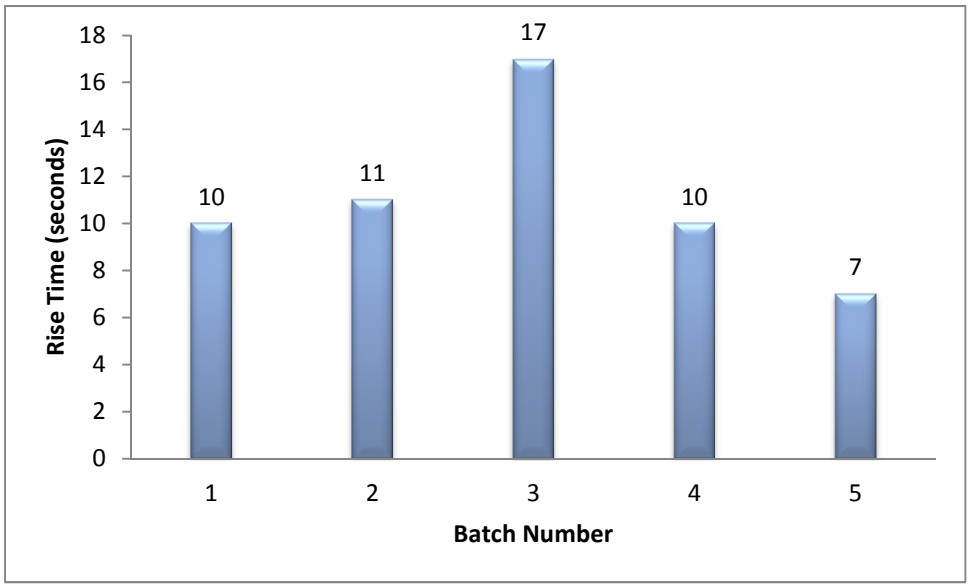

Fig. 3. Variation in rise time with batch number for visco-elastic foam

4.3 FTIR RESULTS

In spectra of the first sample the first peak comes at 3782.41 cm^{-1} which shows water contaminant and it is also present in the spectra of industrial sample. The peak at 3329.14 cm^{-1} shows the C-H stretch of alkynes and peak at 2879.72 cm^{-1} show C-H stretch of aliphatic alkanes. At 1710.86 cm^{-1} peak indicates saturated carboxylic acid derivatives with bond C=O. Peak at 1597.06 cm^{-1} shows aromatic rings and peak at 1525.69 cm^{-1} indicates the presence of nitro compounds N-O. Peak at 1361.74 cm^{-1} shows the presence of C-N amines and peaks at 1301 and 1288.66 cm^{-1} indicates the presence of aromatic ethers C-O which is due to polyether polyol. At 1095.57 cm^{-1} there is C-C stretch of alkanes and at 923.90 cm^{-1} peak shows C-H bend of alkenes. At 827.46 cm^{-1} and 758.02 cm^{-1} peak shows C-H bend of aromatic rings. Figure 4 shows the FTIR spectra of first sample of viscoelastic foam.

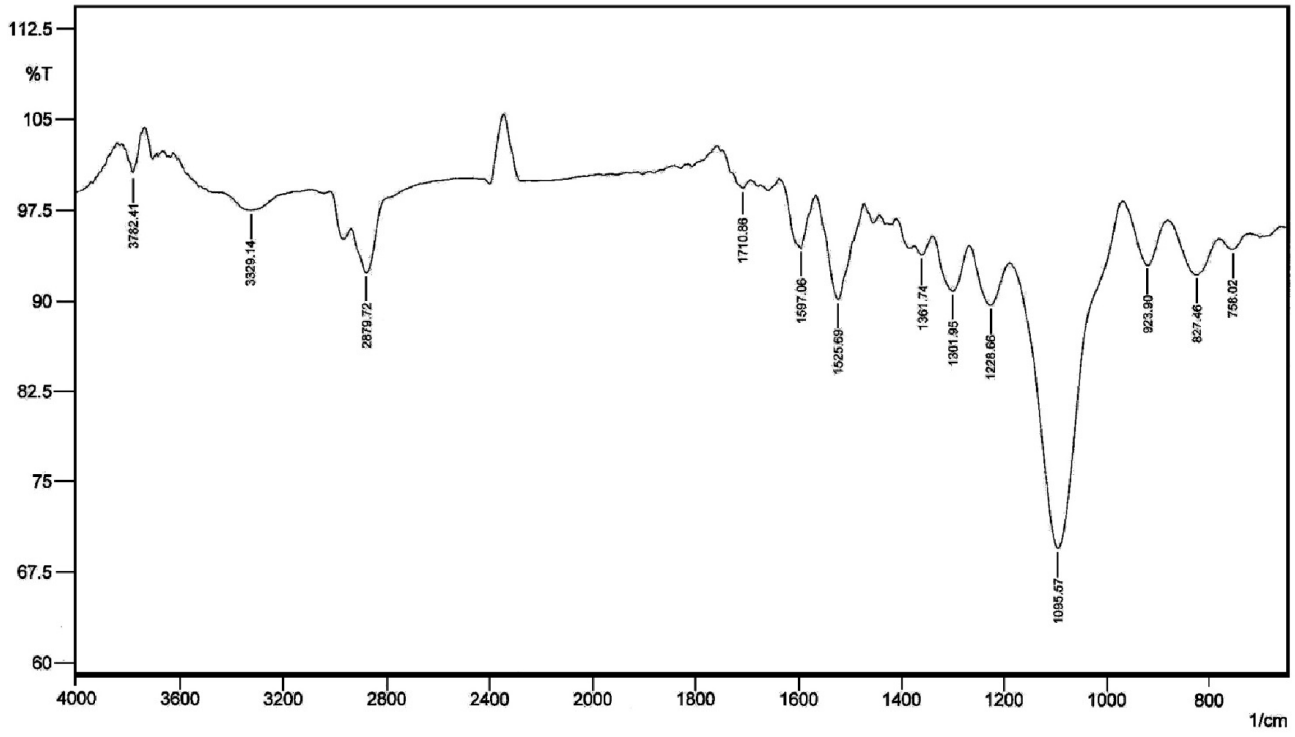

Fig. 4. FTIR spectra of viscoelastic foam (1st sample)

FTIR spectra of viscoelastic foam sample in which catalyst is used is same as that of first sample and no major difference is observed. The only difference is that it is not showing any peak indicating water contaminant which shows that water is not used in synthesis of this sample. Peak at 3329.14 cm^{-1} shows C-H stretch of alkynes and peak at 2872.01 indicates C-H with specific bond methyl which shows the presence of MDI. Rest of the peaks in the spectra are same as the spectra of previous sample and show same functional groups and same frequency values indicating that the same chemicals are used in synthesis as of previous sample and use of catalyst do no effect the results of FTIR. Figure 5 shows the FTIR spectra of this sample.

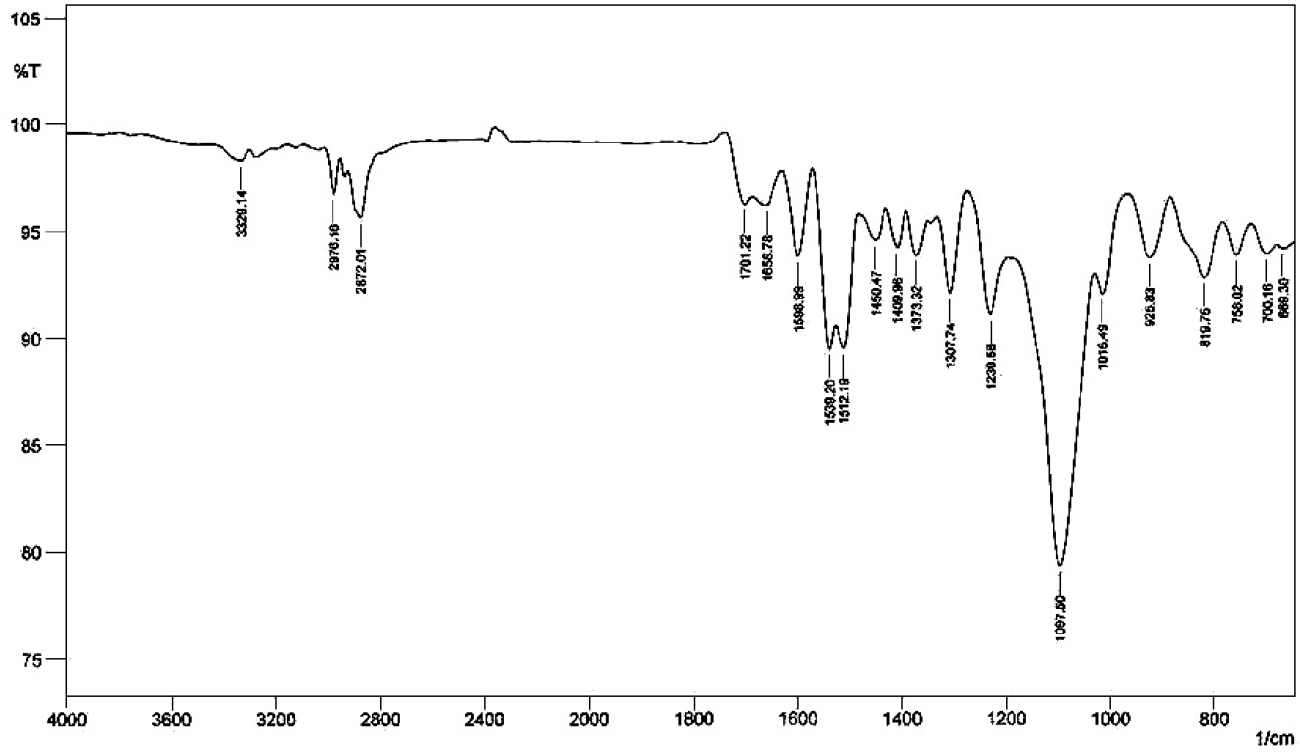

Fig. 5. FTIR spectra of viscoelastic foam sample in which catalyst is used

FTIR spectra of viscoelastic foam synthesized using a blowing agent is also same as spectra of previous samples showing that same chemicals are used. First three peaks shows the same C-H stretch and C-H with specific bonds. At 2870.08 cm^{-1} the peak shows C-H alkyl bond with methyl as a specific bond which is due to the presence of MDI. Peak at 1703.14 cm^{-1} show carboxylic acid derivatives and other rest peaks show aromatic rings, aliphatic nitro compounds, and ethers and in the end of spectrum all peaks show C-H bend of alkenes. Figure 6 shows the FTIR spectra of this sample.

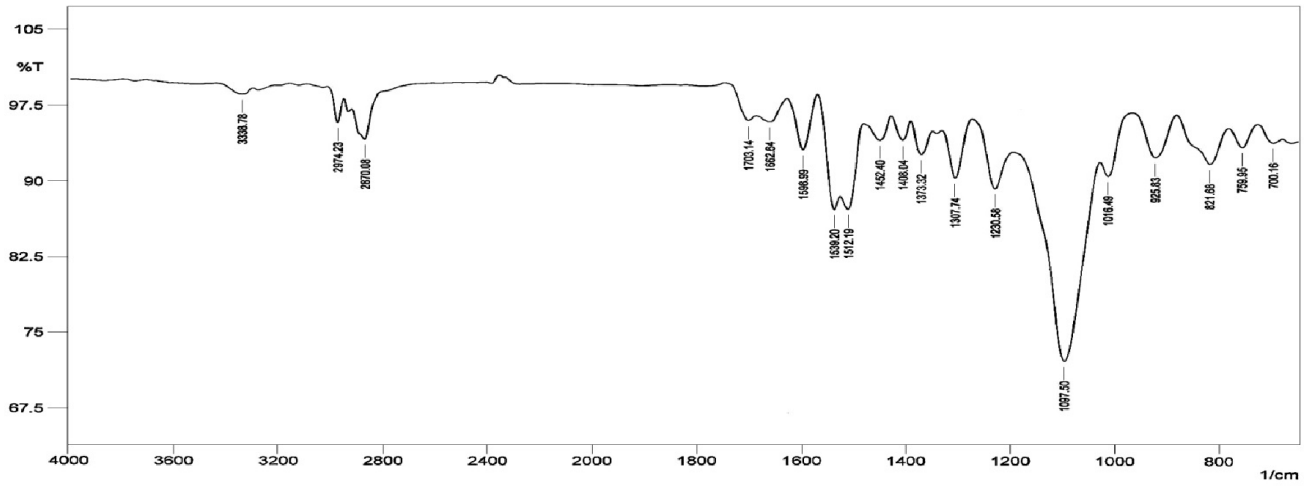

Fig. 6. FTIR spectra of viscoelastic foam sample with blowing agent

FTIR spectra of viscoelastic foam with additive is same as previous sample and no change is observed showing that addition of additive have no effect on FTIR results. All peaks in the spectra of this sample show same functional groups as in the previous samples. Additive used here is monol (benzyl alcohol) and at 1307.74 cm^{-1} peak shows the presence of C-O alcohols that justify the presence of benzyl alcohol in the sample that is used as an additive, rest of peaks are same. An FTIR spectrum of this sample is shown below in figure 7.

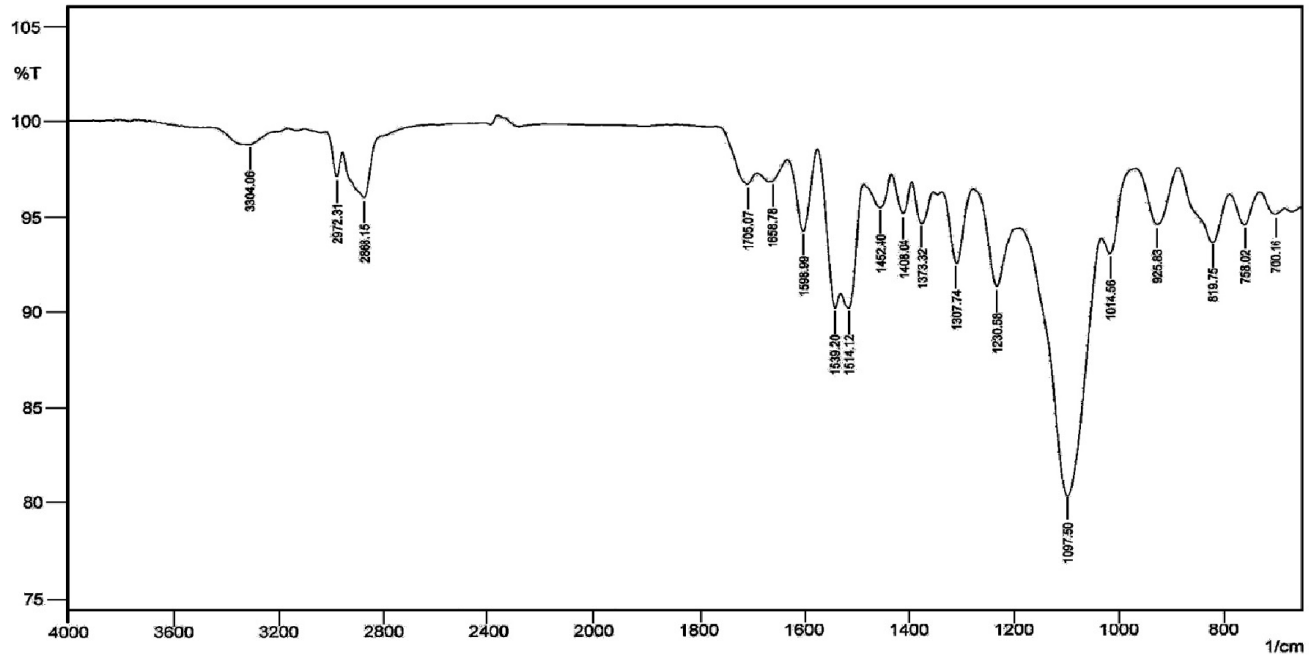

Fig. 7. FTIR spectra of viscoelastic foam sample with additive

FTIR of viscoelastic foam with filler exhibit the same results as of previous sample. As $CaCO_3$ is used as filler in this sample it has no effect on the FTIR spectra. There is a little difference in the values at which peak occurs but the functional groups of all the peaks are same as in the spectra of previous samples. In start the peaks show C-H stretch and bend with some specific bonds like methyl bond shown at 2868.15 cm^{-1}. Then there are different functional groups like carboxylic acid derivatives, aromatic and aliphatic nitro compounds, aromatic rings etc. FTIR spectra of this sample are shown below.

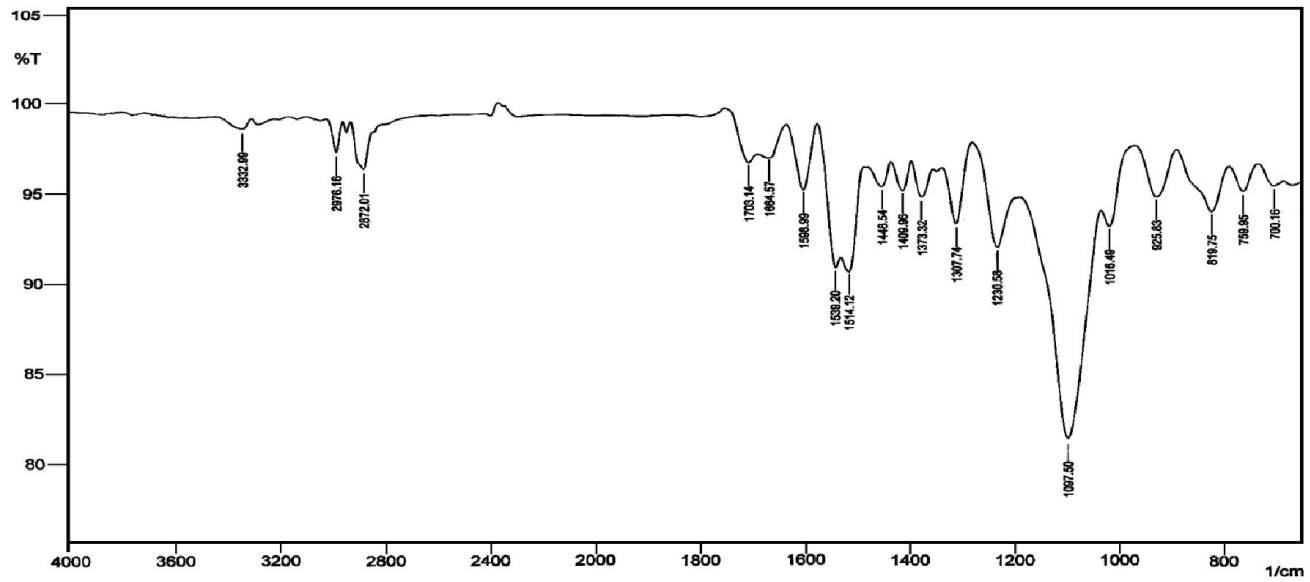

Fig. 8. FTIR Spectra of viscoelastic foam with filler

5 CONCLUSIONS

It can be concluded that:

- Visco-Elastic foam can be synthesized on lab scale using standard hand mixing procedures, as cup foaming was used in this research.
- Little variation in chemicals and their quantities can change the structure of final product.
- Addition of catalyst in foaming processes enhances the reaction speed resulting in rapid rise time.
- Use of blowing agent results in smaller value of rise time rise time because blowing agent causes the mixture to blow rapidly and reaction gets complete in very less time.
- Value of density can define the type of foam synthesized. On the basis of variation in density values of all the samples we can say that we have synthesized different grades of visco-elastic foam.
- FTIR results lead to conclusion that major reactants of foaming processes were present in all types of samples showing their respective peaks in spectra of every foam sample.

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REFERENCES

[1] Ashida, K., Polyurethane and Related Foams: Chemistry and Technology: Taylor & Francis, 2006.
[2] Oertel, G.A.L., Polyurethane handbook: chemistry, raw materials, processing, application, properties, Hanser Publishers; Hanser/Gardner Publications, 1999.
[3] Szycher, M., *Szycher's handbook of polyurethanes*, Boca Raton: CRC Press, 1999.
[4] Matsumura, S., Y. Soeda, and K. Toshima, "Perspectives for synthesis and production of polyurethanes and related polymers by enzymes directed toward green and sustainable chemistry", *Applied Microbiology and Biotechnology,* **70**(1): p. 12-20, 2006.
[5] Begum, M. and Siddaramaiah, "Synthesis and characterization of polyurethane/polybutyl methacrylate Interpenetrating polymer networks", *Journal of Materials Science*, **39**(14): p. 4615-4623, 2004.

[6] Rivera-Armenta, J.L., T. Heinze, and A.M. Mendoza-Martínez, "New polyurethane foams modified with cellulose Derivatives", *European Polymer Journal*, **40**(12): p. 2803-2812, 2004.
[7] Molero, C., A. de Lucas, and J.F. Rodríguez, "Recovery of polyols from flexible polyurethane foam by "split phase" glycolysis: Glycol influence"*,* Polymer *Degradation and Stability,* **91**(2): p. 221-228, 2006.
[8] Krupers, M.J., et al., "Formation of rigid polyurethane foams with semi-fluorinated diblock copolymeric Surfactants", *Polymer,* **39**(10): p. 2049-2053, 1998.
[9] Ligoure, C., et al., "Making polyurethane foams from microemulsions"*. Polymer,* **46**(17): p. 6402-6410, 2005.
[10] Sonnenschein, M.F., R. Prange, and A.K. Schrock, "Mechanism for compression set of TDI polyurethane foams"*, Polymer,* **48**(2): p. 616-623, 2007.
[11] Malak, S.F.F. and I.A. Anderson, "Orthogonal cutting of polyurethane foam", *International Journal of Mechanical Sciences,* **47**(6): p. 867-883, 2005.
[12] Dounis, D.V. and G.L. Wilkes, "Structure-property relationships of flexible polyurethane foams", *Polymer*, **38**(11): p. 2819-2828, 1997.
[13] Everitt, S.L., O.G. Harlen, and H.J. Wilson, "Bubble growth in a two-dimensional viscoelastic foam"*, Journal of Non Newtonian Fluid Mechanics*, **137**(1–3): p. 46-59, 2006.
[14] Singh, R., P. Davies, and A.K. Bajaj, "Identification of Nonlinear and Viscoelastic Properties of Flexible Polyurethane Foam", *Nonlinear Dynamics*, **34**(3-4): p. 319-346, 2003.
[15] T.M Smeicinski, R.A Neff, "Visco-elastic foam: Impact of isocyanate upon foam morphology", *API Polyurethanes technical conference, 2006.*
[16] TeodorSocaciu, Mihai Simon, LiviuDorin Pop, ManuelFreitas, "Research and application of visco-elastic memory foam in the field of footwear manufacturing". *Scientific Bulletin of the PetruMaior University of TirguMures, Vol*. 7,No.2, 2010.
[17] Richard S. Schmidt: "NASA pressure relieving foam technology is keeping the leading inner-spring mattress firms awake at night". Technovation 29 181-191, 2009.
[18] Tanaka, R., S. Hirose, and H. Hatakeyama, "Preparation and characterization of polyurethane foams using a palm oil based polyol"*, Bioresource Technology*, **99**(9): p. 3810-3816, 2008.
[19] Tan, S., et al., "Rigid polyurethane foams from a soybean oil-based Polyol"*, Polymer*, **52**(13): p. 2840-2846, 2011.
[20] Abdel Hakim, A.A., et al., "Preparation and characterization of rigid polyurethane foam prepared from sugar-cane bagasse polyol"*, Materials Chemistry and Physics*, **129**(1–2): p. 301-307, 2011.
[21] Shoaib Suleman, S. M. K., Tahir Jamil, Waqas Aleem, Muhammad Shafiq and Nafisa Gull, "Synthesis and Characterization of Flexible and Rigid Polyurethane Foam" , *Asian Journal of Applied Sciences,* **2**(5): p. 701-710, 2014.

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HOW THE SOVEREIGN DEBT CRISIS AFFECTED THE CAPITAL STRUCTURE OF EURO ZONE BANKS

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ABSTRACT: In this article, we try to identify the link between the capital structure dynamics of banks and the European sovereign debt crisis, looking at the drivers of leverage and how their interactions with leverage changed between the periods before and during the crisis. We review the existing literature on the links between the sovereign debt crisis and banks, as well as literature discussing the changes in bank funding patterns with the view to understanding how leverage dynamics changed during the debt crisis period.

We found out that although most of the variables of interest were relevant in explaining leverage over the period under study as a whole, the variables that captured macroeconomic interactions with leverage were more relevant to leverage during the crisis period than variables capturing bank specific information. Meanwhile this study showed a significant reduction of leverage during the crisis period in line with a risky environment and regulation pressures, with much of this reduction being explained by factors other than bank-specific determinants of leverage.

KEYWORDS: Sovereign Debt; Leverage; Capital Structure; Bank-specific Determinants.

1 INTRODUCTION

Considering the fact that it is still an on-going problem concentrated in the euro area, the sovereign debt crisis has gained a lot of attention from researchers. With traces of the crisis originating back in late 2009, a lot of work has been done into understanding how it unfolded and its widespread effects.

The euro area was an attempt towards promoting the common interests of its member countries through a more robust currency supported by the economies of a group of countries. Efforts towards an Economic and Monetary Union in Europe have been in the works since the 1970s. The Maastricht Treaty was signed in 1992 as part of the efforts towards achieving this, with a timeline for integration as well as conditions for joining the union set out therein. Part of the criteria for membership was that, countries were expected to meet certain thresholds including a budget deficit not exceeding 3% of GDP as well as public debt no more than 60% of GDP. There have however been numerous expressions of skepticism with regards to the implementation of a monetary union without the institution of banking and fiscal union alongside.

Most researchers believe that the crisis began when Greece announced its budget situation and confessed to reporting less than accurate figures. This led to questions about how many other countries were tampering with figures to present a better picture. The intensity of the situation increased Greece was not able to meet debt payments, with impending default lurking.

The sovereign debt crisis had far reaching consequences on the euro area and beyond, with its effects on the banking sector attracting a good share of attention. The link between sovereigns and the banking sector cannot be overemphasized,

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noting the fact that, the banking sector drives economic activity through its intermediation activities of channelling money from lenders especially households, to firms to aid productive activity. In some countries, sovereigns depend a lot on the banking sector as a source of private funding, whilst the efforts by the sovereign to promote economic growth and stability go a long way to boost bank performance and health.

In relation to this interaction between banks and sovereigns though, our focus lies in exploring how the sovereign debt crisis situation affected the capital structure of banks. Since funding is needed for any business to survive and run, capital decisions and its structure is a key area for banks as well. A number of funding sources are open to banks including equity, debt funding, deposits from customers and Central bank lending. Funding decisions whether through equity or through external financing are made in light of several considerations: the business environment, economic situation, availability, bank characteristics and costs. It is no doubt that the sovereign debt crisis introduced a change in dynamics in capital structure decisions, in terms of costs of funding choices and availability. Banks as operating entities take various levels and types of decisions in running their businesses.

As mentioned earlier, the sovereign debt crisis continues to receive a lot of research attention, with a number of papers recently exploring the link between the sovereign debt crisis and the banks. To mention a few, Gennaioli, Martin and Rossi (2012), Bolton and Jeanne (2011) as well as Sosa-Padilla (2012) demonstrate through models how sovereign defaults would affect banks. With the interests of this research geared towards exploring bank capital structure in the midst of the crisis, Gropp and Heider (2010) and Giordana and Schumacher (2012) present papers that are of interest; explore the general drivers of capital structure in banks, albeit without a particular focus on the sovereign debt crisis.

What this study attempts to do is to therefore establish a link between the sovereign debt crisis and bank capital structure with the goal of understanding how capital structure patterns changed in light of the crisis. We explore the some relevant drivers of leverage in an attempt to explore how relevant they were to determining capital structure during the crisis period. Since the data at hand is of the panel type, we employ a fixed effects model to examine the links between various factors influencing leverage and to assess how the sovereign debt crisis changed the interaction of these factors with leverage choices. Findings showed that macroeconomic variables which capture market, lending risk and the spread increases were very significant in explaining leverage during the crisis period, as compared to bank-specific variables.

2 LITERATURE REVIEW

2.1 THE SOVEREIGN DEBT CRISIS

A lot of work has been done in studying the sovereign debt crisis, which turns out to be one of the major crises in history to hit most parts of Europe. The sovereign debt crisis, which followed after the financial crisis of the United States, began sometime in 2009.

Mody and Sandri (2012) consider signs of the euro zone crisis to have started from the impact of the global financial crisis on banks in European countries which then affected sovereign spreads in respective countries. They also point to the bailout of Bear Stearns and the Lehman Brothers bankruptcy as a second phase of events leading to the crisis, with the January 2009 nationalisation of Anglo-Irish in Ireland as the starting point of the crisis in its full-blown form. The figure below shows the transition of sovereign spreads into their rocket high trends during the crisis.

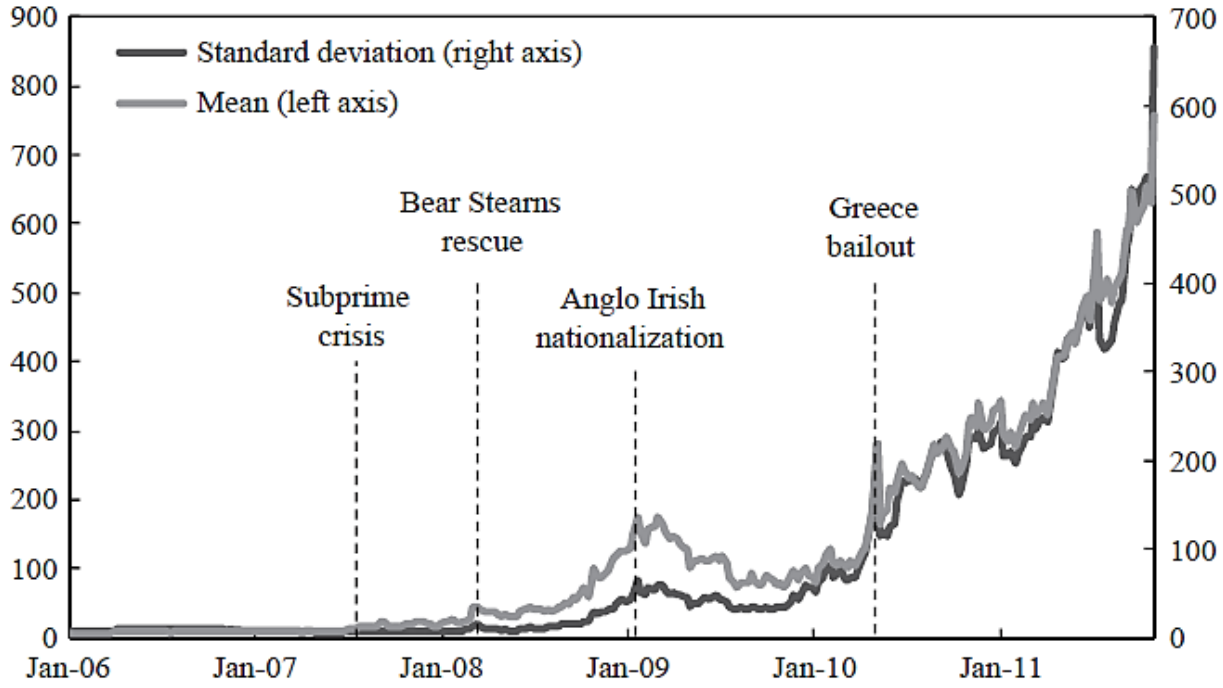

Fig. 1. Increase and dispersion of euro zone sovereign spreads (basis points)

Source: Mody and Sandri (2012)

A main consensus however is that the Greece government's announcement sometime in October 2009 about its previous government reporting wrong budget deficit and public debt figures set the stage for the sovereign debt crisis. A report published in the 12th November, 2011 edition of *The Economist* lends credence to this view: it states that in the German point of view, what set the ball rolling for the crisis was Greece misrepresenting it's national account situation as well as its budgetary mismanagement. This led to agitation in markets and raised concerns about the how deep the deficit and debt situation was in Greece and other countries, especially the periphery (Van Rixtel and Gasperini, 2013). These events led up to a shoot of sovereign spreads to high levels which further aggravated the crisis situation, with spill overs from Greece to other countries, again with peripheral countries most hurt.

In retrospect, certain flaws can be pointed out in the fabric of the plans to establish an Economic and Monetary Union. One of the key observations was that not all countries were able to meet the budget deficit and public debt threshold provisions outlined in the Stability and Growth Pact (SGP) prior to the crisis, with even Germany falling short of its provisions at some point (The Economist, 2011). The provisions of the SGP therefore seemed quite ambitious to start with.

There is also the concern by many researchers about the fact that establishing a monetary union without a backing banking and fiscal union is not feasible, with most researchers pointing to the US example where such mechanisms are in place. Lane (2010) buttresses this point when he contends that the inherent design of the European Union was flawed due to a lack of a total comprehension of the inherent weaknesses of a monetary union, especially without an established banking union.

Greece was the hardest hit country, and probably the main 'centre of attraction' during the crisis, with several arrangements made to curb the severity of the situation. With many European countries holding Greek debt, the need to curb a default situation by Greece was pertinent. As shown in the insert from *The Economist* below, about 70% of Greek government debt amounting to close to EUR 80 billion was held by euro area banks as at the fourth quarter of 2009.

Country	% of total	Government bonds, €bn	Total, €bn
France	32	34	52
Germany	19	20	31
Netherlands	5	5	8
Rest of euro area	16	17	26
Total euro area	72	76	117
Britain	6	7	10
US	7	8	12
Rest of world	15	16	25
Total	**100**	**106**	**164**

Fig. 2. Foreign bank holdings of Greek assets, Q4 2009

Sources: Bank for International Settlements; Bank of Greece; The Economist

The crisis situation was further exacerbated by a series of ratings downgrades from rating agencies. The Economist (2010) points out, Standard and Poor's (S&P) downgraded Greek debt to BB+, followed by a downgrade of Portugal and then Spain to A- and AA respectively. Hence, there was a spill over of the Greece debt problem to other Eurozone countries, with the peripheral countries being most affected. The yield spreads of Portugal and Spain in particular also started to rise amidst growing concerns about the state of the periphery along with the rating downgrades. With these countries tied to a single currency along with sluggish economic prospects, their plight became more burdensome as a somewhat offsetting mechanism like currency devaluation was no longer an available measure under the euro regime.

With Greece having no hope of meeting debt payment deadlines, other remedies had to be sought. Other peripheral countries were also in dire need of funding to bailout their ailing banks. In order to curb the crisis situation, bailouts were arranged initially for Greece, followed by Ireland and Portugal (Lane, 2010). The magnitude of the situation is captured by the joint bailout programmes put together by the European Union (EU) and International Monetary Fund (IMF). Greece was bailed out through the joint programme on March 2010, Ireland on November 2011 and Portugal on May 2011 (Van Rixtel and Gasperini, 2013). Greece however required further assistance and a second bailout was arranged in March 2012. As Lane (2010) points out, this second bailout came with certain provisions with adverse effects on lenders by way of huge haircuts on Greek sovereign debt held; hence lenders were made to accept a reduction of about 50% of the original amount of debt that was due them from their holdings of Greek debt in order to prevent a default on payment by Greece.

With on-going measures to fully arrest the sovereign debt crisis, or the Greek debt crisis as it is sometimes known, the situation is likely to see a prolonged manifestation in the coming years as attempts are made to cure the ailing countries and their financial systems from the impact.

2.2 INTERCONNECTION BETWEEN THE SOVEREIGN DEBT CRISIS AND THE BANKING CRISIS

The banking crisis of the euro area is said to have started before the European Sovereign debt crisis, with the debt crisis leading to an intensification of the banking crisis.

According to Van Rixtel and Gasperini (2013), a banking crisis often occurs as a result of a decline in economic asset values. They refer to the case of the 2007-2009 financial crises, where banks built large exposures to mortgage assets which plunged in value and affected the financial strength of those banks. In line the above assertion, the banking crisis in Europe began to emerge during the global financial crisis, after the bailout of Bear Stearns (Mody and Sandri, 2012).

In addition to the exposures to US mortgage assets, there was an observed trend as Caruana and van Rixtel (2012) point out, where preceding the global financial crisis as well as the sovereign debt crisis, banks had eased on raising funds through deposits and increasingly depended on the global financial markets for funding with the US being an important source of funding. Additionally, during the 2007-2009 financial crisis, most money market funds transferred their investments from US

banks to European banks, increasing their share of investments in the euro area. This could be attributed to the relative safe haven the euro area provided at the time. Hence, Europe was enjoying a healthy patronage from money market investors as well as hedge funds from the US.

What this resulted into was that in light of the financial crisis and the sovereign debt crisis, euro area banks started scrambling for more stable sources of funds which they had focused less on because of the US markets they easily accessed prior to the two crises.

In light of the above developments, some researchers are of the view that there was a strong link between the global financial crisis and the banking problems that followed in Europe. In line with this, Van Rixtel and Gasperini (2013) establish the fact that the global financial crisis and banking funding are interconnected by reason that the financial crises affected the quality of assets on the balance sheets of banks, which led to massive selloffs of these bad assets and a worsening of the balance sheet positions of these banks as asset prices plunged during selloff. They also mention that this deterioration in the liquidity position of banks led them to increase their debt exposures as a means of funding and hence into more risky business areas. This situation further worsened the quality of their assets and eventually led to a limited access of banks to funding markets.

When the sovereign tensions began, euro area banks underwent the major phase of a banking crisis. In the words of Van Rixtel and Gasperini (2013), "... Sovereign tensions morphed into a banking crisis". Although most European banks were affected by the Global financial crisis (with some banks in countries like Ireland severely affected), the sovereign debt crisis that emerged afterwards further worsened the financial health of banks extensively. Caruana and van Rixtel (2012) point out that the sovereign tensions that emerged came at a time when banks were recovering from the global crisis and trying to purge their balance sheets from the bad assets that they had acquired from its aftermath. With most banks holding large amounts of sovereign debt on their balance sheets, banks mainly in peripheral countries, suffered severely as a result of the rise in sovereign spreads. The nature of holdings were such that most euro area banks held the sovereign debt of other euro area countries, with banks in countries like Germany heavily exposed to debt from the peripheral countries. Figure 3 below from Bolton and Jeanne (2011) shows the proportions of sovereign debt held by both local and foreign banks, with over 50% of Spanish sovereign debt held by banks. Domestic banks in Spain, Germany and Greece were the most exposed to sovereign debt, with domestic banks holding around 42%, 34% and 19% of sovereign debt in these countries respectively.

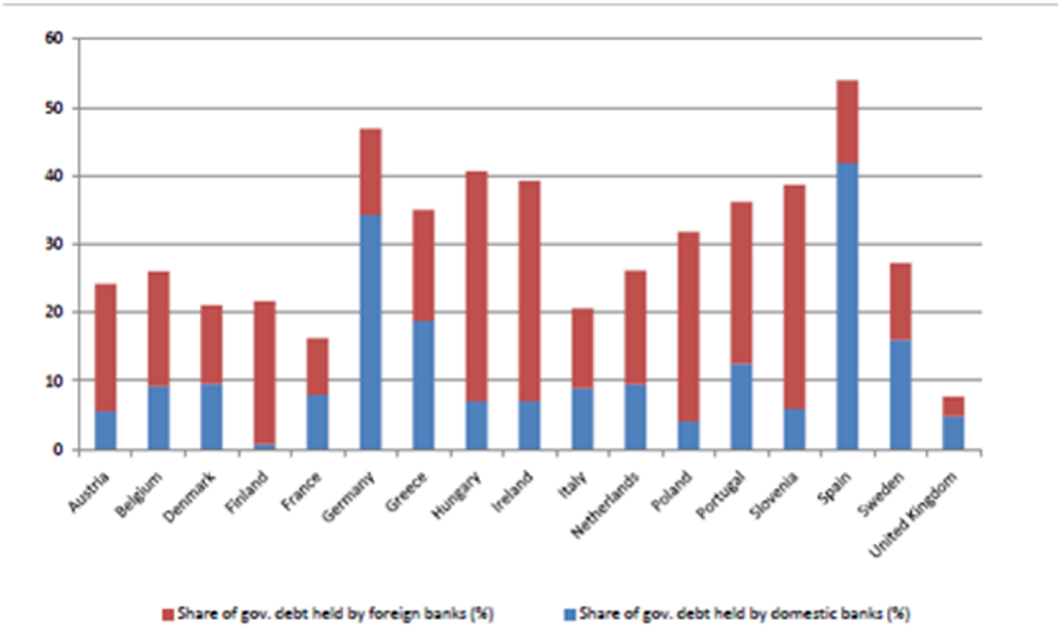

Fig. 3. Proportion of Sovereign Debt held by Domestic and Foreign Banks

Source: Bolton and Jeanne (2011)

With perspective on how exposed banks in the euro area were to sovereign debt, there were a number of ways or channels through which the sovereign debt crisis affected the health of banks:

- First of all, the rise in sovereign spreads—a sign of rising sovereign credit risk—reduced the value of debt and hence directly affected the health of banks' balance sheets through a reduced value of sovereign debt held by these banks as assets. Panetta et al (2011) point to the fact that the amount of damage sustained by banks through holding sovereign debt depended on the accounting treatment used by banks to record such holdings: whether investments in sovereign assets are recorded as held at market value or at amortised cost on their balance sheet. The paper notes that in the case of holding debt at market value, any changes in the value of sovereign debt directly reflect on the income statements of such banks and hence directly affect their profit positions. Additionally, due to looming defaults on some sovereign debt, agreements had to be reached with creditors to accept haircuts to their debt holdings; this was the case for Greek debt. The banks holding Greek debt hence likely lost substantial values of their investments, considering that haircuts were about 50% of the value of debt.
- As part of their lending activities, most banks have to put up collateral for repo transactions, lending from Central bank and other secured forms of borrowing. An important composition of bank collateral for lending is sovereign debt, due to its relatively credit risk-free status—at least prior to the sovereign debt crisis, which rendered some sovereign debt like that of Greece highly risky. During the height of the debt crisis, the falling values of sovereign debt effectively made it difficult for banks to obtain funding as a result of the shrinking value and pool of bank collateral (Van Rixtel and Gasperini, 2013). The crisis also made sovereign debt use as collateral difficult due to its falling eligibility for use in funding transactions (Panetta et al, 2011).
- Another channel through which banks are affected by sovereign debt is through sovereign downgrades. Panetta et al (2011) argue that sovereign ratings serve as a cap for the ratings of banks due to the strong link between sovereigns and banks. Hence, what that means is that banks are limited as to the ratings they can attract on their debt issues and their ratings depend much on the ratings of the sovereign in which they are located. A complexity arises in this situation as a result of possible spillovers between parent and subsidiary banks in different countries, with a likely adverse effect on a subsidiary's ratings arising from the ratings of the sovereign in which its parent bank is based.
- Additionally, as pointed out by ECB (2012), with the sovereign debt crisis and reducing sovereign credibility followed a decline in the value of government guarantees. These guarantees were of potentially great importance to banks in obtaining funding, considering that governments were able and more credit-worthy and hence guarantees were weighty in circumstances where banks had to issue securities. The crisis however has diminished the credit position of many sovereigns and the value of their guarantees, mainly in peripheral countries.
- A final transmission channel worth mentioning is the case where the debt crisis affected household wealth and firm profits. Lane (2010) points out in relation to the efforts to curb the European debt crisis through fiscal consolidation, that those measures could further weaken the banking system through reducing household disposable incomes and private sector profits, hence making default on bank lending more likely.

  Apart from the effects holding sovereign debt had on bank health, the sovereign debt crisis affected the banking system through other ways.

  Van Rixtel and Gasperini (2013) mention the fact that these sovereign tensions were followed by a rise in interbank funding costs, both in euro and other currencies, hence limiting the funding sources available to banks.

  Additionally, US money market funds which supplied huge amounts of funding to the euro area banks began to withdraw their investments from the euro area banks as the sovereign tensions soared. As these money market funds were an important provider of dollars to the euro area, European banks especially the peripheral countries suffered from limited supply of dollars in the region.

  The effects of the debt crisis were actually quite pervasive; the sovereign crisis not only affected euro zone countries, but stock prices of banks in the UK and US fell along with stock price declines in the euro zone banks (Van Rixtel and Gasperini, 2013).

2.3 CHANGES IN FUNDING SOURCES OF BANKS AS A RESULT OF THE DEBT CRISIS

The Sovereign debt crisis saw banks in both core and peripheral countries experience difficulties in accessing funding from a number of sources. The main sources of funding for banks include customer deposits; long-term debt such as debentures;

short-term funding from interbank markets and money markets; raising equity from shareholders and potential shareholders; and funding from Central Banks which are normally lenders of last resort.

The sovereign debt crisis led to structural changes in funding choices by banks as certain funding sources were more difficult to access and other means of funding had to be sought. The following main changes in bank funding occurred during the euro area crisis period:

- ***Deposit funding***: The crisis period saw banks increasingly move towards more stable sources of funding, prime of which was funding from deposits. Within the euro area however, Van Rixtel and Gasperini (2013) record that there was a gradual movement of deposit funding from some peripheral countries like Greece to core countries like Germany and France which were more of a safe haven for funds; peripheral countries, in order to attract some deposits, had to offer much higher deposit rates than what was being offered by core countries. This points to the selective provision of funding provision based on country, where euro zone countries considered more stable and less affected by the sovereign crisis had more funding opportunities open to them, whilst those countries, precisely the peripheral countries, most hit by the crisis suffered limitations to accessing funding markets.
- ***Short-term wholesale funding***: Van Rixtel and Gasperini (2013) define this to include secured and unsecured borrowing from money markets as well as other short-term borrowing like commercial paper. They point out that the debt crisis led to limitations in raising unsecured debt, leading to a greater dependence on interbank borrowing. The situation might be attributed to uncertainties in the short-term funding markets about the intensity of the crisis situation and how it would affect bank balance sheets and their ability to pay off their obligations. The authors also point out the fact that interbank lending in the form of repo financing saw a lot of scrutiny regarding the form of collateral provided and the choice of counterparties. This arose as the value of sovereign debt, which before was an eligible form of collateral, experienced falls especially in the case of peripheral countries, with debts of the likes of Greece undergoing cuts to prevent a default. Hence, banks in most peripheral countries were unable to obtain secured funding as a result of the deterioration in the value of their collateral.

  Additionally, US money markets, which were important providers of short-term funding, reduced their investments drastically during the crisis and moved to other foreign countries as a drive to safety. Even the core countries experienced reductions in money market investments, a case in point being France, which saw a cut in US money market funding due to the heavy exposure of its banks to the sovereign debt of peripheral countries (Van Rixtel and Gasperini, 2013).
- ***Long-term wholesale funding***: The euro area debt crisis had a severe impact on access to long-term funding, with some peripheral countries almost entirely cut out of these funding markets. National segmentation was again prominent in this case where selective access was available only to some countries mainly the core European countries.

  Van Rixtel and Gasperini (2013) reiterate the fact that only some peripheral countries were able to access these markets mainly Italy and Spain, albeit a very limited access; the others were literally shut out of the long-term debt market. Core countries were not without difficulty in accessing funding, as spillovers from peripheral countries made it difficult for them as well.

  Covered bond issuance (a secured form of issuance) and other forms of secured funding increased generally in the euro region as other means of funding, which meant that more assets were tied as collateral in this form of issuance. ECB (2012) lends further credence to the point by emphasizing that secured lending led to an over-collaterised position for the banks, further shrinking the availability of unsecured funding as most assets of banks were tied in secured funding transactions.

  Government-guaranteed issuance also increased momentarily as they were reintroduced with programmes in Spain and Italy in the second quarter of 2012, an indication that government guarantees still had some value during the euro area crisis period (Van Rixtel and Gasperini, 2013).

  Retained issuance, where banks retained securities instead of issuing them, was also a major activity for banks in peripheral countries as they had limited markets to sell bonds to; German, French and Dutch banks still had a market for their bond issues though. Retained issuance mainly involved covered bonds and government-guaranteed bonds, and was an important form of collateral in obtaining funding from the ECB—the ECB being lenient in its defining qualifying collateral (Caruana and van Rixtel, 2012).
- ***ECB Liquidity Provision***: With ever-rising tensions in the funding markets, most peripheral countries resorted to the ECB for funding. The ECB's full-allotment policy made it possible for banks to access ECB lending in place of interbank funds amidst the tensions, especially in 2011 when the crisis situation worsened (ECB, 2012). The critical nature of the sovereign debt crisis led to the ECB undertaking various assistance programmes. As a result, the ECB made various liquidity

provisions to salvage the situation and curb the damage sustained by banks on their balance sheets. These provisions include the Long-Term Refinancing Operations and Main Refinancing Operations, through which the ECB provided liquidity to struggling banks. European central banks also provided emergency finance under the Emergency Liquidity Assistance Programme.

- ***Bank Capital***: As a result of the weakening access to funding sources and the deteriorating value of sovereign debt assets, banks in the euro area made frantic efforts to deleverage by raising equity capital. Van Rixtel and Gasperini (2013) make mention of the fact that banks' ratio of capital plus reserves to total assets did not change much in pre-crisis period, but started increasing at the end of 2008 as a move to more stable funding; they record that there were increases in equity issues, with an issue amount of EUR 88 billion in September 2012.

  ECB (2012) also lends corroborating evidence of the fact that the capital plus reserves to assets ratio was on the incline, driven mainly by the fact that capital growth exceeded the growth in assets. The deleveraging efforts were believed to be driven mainly by the need to increase safety capital levels in response to the funding difficulties in the markets as well as in anticipation of the new provisions the Basel III framework may bring along in response to the global and sovereign debt crises (Van Rixtel and Gasperini, 2013).

2.4 DETERMINANTS OF BANK CAPITAL STRUCTURE/ FUNDING CHOICES

Banks as businesses make decisions about various aspects of operation, an important part of which is how operations are funded. From classical corporate finance literature, Modiglianni and Miller (1958) proposed a theory of capital structure which put forward the view that the method of financing used by a firm, whether through equity or debt, does not matter. Their first proposition, as it was referred to, stated that the market value of a firm does not depend on its capital structure. In the ideal world however, there may be various relative benefits to financing from one method over another, hence the first Modigliani and Miller proposition does not hold in real life situations.

Other capital structure theories therefore emerged to explain capital structure with more realistic assumptions in mind. Two famous theories emerged. Fama and French (2005) describe the trade-off theory as follows:

> "*In the trade-off model, firms identify optimal leverage by weighing the costs and benefits of an additional dollar of debt. The benefits of debt include, for example, the tax deductibility of interest and the reduction of free-cash-flow agency problems. The costs of debt include potential bankruptcy costs and agency conflicts between stockholders and bondholders. At the leverage optimum, the benefit of the last dollar of debt just offsets the cost*."

Myers (1984) argues in favour of an alternate theory: the pecking order theory. According to the pecking order theory, internal financing is preferable to debt financing—with safe debt preferred to risky debt—which is also preferable to equity financing; the idea being that information asymmetry increases the cost of raising finance. Hence under this theory, equity is most expensive because of management hold superior information about the company creating a larger information asymmetry problem (Fama and French, 2005).

Despite the many theories that have been developed to explain firm capital structure, a lot is still yet to be understood about it. Myers (1984) makes this clear when he openly states in his paper the fact that very little is known about how firms choose between equity, debt and hybrid securities. With this in mind, many researchers have undertaken practical work using econometric techniques to understand how capital structure interacts with various bank-specific as well as external macroeconomic factors, in an attempt to gain further insight into firm choices between self-funding and funding from outside sources.

The case of banks is quite unique as are heavily regulated in relation to their capital management practices. Capital regulations require banks to hold a certain minimum amount of capital and reserves in order to meet capital adequacy requirements; hence there is some regulatory input into the capital decisions of banks to start with. We explore a number of factors that drive capital structure decisions of banks.

2.4.1 CAPITAL REGULATION

Despite the fact that capital regulation is not a focal point of study of this research, it is worth mentioning its role in banks' capital structure decisions, a role which was quite emphasized after the global financial crisis. Capital regulation has to do with setting minimum capital requirements for banks in an attempt to ensure the safety and health of capital. In light of the recent crises both in the United States and the on-going sovereign debt crisis, there have been a series of modifications

made to capital regulation to safeguard against the devastating effect that the past and on-going crises have had on bank health.

The global financial crisis was an eye-opener for regulators who came to the realisation of the insufficiency of previous Basel provisions to deal with crises situations. As Demirgüç-Kunt et al (2010) note, the US financial crisis revealed the inadequacies of capital regulation pointing to the fact that most of the banks in the crisis period were within capital regulation requirements, but still needed bailouts.

In September 2010, the Basel Committee agreed on new reforms to the capital regulations banks were required to meet. The Basel III was a response to the need for a more robust capital and liquidity base of banks in order to better handle economic and financial stress. It hence has a number of more stringent provisions that attempt to improve on the requirements set out in the previous agreement.

Härle et al (2010) point out that fact that the Basel III framework focuses on improving two main weaknesses in the banking system that came to light during the global financial crisis: improving on the quality of capital and making provisions for liquidity and funding management.

In relation to the main capital requirements, the figure below outlines the capital provisions under Basel III.

Calibration of the Capital Framework

Capital requirements and buffers (all numbers in percent)

	Common Equity Tier 1	Tier 1 Capital	Total Capital
Minimum	4.5	6.0	8.0
Conservation buffer	2.5		
Minimum plus conservation buffer	7.0	8.5	10.5
Countercyclical buffer range*	0 – 2.5		

Fig. 4. Basel III Capital Requirements

Source: Bank for International Settlements

As can be seen from the table, there has been an increase in the amount of equity capital banks are required to hold to 4.5%, more than twice the previous provisions of 2%. The minimum total capital of 8% remains the same as in previous Basel provisions. One of the main changes though is the introduction of the capital buffer of 2.5%, which effectively increases the total capital requirement to 10.5%. There is also the new countercyclical buffer, which is expected to be a means for banks to build up additional capital buffer in times of excess credit growth (Basel Committee, 2010). The Basel III provisions therefore provide for a more robust capital base for banks against risk.

The provisions made under liquidity and funding, as described by Härle et al (2010b), are made up of two indicators:

- The liquidity coverage ratio (LCR) which is supposed to prevent banks from suffering from shortages of short-term funds; and
- The net stable funding ratio (NSFR) supposed to set out requirements in terms of long-term funding by banks. The purpose of the NSFR is to mitigate against refinancing risk by providing for amounts of long-term funds banks must raise; these funds must be equivalent to the value of their long-term assets.

Other provisions made by the committee, as outlined in The Economist (2010b), include another 1.5% of capital in addition to the mentioned equity requirements; this component of capital is not expected to be of the same quality as equity. The authors also mention a total leverage provision, which is to ensure that equity value is at least 3% of total assets.

Despite the fact that the capital and liquidity requirements of Basel III are quite robust, they are also quite substantial to satisfy and the lengthy implementation period of up to 2019 for certain provisions does not make it any less daunting a task. The statistics estimated by Härle et al (2010b), though higher than other authors' estimates, emphasize the point of how high a shortfall banks may have to meet: capital provisions in Basel III are expected to leave banks with the need to raise an additional €700 billion, which would amount to a shortfall of about 40% of the core Tier 1 capital of the banking system; the funding and liquidity provisions would additionally require banks to raise between €3.5 trillion and €5.5 trillion in long-term funding, and a further €2 trillion in liquid assets.

There has also been a fair amount of concern about certain tools being considered by regulators as part of the means to curb risk contagion in the banking system. An interesting one worth mentioning is the concept of bail-in. As Pengelly (2012) explains, a bail-in is supposed to be an arrangement where bank creditors bear part of the damage of bank losses. Hence, in addition to equity holders taking losses, bondholders will be next in line to shoulder losses from banks by having an appropriate amount of their bond holdings converted to equity in order to cover such losses. Despite the fact that certain regulators—such as the Financial Stability Board—deem the concept worthy of implementation, the author expresses concern for the defeating purpose it may have on banks: with banks expected under the NSFR to raise extra long-term funds, the bail-in concept would push potential lenders away, who would not want to shoulder such responsibilities for bank losses. The bail-in idea, if implemented could also shoot long-term spreads very high to compensate for the high risks involved for bondholders.

In response to the implementation of Basel III, most banks started putting in place measures to meet its requirements, which led to a steady increase in capital and reserves by the banking system. The figure below shows the increase in capital and reserves by Monetary Financial Institutions (MFI) in the European Union, of which banks make up the majority.

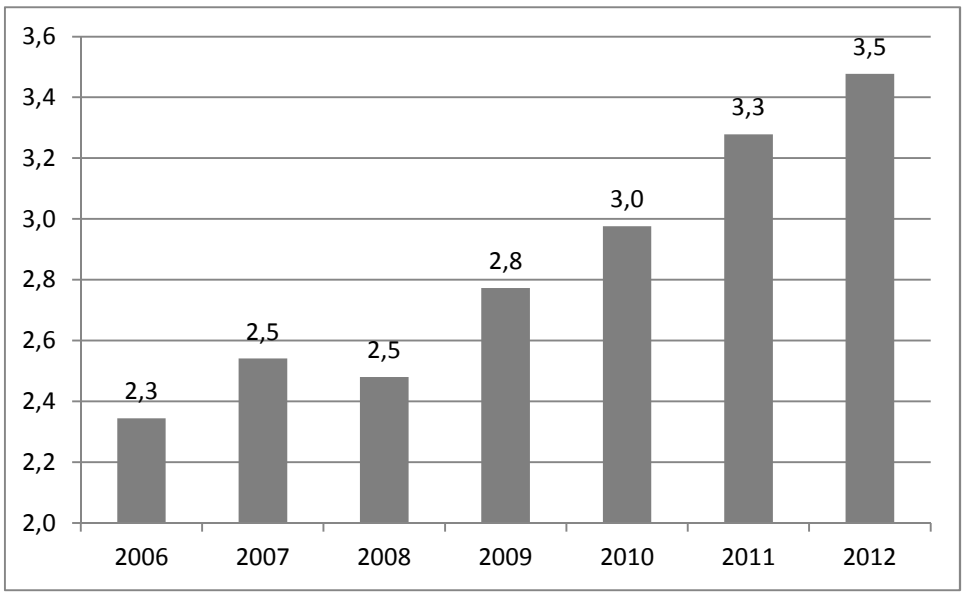

Fig. 5. MFI capital & reserves in EU (€ trln)

Source: ECB

As figure shows, a significant increase in capital is seen in the year preceding the Basel III agreement, most likely in preparation for the more stringent capital requirements that was being expected, and rightly so. It is hoped that the new provisions will somewhat contribute to ensuring a banking system that is more robust to market risks.

2.4.2 BANK-SPECIFIC AND MACROECONOMIC DETERMINANTS OF CAPITAL STRUCTURE

Gropp and Heider (2010) believe based on their research that in relation to variables affecting leverage, capital regulation is only of second-order importance in explaining leverage dynamics; this therefore provides a background for exploring the more relevant factors that are related to bank capital structure.

A considerable amount of research has been done in the corporate finance literature on the effects bank-specific characteristics have on leverage. A number of researchers find that most variables that are related to the leverage of non-financial firms are also able to explain the dynamics in the leverage of banks; the paper by Gropp and Heider (2010) provides evidence to buttress that there may be similarities between the capital structure of banks and non-financial firms. Amongst the variables found relevant to explaining capital structure of banks, Gropp and Heider (2010) make use of size, collateral, profits, market-to-book ratio and dividends; they find all these variables significant to leverage for their period of study. Another paper of reference, Giordana and Schumacher (2012): they model leverage of Luxemburgish banks with variables including loans-to-deposits ratio, the liquid-assets-to-assets ratio and the off-balance-to-assets ratio. Evidence from these papers indicates that bank-specific variables under normally circumstances hold high significance to explaining leverage movements.

Macroeconomic factors tend to affect leverage in many ways. Conditions in the funding Market, which are determined to a large extent by the macroeconomic environment, are also important in affecting the capital structure of banks. As mentioned earlier, during the debt crisis, most banks especially in the peripheral countries were shut out of debt markets, causing a shift to other sources of funding. It cannot be overemphasized how important macroeconomic factors are to explaining capital structure changes; as Brewer et al (2008) point out, recession situations could lead to increases in bad loans due to more defaults, and hence more losses which reduce bank profitability.

Some macroeconomic factors found in Gropp and Heider (2010) as well as in Giordana and Schumacher (2012) to be relevant to explaining leverage behaviour include GDP growth, the spread of the EURIBOR rate over the overnight 'risk free' swap rate and the term structure of interest rates.

3 METHODOLOGY

3.1 INTRODUCTION

We intend to go about conducting the data analysis part of the research which will include a discussion on the type of data we make use of, the data collection techniques used, the methods used for the analysis as well as any limitations of the study. What Intend to explore by way of hypothesis is whether bank-specific variables became less relevant during the sovereign debt crisis compared to the significance of the macro-economic factors, as we believe should be the case.

3.2 RESEARCH DESIGN

We make use of a quantitative approach to analysis. The period of time under study for this research is the period from 2005 to 2012, which is broken down into a pre-sovereign debt crisis period (2005-2008) and the period during the crisis (2009-2012). The data consists of panel data on 1521 banks from 7 countries, namely Germany, France, Italy, Spain, Ireland, Portugal and Greece. Our use of panel data has many advantages over a conventional cross sectional data approach, as panel data captures time varying information in the variables of interest. Panel data also makes it possible to model how data for each observation changes from one period to another. It therefore tends to be more informative especially in our case where we study the significance of variables from one period to another, and make use of 8 years of data.

For the purposes of exploring the effects of the sovereign debt crisis on capital structure, we make use of a number of variables which drive leverage with the hope to study their dynamics on leverage before and during the debt crisis era. Our main variables of choice include: Bank-specific variables that capture bank characteristics like size, profitability, collateral availability and off-balance sheet items; and Macroeconomic variables which include GDP Growth, the yield curve spread and the EURIBOR-OIS spread.

Choice of variables is informed by previous research literature which has found these variables significant in various levels to explaining changes in capital structure. Our main papers of reference that are informative to my choice of variables are Giordana and Schumacher (2012) as well as Gropp and Heider (2010). Although these papers make use of more variables than we have specified above for our study, we find some of the other variables econometrically insignificant for our study—based on t-statistics. We do not expect our selection of variables to be a problem as they are the variables that hold the most significance from the aforementioned papers; hence we do not expect the variables we fail to capture as controls to pose too much of an endogeneity problem, albeit not to ignore its existence.

3.3 SOURCE OF DATA AND DATA COLLECTION TECHNIQUE

Much of our data is gathered from the Bankscope - Bureau van Dijk database, which is a well-known source of bank balance sheet data. We also make use of GDP data from the World Bank database, yield curve data from the macro-economic database (AMECO) of the European Commission and the EURIBOR-OIS rate from the EURIBOR website (http://www.euribor-rates.eu). In relation to data collection, we do not make use of any screening techniques in particular; we simply make use of banks for which we have the data we need, available. In this sense, data in terms of sampling is not entirely random as we have excluded banks for which data to calculate certain key model variables is woefully unavailable.

3.4 TECHNIQUE OF ANALYSIS

There are a number of techniques available to estimate panel data. Wooldridge (2012) identifies some of the main tools, namely random effects estimation, fixed effects estimation as well as the correlated random effects approach. We will be making use of a fixed effects method for panel data analysis for a simple reason: for the purposes of this research, this method eliminates any time-invariant bank and country effects on leverage, hence dealing to some extent with endogeneity in the model. This elimination of time-invariant variables hence helps us to focus on variables of interest in the model, without having to worry about how much of leverage is explained by unobserved time invariant variables in the model. Another well-known method which is gaining a lot of use recently is the generalized method of moments. Most studies that are done with panel data in this area favour the use of System GMM method of estimation rather than the fixed effects model, with Giordana and Schumacher (2012) asserting as the System GMM method is supposed to give more reliable estimates by way of dealing more effectively with endogeneity, heteroskedasticity and serial correlation. For the purposes of our study however, we make use of the fixed effects method as we find that for our purposes, the fixed effects model is more pliable. Additionally, due to the complexity of finding a suitable moment condition as a starting point for the System GMM method, we find the fixed effects method more suitable overall.

In order to deal with any issues of heteroskedasticity and serial correlation in the fixed effects model, we employ Stata's clustered robust standard error correction, which takes care of the aforementioned problems. The issue of endogeneity is also partially dealt with by the fixed effects model, as it irons out specifically any unobserved time-invariant affects in the data through differencing.

4 DATA ANALYSIS AND FINDINGS

4.1 DESCRIPTION OF DATA AND MODEL

Our dependent variable, leverage, is defined as total assets-to-equity. The control variables are made up of bank-specific variables as well as macroeconomic variables: loan-to-deposits, the log of profitability, the log of size, off-balance sheet items-to-assets, collateral-to-assets, EURIBOR-OIS spread, GDP growth and the yield curve spread. All the explanatory variables are lagged by one year, with the exception of GDP growth which is lagged by two years. A brief description of variables follows, with additional definitions provided in the appendix.

The loans-to-deposits ratio is composed of bank loans issued to customer deposits. Changes in this ratio indicate a banks source of funding; whether it is being funded increasingly by customer deposits or by other sources of funding, say by either debt or equity other than deposits (Giordana and Schumacher, 2012).

Profitability is one very important variable in determining capital structure, the reason being that the more profitable a bank, the more reserves and hence self-funding it is able to provide; an increase in bank profitability will therefore in this case lower leverage. Additionally, a profitable bank is more likely to be considered by the capital markets for long-term borrowing than a less-profitable bank, although profitability is not the main consideration in testing a bank's creditworthiness. Most research findings validate the former argument, that profitability is negatively correlated with leverage.

Size is probably the most significant driver of leverage, with the larger and more established banks being more able to increase their leverage due to the fact that they are well known and have significant assets. On the other hand, it is possible that the larger banks may also have more capital and reserves, and hence be in a better position to fund their activities internally, hence resulting in relatively lower leverage. We would expect in general though that size will be positively correlated with leverage, as found by Gropp and Heider (2010).

Off-balance sheet items give information on the number of future commitments banks may need to meet in future, depending on a uncertain events yet to occur; these future commitments go to contribute to leverage in future as they materialize and make their way onto the balance sheet of banks. Hence holding all else constant, a high amount of off-balance sheet items reported in footnotes is a signal to the high probability of an increase in leverage in future.

Collateral is normally needed by banks in securing debt; it therefore normally has a positive contribution to the leverage of banks as banks with more collateral are more likely to be considered if they want to fund their activities through borrowing. The availability of assets that can be used as collateral however does not ensure lending by banks, since a number of other factors may be considered before lending decisions are made.

The EURIBOR_OIS spread is the main indicator of risk in the interbank market, with higher spreads indicating more risk in lending activity. As a risk indicator, the higher these spreads, the more uncertain markets become in regards to lending and hence, the more restrained borrowing activity becomes.

The yield curve spread is the difference between the yields on long-term (including sovereign debt) and short-term instruments. Higher spreads indicate that markets attach a higher premium to lending for longer periods as a compensation for higher credit risks in times of higher market uncertainty. This spread hence directly affects banks' ability to borrow long-term. We use it as a proxy of the riskiness the markets perceive in long-term sovereign debt in relation to short-term instruments.

The last variable, GDP growth, is a well-known economic variable used here to indicate general economic growth; better economic conditions as indicated by higher GDP growth trickle down to market growth and hence more leverage buildup.

As mentioned earlier, the bank-specific and macroeconomic variables used have been found relevant in a number empirical studies in corporate finance as well as some studies on determinants of leverage in European banks. In relation to the macroeconomic variables, Giordana and Schumacher (2012) do find evidence of the procyclicality of leverage, with their evidence gathered from Luxemburgish banks; this should mean that leverage should increase in good times and fall in situations like the sovereign debt crisis, and we expect macroeconomic variables of choice to hold key insights into these dynamics of leverage.

4.2 SPECIFYING THE ECONOMETRIC MODEL

We shall proceed with carrying out a number of regressions. Our first regression comprises leverage on the relevant variables and a time dummy variable. Hence model takes the following form:

$$\textbf{Leverage}_{it} = \alpha + \beta X_{it-1} + \gamma d_t + u_i + e_{it-1}$$

Where X_{it-1} comprises the explanatory variables; d_t is the time dummy, which takes on the value one for the crisis period, and zero otherwise; The variable 'u_i' captures the unobservable time-invariant fixed effects (at both the bank level and country level) we eliminate from the model using a fixed effects transformation; and e_{it-1} is the time-variant error term. My second regression is specified as:

$$\textbf{Leverage}_{it} = \alpha + \beta X_{it-1} + \gamma d_t + \delta d_t X_{it-1} + u_i + e_{it-1}$$

The addition here is $d_t X_{it-1,}$ a set of interactions of the time dummy variable with relevant explanatory variables to determine how those variables changed between the periods under study.

4.3 FINDINGS

With the predicted effects of the various variables in mind as well as the hypothesis of finding that the relevant macroeconomic variables should be more significant than the bank-specific variables, the results show the following trends.

The first regression of the log of leverage on the relevant bank-specific as well as macroeconomic variables reveals that the loans-to-deposits ratio, the collateral-to-assets ratio, profitability, the Euribos_OIS spread and the yield curve spread have a negative effect on leverage whilst the log of size, off balance sheet-to-assets ratio, GDP growth have a positive effect on leverage. This is shown in Table 1 in the appendix.

The most significant bank-specific variable explaining leverage dynamics is bank size as measured by the log of assets. The results indicate that for a 10% increase in size, firms increase leverage by 3.4% controlling for the known variables in the model and fixed effects. Profitability is also very significant to leverage, with a 0.5% fall in leverage for a 10% increase in profits. The macroeconomic variables are all significant at a 1% level. The only variable with little significance is the collateral-

to-assets ratio, which is significant only between 10%-15%. The signs on all variables are also as expected except for the collateral-to-assets ratio, which is the only less significant variable here as well; collateral availability should normally affect leverage positively. We will examine the sign on the collateral variable later.

We also include a time dummy variable to determine how leverage changed between the two periods involved in the study. Also very significant, it shows that leverage fell about 11.4% (exp(-.121148) – 1) from the pre-crisis period to the period of the sovereign crisis period.

4.3.1 COMPARISON BETWEEN PERIOD BEFORE AND DURING THE SOVEREIGN DEBT CRISIS

We now proceed with examining the results of analyzing changes in variables between the pre and during crisis periods, as captured in the second regression equation.

Table 2 and 3 (in appendices) give results of the said regressions. Running a regression with all the macroeconomic variables drastically affects the coefficients of the other control variables in the regression model. Wooldridge (2012) points out the reason for such changes, asserting the issue of multicollinearity between the explanatory variables and the dummy-explanatory variable interaction. Hence, whilst we can draw inferences from the dummy-explanatory variable interactions, the coefficients on the control variables in the second regression are not estimated properly. We however run separate regressions for the dummy interactions with the relevant macroeconomic variables, in order to be able to better interpret the results.

Table 2 (in appendices) shows the results of running a regression with all controls and dummy interactions with bank-specific controls and another interaction for the EURIBOR_OIS spread; in Table 3 (in appendices), we replace the dummy on EURIBOR_OIS spread with a dummy on yield curve spread. In relation to the significance of variables, what we see in Table 2 (in appendices) compared to similar variables in Table 1 (in appendices) is that the time dummy is now insignificant; this arising from the introduction of the dummy interactions. Amongst the new variables introduced, all the dummy interactions with bank specific variables turn out insignificant, except for the interaction with the collateral variable. The dummy interacted with the collateral variable shows a significant negative slope in the crisis period, whilst the main collateral control variable becomes even more insignificant with the introduction of the interaction variable. As mentioned earlier, we expect generally that collateral should be positively related with leverage. This positive relationship is verified by ECB (2012) and other papers mentioned therein. A number of factors could account for this negative relationship with leverage during the period under study.

First of all, there was the global financial crisis, which pushed forward the need for banks to build more robust capital buffers to prevent bank insolvencies; then came the sovereign debt crisis to further buttress the need for a solid capital base for banks. During these two crises periods which were almost in succession of each other, markets were very turbulent and borrowing activities were tampered. In the euro area for instance, most banks experiences difficulties borrowing during the debt crisis and made frantic attempts to deleverage. Some of these could hence account for the negative relationship collateral had with leverage during the sovereign debt crisis period.

In relation to the dummy interation with EURIBOR_OIS spread, it can be seen that the relationship between the pre-crisis period and the crisis period strengthened, with the spread increasing by approximately 19% between periods. As an indicator of risk, this makes perfect economic sense as markets became increasingly turbulent during the crisis period.

A look at the dummy interaction with the yield curve spread in Result 3(in appendices) reveals a somewhat different picture: although the yield curve spread interaction term has an addition to the negative relation of yield curve spread to leverage, it is not significant. This means that the effect of the yield curve spread on leverage did not change much between the pre-crisis period and during the crisis period, albeit the spread as a whole reduced leverage. This goes to alter our expectations in relation to the yield curve spread in particular; having in mind that increasing spreads would reduce the value of sovereign debt holdings by banks, we expected a highly significant change in the spread during the crisis period compared to the base period. However, this result could be justified if short-term spreads rose with similar magnitude during the crisis period, in order to iron out a drastic increase in this spread measure.

5 CONCLUSION

This study attempts to provide evidence of the fact that the sovereign debt crisis made bank capital structure less reactive to bank-specific factors and characteristics, and macroeconomic factors became relatively more important in driving leverage decisions. Our periods of interest have been 2005-2009 and 2010-2012, in an attempt to capture how variables' interaction with leverage transitioned from the pre-debt crisis to the debt crisis period.

The effect of the sovereign debt crisis on the banking system has definitely been one that requires further research to continually monitor the linkages between sovereigns and banks, with the view to be able to arrest spill overs from sovereigns to banks.

As we have also established, the capital structure of banks become disentangled from bank-specific drivers and are driven by macroeconomic conditions in turbulent times as in the case of the sovereign debt crisis. This is not ideal as capital structure decisions by banks are normally made with long-term targets in mind, and hence crises situations disrupt the internal operations of banks and impede their drive towards their target mix of internal and external financing.

In line with the above, the sovereign debt crisis has also led to the realization of the need for a more robust banking system through providing for more capital cushion for banks. It is hoped that the reformed capital regulations under Basel III regime will assist banks to remain stable in crises situations like the on-going one.

REFERENCES

[1] Basel Committee. (2010). Basel III: A global regulatory framework for more resilient banks and banking systems. Basel Committee on Banking Supervision, Basel.

[2] Brewer Iii, E., Kaufman, G. G., & Wall, L. D. (2008). Bank capital ratios across countries: Why do they vary?. *Journal of Financial Services Research*, *34*(2-3), 177-201.

[3] Caruana, J., & Van Rixtel, A. (2012). International financial markets and bank funding in the euro area: dynamics and participants. *BIS Working Papers*

[4] Demirgüç-Kunt, A., Detragiache, E., & Merrouche, O. (2010). Bank capital: lessons from the financial crisis. *IMF Working Papers*, 1-35.

[5] European Central Bank (2012): Changes in bank financing patterns, April.

[6] Fama, E. F., & French, K. R. (2005). Financing decisions: who issues stock?.*Journal of Financial Economics*, *76*(3), 549-582.

[7] Gennaioli, N., Martin, A., & Rossi, S. (2012). Sovereign default, domestic banks, and financial institutions. *Domestic Banks, and Financial Institutions (March 15, 2012)*.

[8] Giordana, G., & Schumacher, I. (2012). What are the bank-specific and macroeconomic drivers of banks' leverage? Evidence from Luxembourg. *Empirical Economics*, 1-24.

[9] Gropp, R., & Heider, F. (2010). The Determinants of Bank Capital Structure.*Review of Finance*, *14*(4), 587-622.

[10] Härle, P., Lüders, E., Pepanides, T., Pfetsch, S., Poppensieker, T., & Stegemann, U. (2010). Basel III and European banking: Its impact, how banks might respond, and the challenges of implementation. *Online verfügbar unter http://www.mckinsey.com/clientservice/Financial_ Servicvices/Knowledge_Highlights/~/media/Reports/Financial_Services/Basel%20III%20and%20European% 20banking% 20FINAL. ashx, zuletzt geprüft am*,*24*, 2011.

[11] Härle, P., Heuser, M., Pfetsch, S., & Poppensieker, T. (2010). Basel III: What the draft proposals might mean for European banking. *Online verfügbar unter http://www.mckinsey.com/clientservice/Financial_ Servicvices/Knowledge_Highlights/~/media/Reports/Financial_Services/MoCIB 10_Basel3. ashx, zuletzt geprüft am*, *30*, 2011.

[12] Lane, P. R. (2012). The European sovereign debt crisis. *The Journal of Economic Perspectives*, *26*(3), 49-67.

[13] Modigliani, F., & Miller, M. H. (1958). The cost of capital, corporation finance and the theory of investment. *The American economic review*, *48*(3), 261-297.

[14] Mody, A., & Sandri, D. (2012). The eurozone crisis: how banks and sovereigns came to be joined at the hip. *Economic Policy*, *27*(70), 199-230.

[15] Myers, S. C. (1984). The capital structure puzzle. *The journal of finance*, *39*(3), 574-592.

[16] Noeth, B. J., & Sengupta, R. (2012). Global European banks and the financial crisis. *Federal Reserve Bank of St. Louis Review*, *94*(6), 457-79.

[17] Panetta, F., Correa, R., Davies, M., Di Cesare, A., Marques, J. M., Nadal de Simone, F., & Zaghini, A. (2011). The impact of sovereign credit risk on bank funding conditions. *CGFS Papers.*

[18] Pengelly, M. (2012). Funding-The funding squeeze. *Risk-London*, *25*(4), 40.

[19] Shambaugh, J. C. (2012). The Euro's Three Crises. *Brookings Papers on Economic Activity*.

[20] Sosa-Padilla, C. (2012). Sovereign defaults and banking crises. *Manuscript, University of Maryland. Available at http://www.sosapadilla.com/resources/sovdef_bankcrises.pdf last accessed*, *8*.

[21] The Economist, 29th April 2010: The cracks spread and widen, http://www.economist.com/node/16009119.

[22] The Economist, 13th September 2010. Basel III: Thicker cushions, when you're ready http://www.economist.com/blogs/newsbook/2010/09/basel_iii

[23] The Economist, 12th Nov 2011: A very short history of the crisis http://www.economist.com/node/21536871.

[24] Van Rixtel, A., & Gasperini, G. (2013). Financial crises and bank funding: recent experience in the euro area. *BIS Working Papers*

[25] Wooldridge, J. M. (2012). Introductory econometrics: a modern approach. *Cengage Learning*.

APPENDICES

Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Loglev	12183	2.712802	.595904	-.3221355	7.228635
loandeposits	12208	93.3676	89.07796	0	988.88
logprofit	11582	-5.359255	.9516662	-12.3	.6590991
sizelogass~s	12208	13.81693	1.679159	3.61092	21.3543
offbalshee~s	12208	.1347935	.7757048	-.0081	40.8264
collateral~s	12208	.2685811	.1630859	0	1
euriborois	12208	.4675	.3260766	.064	.953
gdpgrowth_l	12208	1.084959	2.702852	-5.49441	5.94338
yieldcurve	12208	1.117246	1.113481	-.65	14.36

Correlation Matrix

	Loglev	loande~s	logpro~t	sizelo~s	offbal~s	collat~s	euribo~s	gdpgro~l	yieldc~e
Loglev	1.0000								
loandeposits	-0.0262	1.0000							
logprofit	-0.5253	0.0482	1.0000						
sizelogass~s	0.3553	0.1595	-0.1726	1.0000					
offbalshee~s	-0.1713	-0.0438	0.0756	-0.0416	1.0000				
collateral~s	-0.0568	-0.2671	-0.0406	-0.0797	0.1187	1.0000			
euriborois	-0.0763	-0.0155	-0.0599	0.0394	0.0096	-0.0121	1.0000		
gdpgrowth_l	0.0351	-0.0030	-0.0544	0.0147	0.0038	-0.0470	0.3445	1.0000	
yieldcurve	-0.0471	0.0377	0.1198	0.0770	0.0053	0.0526	-0.3096	-0.5881	1.0000

Regression Results

Table 1

Dependent Variable	Log(Leverage)
loandeposits |	-.0001992 (.0000873)
logprofit |	-.0501531 (.0065572)
sizelogassets |	.3432565 (0 .0428908)
offbalsheet~s |	.0224515 (0.009072)
collaterala~s |	-.1112544 (0.0693832)
euriborois |	-.1627364 (0.0130548)
yieldcurve |	-.0251688 (0.0042129)
gdpgrowth_l |	.0037444 (0.0006008)
d_200912 |	-.121148 (0.0066514)
Constant |	-2.085179 (0.588514)
Number of observations	11569
R^2	0.1688

Result 1

```
Fixed-effects (within) regression               Number of obs      =     11569
Group variable: id                              Number of groups   =      1521

R-sq:  within  = 0.2638                         Obs per group: min =         1
       between = 0.1884                                        avg =       7.6
       overall = 0.1688                                        max =         8

                                                F(9,1520)          =     82.22
corr(u_i, Xb)  = -0.5631                        Prob > F           =    0.0000

                                    (Std. Err. adjusted for 1521 clusters in id)
```

Loglev	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
loandeposits	-.0001992	.0000873	-2.28	0.023	-.0003704	-.000028
logprofit	-.0501531	.0065572	-7.65	0.000	-.0630153	-.037291
sizelogassets	.3432565	.0428908	8.00	0.000	.2591252	.4273878
collateralass~s	-.1112544	.0693832	-1.60	0.109	-.2473514	.0248426
offbalsheetit~s	.0224515	.009072	2.47	0.013	.0046565	.0402465
euriborois	-.1627364	.0130548	-12.47	0.000	-.1883437	-.1371292
gdpgrowth_l	.0037444	.0006008	6.23	0.000	.0025659	.0049229
yieldcurve	-.0251688	.0042129	-5.97	0.000	-.0334325	-.016905
d_200912	-.121148	.0066514	-18.21	0.000	-.1341948	-.1081012
_cons	-2.085179	.588514	-3.54	0.000	-3.239565	-.9307937
sigma_u	.6034705					
sigma_e	.17356844					
rho	.92359675	(fraction of variance due to u_i)				

Table 2

Dependent Variable	Log(Leverage)
sizelogassets |	-0.0002326 (.0001089)
collateralass~s |	0.3433352 (0.0432897)
offbalsheetit~s |	-0.0200322 (0 .073011)
euriborois |	.0242716 (0.0080681)
gdpgrowth_l |	0.0064234 (0.0006326)
Logprofit |	-0.0405298 (0.0068333)
d_200912 |	0.1170594 (0.0743471)
d_loandeposits	.0000567 (0.0001038)
d_logprofit	-0.013336 (0.074548)
d_sizelogassets	-0.01131152 (0.0044088)
d_offbalsheet~s	-0.0045371 (0.0053285)
d_collaterala~s	-0.2054581 (0.0517604)
d_euriborois	-0.192775 (0.011985)
Constant	-2.086136 (0.5973527)
No. of Obs	11569
R^2	0.1686

Result 2

```
Fixed-effects (within) regression               Number of obs      =     11569
Group variable: id                              Number of groups   =      1521

R-sq:  within  = 0.2876                         Obs per group: min =         1
       between = 0.1863                                        avg =       7.6
       overall = 0.1686                                        max =         8

                                                F(15,1520)         =     78.54
corr(u_i, Xb)  = -0.5543                        Prob > F           =    0.0000

                                    (Std. Err. adjusted for 1521 clusters in id)
```

Loglev	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
loandeposits	-.0002326	.0001089	-2.14	0.033	-.0004463	-.000019
sizelogassets	.3433352	.0432897	7.93	0.000	.2584213	.4282491
collateralass~s	-.0200322	.073011	-0.27	0.784	-.1632451	.1231808
offbalsheetit~s	.0242716	.0080681	3.01	0.003	.0084458	.0400974
euriborois	-.1039051	.0130478	-7.96	0.000	-.1294987	-.0783114
gdpgrowth_l	.0064234	.0006326	10.15	0.000	.0051825	.0076643
yieldcurve	-.0165766	.0040239	-4.12	0.000	-.0244696	-.0086836
logprofit	-.0405289	.0068333	-5.93	0.000	-.0539326	-.0271253
d_200912	.1170594	.0743471	1.57	0.116	-.0287744	.2628931
d_loandeposits	.0000567	.0001038	0.55	0.585	-.000147	.0002604
d_logprofit	-.0133336	.0074549	-1.79	0.074	-.0279565	.0012893
d_sizelogassets	-.0113152	.0044088	-2.57	0.010	-.0199631	-.0026673
d_offbalsheet~s	-.0045371	.0053285	-0.85	0.395	-.0149891	.005915
d_collaterala~s	-.2054581	.0517604	-3.97	0.000	-.3069876	-.1039286
d_euriborois	-.1927751	.0111985	-17.21	0.000	-.2147414	-.1708089
_cons	-2.086136	.5973527	-3.49	0.000	-3.257859	-.9144135
sigma_u	.60026843					
sigma_e	.17078285					
rho	.92511526	(fraction of variance due to u_i)				

Result 3

```
Fixed-effects (within) regression               Number of obs      =     11569
Group variable: id                              Number of groups   =      1521

R-sq:  within  = 0.2722                         Obs per group: min =         1
       between = 0.1884                                        avg =       7.6
       overall = 0.1693                                        max =         8

                                                F(15,1520)         =     65.21
corr(u_i, Xb)  = -0.5617                        Prob > F           =    0.0000

                                    (Std. Err. adjusted for 1521 clusters in id)
```

Loglev	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
loandeposits	-.0002408	.0001094	-2.20	0.028	-.0004554	-.0000263
sizelogassets	.3479477	.0443425	7.85	0.000	.2609688	.4349267
collateralass~s	-.0220525	.0732133	-0.30	0.763	-.1656622	.1215572
offbalsheetit~s	.024517	.0080851	3.03	0.002	.0086579	.0403762
euriborois	-.1485744	.0097991	-15.16	0.000	-.1677957	-.1293532
gdpgrowth_l	.003327	.0005672	5.87	0.000	.0022144	.0044395
yieldcurve	-.0172991	.0048051	-3.60	0.000	-.0267245	-.0078737
logprofit	-.0443063	.0068734	-6.45	0.000	-.0577886	-.030824
d_200912	.0212872	.0763033	0.28	0.780	-.1283836	.1709581
d_loandeposits	.000071	.0001036	0.69	0.493	-.0001322	.0002742
d_logprofit	-.0124371	.0075229	-1.65	0.098	-.0271934	.0023193
d_sizelogassets	-.0118837	.004408	-2.70	0.007	-.0205301	-.0032374
d_offbalsheet~s	-.0062442	.0051426	-1.21	0.225	-.0163315	.0038431
d_collaterala~s	-.187955	.051557	-3.65	0.000	-.2890854	-.0868245
d_yieldcurve	-.0062512	.0062911	-0.99	0.321	-.0185914	.0060889
_cons	-2.149412	.6157049	-3.49	0.000	-3.357133	-.9416908
sigma_u	.60292745					
sigma_e	.17262308					
rho	.924238	(fraction of variance due to u_i)				

Definition of terms

Leverage= Total Assets / Equity

Loan to Deposits = Loans / Customer Deposits

Profitability = Profit before tax / Total Assets

Size = Natural Log of Total Assets

EURIBOR-OIS Spread = 12 month EURIBOR – **E**uro **O**ver**n**ight **I**ndex **A**verage (Eonia)

Yield curve spread = Nominal long-term interest rates on Government bonds - Nominal short-term interest rates on short-term government bills or interbank lending (Source AMECO).

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Effects of chronic cigarette and marijuana smoking on reproductive health

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ABSTRACT: The current study was aimed to analyze the ill effects of chronic cigarette, marijuana and marijuana plus cigarette smoking on the reproductive health of addicted men. The study was carried out in district Dir, Khyber Pakhtunkhwa (Pakistan). Four groups were made. These groups were control, cigarette smokers, marijuana smokers and marijuana plus cigarette smokers. Each group included 15 participants. Their age range was 30 to 40 years. A questionnaire was filled and blood samples were analyzed for serum total testosterone level by using Bio-check (USA) kit. A significantly reduced testosterone level was found in cigarette smokers (Mean ± SEM 5.933 ± 0.1801 ng/mL, P*** 0.0003), marijuana smokers (Mean ± SEM 3.7 ± 0.12 ng/mL, P**** < 0.0001) and marijuana plus cigarette smokers (Mean ± SEM 3.2 ± 0.15 ng/mL, P**** < 0.0001) when compared with control (Mean ± SEM 7.293 ± 0.2749 ng/mL). Reproductive health problems like decreased libido, erectile dysfunction, absent morning and nocturnal erection and infertility were more common in addicted groups as compared to control. In summary our findings support the role of cigarette and marijuana smoking in the negative regulation of testosterone and male reproduction.

KEYWORDS: Cigarette, marijuana, testosterone, reproductive health, District Lower Dir.

1 INTRODUCTION

Very complex cellular machinery is responsible for the regulation of reproduction, including three principal regulatory organs, hypothalamus **[1], [2]** pituitary **[3]** and gonads **[4]** that form reproductive axis. Luteinizing hormones (LH) and follicle stimulating hormones (FSH), also called gonadotropins, regulate the maturation and functions of gonads and are regulated by gonadotropins releasing hormones (GnRH) **[5]**. Many central and peripheral signals (both stimulatory and inhibitory) are responsible for the regulation of GnRH secretion and the reproductive axis **[6], [7], [8], [9]**. Nowadays one of the main health problems in public is the use of cocaine and cigarette smoking. It is very difficult to determine the exact sickness and death rates in the case of cocaine misuse but it is estimated that the death rate is 430,000 per year due to lung cancer, obstructive pulmonary disease and ischemic heart disease **[10], [11]**. There are important evidences that link smoking and coronary heart diseases. Several studies have shown that smoking causes reduction in androgen concentration in coronary heart disease patients when compared with disease free control individuals **[12]**, proved by the measurement of biologically active androgens **[13]**. It has been documented that effects of i.v administration of nicotine are very similar physiologically to the effects of cocaine, introduced into the body by cigarette smoking **[14]**. Cocaine and nicotine have similar pharmacological mechanism of action regardless of route of administration **[15], [16]**. Cigarette smoking is an addictive problem like cocaine abuse **[11], [17], [18]**. It has been reported that nicotine stimulates mesolimbic dopamine system like cocaine that results in the increased concentration of extracellular dopamine level that in turn regulate the abusing effects of these chemicals **[19], [20], [21], [22]**. Dopamine negatively regulates GnRH secretion **[23]** suggesting the suppression of reproductive axis. Cocaine is also involved in the regulation of the pituitary, gonadal and adrenal hormone secretion **[24]**.

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Mammalian reproduction has been affected by marijuana and its neuroactive component delta-9-tetrahydrocannabinol (D-9-THC) but the results are controversial **[25]**. Marijuana has been shown to reduce circulating plasma testosterone levels in male rats **[26]**. There are several evidences that support the anti- estrogen functions of marijuana in female rats **[27]**. There are several findings in in vivo models, showing that D-9-THC positively regulate estrogens **[28], [29], [30]** but regulate androgens negatively **[27], [31], [32]**. The above variable effects suggest that different constituents of marijuana may have different effects on hormonal profiles. It has been reported that the receptors of the cannabinoid, have their important contribution in the regulation of hormonal profile via cannabinoid **[23]**. Low testosterone level in the body for long time due to either reason can causes cardiovascular problems, insulin resistance, obesity, osteoporosis, erectile dysfunction, hypoactive sexual desire, absent nocturnal and morning erection, disturb secondary sex characters, muscle weakness, fatigue and depression **[33], [34]**.

The aim of current study was to determine whether chronic marijuana and cigarette smoking addiction is involved in the suppression of reproductive axis in the context of total testosterones separately and synergistically in human males. To test our hypothesis we have studied testosterone levels and reproductive problems in people addicted to cigarette, marijuana and both cigarette plus marijuana.

2 MATERIALS AND METHODS

2.1 INFORMED CONSENT

A written informed consent was taken from all the participants before starting the study. All the participants entered the study voluntarily and sufficient information was given to them about the purpose and outcomes of this study.

2.2 STUDY AREA

The present study was conducted in district Lower Dir, Khyber Pakhtunkhwa Pakistan.

2.3 QUESTIONNAIRE

A standard format questionnaire was designed by two experts. Questions about participant's age, profession, income, marital status, type of addiction, duration of addiction, dosage of abuse drugs as well as about their general health and reproductive health were asked from every participant.

2.4 STUDY DESIGN

Only married adult males were selected randomly form the community. Their age ranges from 30 to 40 years. Four groups were made such as, control, cigarettes smokers, marijuana smokers and cigarette plus marijuana smokers. Each group had 15 individuals. The control group participants were healthy and had no history of drug addiction or any other severe abnormalities. The details of socio-demographic characteristics, addiction type and history of drug addiction, dosage of drugs, occupational activities and clinical characteristics are summarized in Table 1.

2.5 BLOOD SAMPLING

A health technician collected 5 ml of the blood in vacutainers tube containing no anticoagulants. Blood was collected from the brachial vein of all participants aseptically between 9:00 A.M and 10:30 A.M. The collection tube and catheter site were covered so that smoke in air would not contaminate the samples. Immediately all samples were placed in ice. All the blood samples were centrifuged at 3000 rpm for 15 minutes at 4 ºC and the resulting serums were frozen at -20 ºC for latter analysis.

2.6 ASSAY

Testosterone enzyme immunoassay test kit, Bio-check (USA) was used for the determination of total serum testosterone level according to the manufacturer's protocol and procedures.

2.7 EXCLUSION CRITERIA

Individuals with a history of severe diseases like tuberculosis, hepatitis, typhoid, renal problems, pneumonia, heart problems and mental problems were excluded from the study.

2.8 STATISTICS

Analysis of data was done by using Graph Pad Prism (www.graphpad.com), version 6.03 (Graph Pad Software Inc., San Diego, CA, USA). Cigarette smokers, marijuana smokers and cigarette plus marijuana smokers were compared one by one with control group by using unpaired t test. All data were presented as Mean ± SEM. A $P < 0.05$ indicated the significant difference.

3 RESULTS

3.1 HISTORY

The general and reproductive health problems found in all groups are summarized in Table 1.

3.2 TESTOSTERONE CONCENTRATION IN CIGARETTE SMOKERS

Statistically significant (P*** 0.0003) lower testosterone level (Mean ± SEM 5.933 ± 0.1801 ng/mL) was observed in chronic cigarette smokers when compared with control (Mean ± SEM 7.293 ± 0.2749 ng/mL) at 95% of confidence interval.

3.3 TESTOSTERONE CONCENTRATION IN MARIJUANA SMOKERS

Marijuana smoking has significant effect on testosterone level. Unpaired t-test has shown that marijuana smoking significantly (P**** < 0.0001) reduce testosterone level in marijuana addicted individuals (Mean ± SEM 3.7 ± 0.12 ng/mL) as compared to control group (Mean ± SEM 7.3 ± 0.27 ng/mL) at 95% confidence interval.

3.4 TESTOSTERONE CONCENTRATION IN MARIJUANA PLUS CIGARETTE SMOKERS

Marijuana plus cigarette smoking has more pronounced effect (P**** < 0.0001) on testosterone concentration (Mean ± SEM 3.2 ± 0.15 ng/mL) than marijuana (Mean ± SEM 3.7 ± 0.12 ng/mL) and cigarette smoking (Mean ± SEM 5.933 ± 0.1801 ng/mL) alone at 95 % confidence interval when compared with control group (Mean ± SEM 7.3 ± 0.27 ng/mL).

Table 1. Characteristics of study population

Groups	Economic status	Profession	Addiction	History (Years)	Dose (per day)	General health problems	Reproductive health problems
Control	Middle	5 teachers 5 doctors 5 farmers	Nil	Nil	Nil	Absent	Absent
Cigarette smokers	Middle	All merchants	Capstan®, Red & White®	≥ 10	≥ 35	02 HT* 03 Cough 03 fatigue	06 DL*
Marijuana Smokers	Middle	8 drivers 7 tandoor occupants	Scorpion®	≥ 10	≥ 5 grams	04 HT* 03 A* 02 P*	04 AMN* 04 DL* 03 ED* 03 infertility
Marijuana plus cigarette smokers	Middle	5 drivers 5 farmers 5 barbers	Scorpion® Capstan®, Red & White®	≥ 10	≥ 5 gram plus ≥ 25	06 HT* 03 DM* 02 P* 04 CC*	04 infertility 04 DL* 05 ED*

DL= Decreased Libido, ED*= Erection Dysfunction, AMN*= Absent Morning and Nocturnal erection, DM*= Diabetes Mellitus, HT*= Hypertension, A*= Asthma, RA*= Rheumatoid Arthritis, P*= Peptic ulcer, CC*= Chronic Cough.*

4 DISCUSSION

In the current study we have analyzed the effects of marijuana and cigarette smoking on mean testosterone concentration. Our hypothesis was that, whether cigarette and marijuana smoking reduces testosterone level? To test our hypothesis we measured testosterone levels in cigarette and marijuana smokers. Hypothalamic stimulatory peptides act on pituitary gonadotrophs to release gonadotrophins that in turn act on testicular cells to produce testosterone which is the principal hormones responsible for male reproduction. In our results, cigarette, marijuana and marijuana plus cigarette smokers have shown significantly reduced testosterone levels than control group. A significant reduction has been reported in testosterones levels in cigarette smokers when compared with control individuals **[35], [36]** that support our findings. The concentration of biologically active testosterones does not vary in smokers versus nonsmokers but the total and free testosterone shows a significant increase in smokers suggesting that this difference is due to the high concentration of sex hormone binding globulin (SHBG) in smokers that give the speculation that smoking effects SHBG, not the hormones itself **[37]**. Key depression has been reported in smokers than in nonsmokers **[38], [40]**. Intra peritoneal, central administration and microinjection of nicotine in the catecholaminergic area of the brain has been shown the rapid increase in adrenocorticotrpic hormone (ACTH) secretion but these effects has been blocked by the injection of nicotine antagonist **[41], [42], [43], [44]** suggesting that nicotine is responsible for the release of ACTH. The concentration of corticotropin- releasing factor (CRF) can't be measured in blood plasma but we can predict its secretion by the concentration of ACTH and cortisol in rodents. RFRP-3(mammalian ortholog of GnIH) expression increases during chronic and acute stress **[45]**. Cortisol (glucocorticoids) receptors are present on RF-amide related peptide- 3 (RFRP-3) neurons, GnRH neurons and gonadotrophs and collectively regulate LH secretion negatively. Cortisol level increases in smokers that positively regulate RFRP-3 secretion while inhibit GnRH and LH secretion that ultimately results in the reduced testosterone concentration in smokers **[45]**.

Acute injection of D-9-THC, principal constituent of the marijuana, has shown a rapid decrease in the secretion of gonadotropins **[23]** that supports our findings that marijuana addiction reduces testosterone levels. Cultural analysis of pituitary cells for D-9-THC has not shown to reduce the secretion of LH and FSH **[46], [47]** and the sensitivity of the pituitary cells to GnRH **[46], [47], [48]**. Exogenous GnRH stimulation **[49], [50]** or injection of endogenous GnRH **[48], [51], [52], [53], [54], [55]** has shown to recover D-9-THC induced inhibition of LH surge before ovulation and its basal level speculating the notion that marijuana centrally suppresses reproductive axis. Various studies have shown that D-9-THC is capable to activate gamma-amino butyric acid (GABA), dopamine, opioids and CRF activities that are responsible for the inhibition of GnRH secretion while it inhibits norepinephrine and glutamate function that positively regulate GnRH secretion that in turn result in the reduced release of LH **[23]**. As CRF is stimulated by D-9-THC **[23]** suggesting that it also activates adrenal axis that has the main contribution to the suppressed reproductive axis and thus testosterones. In the case of our results the decreased levels of testosterones in smoking, marijuana and marijuana plus smoking addiction males might be due to the increased concentration of cortisol, ACTH, CRF, GABA and opioids and the reduced concentration of norepinephrine and glutamate concentration that is the main regulator of the reproductive axis.

In the present study we have studied the combined effects of cigarette and marijuana smoking on total serum testosterone and found that, individuals addicted to both of cigarette and marijuana show a more reduced levels of testosterones than cigarette and marijuana addicted alone. This suggests that the combined addiction synergistically suppress testosterone secretion. The activation of some pathways that is responsible for the reduced testosterone shows overlapping in cigarette and marijuana addiction but some are specialized and are associated with cigarette or marijuana smoking alone. In the light of the above scenario, more pathways are activated in the combined addiction that are responsible for the reduced testosterone than those that become active in cigarette or marijuana addiction alone and this may be the cause for the highly reduced testosterone level in the combined addiction.

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DISCLOSURE

None of the authors is having any conflict of interest.

REFERENCES

[1] F. Docke, "Neurohormonal regulation of male gonadal function," Z Gesamte Inn Med, 34: 589-592, 1979.

[2] R.H. Castillo, R.L. Matteri, D.A. Dumesic, "Luteinizing hormone synthesis in cultured fetal human pituitary cells exposed to gonadotropin-releasing hormone," J Clin Endocrinol Metab, 75: 318-322,1992.

[3] T. Hori, M. Ide, T. Miyake, "Pituitary regulation of preovulatory estrogen secretion in the rat," Endocrinol Jpn, 16: 351-360, 1969.

[4] D.J. Bolt, H.E. Kelley, H.W. Hawk, "Release of LH by estradiol in cycling ewes," Biol Reprod, 4:35-40, 1971.

[5] A.V. Schally, A. Arimura, Y. Baba, R.M. Nair, H. Matsuo, T.W. Redding, L. Debeljuk, "Isolation and properties of the FSH and LH- releasing hormone," Biochem Biophys Res Commun, 43: 393-399, 1971.

[6] A. Barnea, G. Cho, "Evidence that copper- amino acid complexes are potent stimulators of the release of Luteinizing hormone-releasing hormone from isolated hypothalamic granules," Endocrinology, 115: 936-943, 1984.

[7] F.J. Karsch, J.T. Cummins, G.B. Thomas, I.J. Clarke, "Steroid feedback inhibition of pulsatile secretion of gonadotropin releasing hormone in the ewe," Biol Reprod, 36: 1207-1218, 1987.

[8] I.J. Clarke, "Variable patterns of gonadotropin-releasing hormone secretion during the estrogen- induced luteinizing hormone surge in ovariectomized ewes," Endocrinology, 133: 1624-1632, 1993.

[9] N. Mohagheghpour, K. Abel, P.N. La, N.V. Emanuele, N. Azad, "Signal requirements for production of luteinizing hormone releasing-hormone by human T cells," Cell Immunol, 163: 280-288, 1995.

[10] CDC (Centers for Disease Control), "Cigarette smoking-attributable mortality and years of potential life lost - United States," 1990. Morb Mortal Wkly Rep, 42:645–649, 1993.

[11] CDC. Women and smoking: a report of the Surgeon General. National Center for Chronic Disease Prevention and Prevention and Health Promotion. Office on Smoking and Health, Washington, DC, pp.675, 2001.

[12] P. Alexandersen, J. Haarbo, C. Christiansen, "The relationship of natural androgens to coronary heart disease in males: a review," Atherosclerosis, 125: 1-13, 1996.

[13] K.M. English, O. Mandour, R.P. Steeds, M.J. Diver, T.H. Jones, K.S. Channer, "Men with coronary artery disease have lower levels of androgens than men with normal coronary angiograms," Eur Heart J, 21: 890- 894, 2000.

[14] H.E. Jones, B.E. Garrett, R.R. Griffiths, "Subjective and physiological effects of intravenous nicotine and cocaine in cigarette smoking cocaine abusers," J Pharmacol Exp Ther, 288:188–197, 1999.

[15] S.M. Evans, E.J. Cone, J.R. Henningfield, "Arterial and venous cocaine plasma concentrations in humans: relationship to route of administration, cardiovascular effects and subjective effects," J Pharmacol Exp Ther, 279:1345–1356, 1996.

[16] J.E. Rose, F.M. Behm, E.C. Westman, R.E. Coleman, "Arterial nicotine kinetics during cigarette smoking and intravenous nicotine administration: implications for addiction," Drug Alcohol Depend, 56: 99–107, 1999.

[17] J.H. Jaffe, Tobacco smoking and nicotine dependence, in Nicotine Psychopharmacology Molecular, Cellular and Behavioural Aspects, In: S. Wonnacott, M.A.H. Russell, I.P. Stolerman (Eds.) Oxford University Press, New York, pp 1–37, 1990.

[18] APA, Diagnostic and Statistical Manual of Mental Disorders (4th Edition), American Psychiatric Association: Washington, DC, pp. 886, 1994.

[19] M.J. Kuhar, M.C. Ritz, J.W. Boja, "The dopamine hypothesis of the reinforcing Properties of cocaine," Trends Neurosci 14:299–302, 1991.

[20] W.A. Corrigall, K.B.I. Franklin, K.M. Coen, P.B.S. Clarke, "The mesolimbic dopamine system is implicated in the reinforcing effects of nicotine," Psychopharmacology, 107:285–289, 1992.

[21] G. Di Chiara, "Role of dopamine in the behavioural actions of nicotine related to Addiction," Eur J Pharmacol, 393:295–314, 2000.

[22] S.S. Watkins, G.F. Koob, A. Markou, "Neural mechanisms underlying nicotine addiction: acute positive reinforcement and withdrawal," Nicotine Tobacco Res, 2: 19–37, 2000.

[23] L.L. Murphy, R.M. Munoz, B.A. Adrian, M.A. Villanu'a, "Function of cannabinoid receptors in the neuroendocrine regulation of hormone secretion," Neurobiol Dis, 5: 432–446, 1998.

[24] N.K. Mello, J.H. Mendelson, "Cocaine, hormones and behavior: clinical and Preclinical studies, in Hormones, Brain and Behavior," Pfaff DW, Arnold AP, Etgen AM, Fahrbach SE, and Rubin RT eds. Academic Press, New York, pp. 665–745, 2002.

[25] G.G. Nahas, In: G.G. Nahas (Ed.), Marihuana in Science and Medicine. Raven Press, New York, pp. 109–246, 1984.

[26] A.B. Okey, G.S. Truant, "Cannabis demasculinizes rats but is not estrogenic," Life Sci, 17: 1113–1118, 1975.

[27] I. Chakravarty, D. Sengupta, P. Bhattacharya, J.J. Ghosh, "Effect of treatment with cannabis extract on the water and glycogen contents of the uterus in normal and estradiol-treated prepubertal rats," Toxicol. Appl. Pharmacol, 34: 513–516, 1975.

[28] J. Solomon, M.A. Cocchia, R. Gray, D. Shattuck, A. Vossmer, "Uterotrophic effect of delta-9-tetrahydrocannabinol in ovariectomized rats," Science, 192: 559–561, 1976.
[29] J. Solomon, M.A. Cocchia, "Is delta-9-tetrahydrocannabinol estrogenic?," Science, 195: 905–906, 1977.
[30] J. Solomon, M.A. Cocchia, R. DiMartino, "Effect of delta-9- tetrahydrocannabinol on uterine and vaginal cytology of ovariectomized rats," Science, 195: 875–877, 1977.
[31] V.P. Dixit, M. Arya, N.K. Lohiya, "The effect of chronically administered cannabis extract on the female genital tract of mice and rats," Endokrinologie, 66: 365–368, 1975.
[32] I. Chakravarty, D. Sengupta, P. Bhattacharya, J.J. Ghosh, "Effect of cannabis extract on the uterine monoamine oxidase activity of normal and estradiol treated rats," Biochem Pharmacol, 25: 377–378, 1976.
[33] J. Buvat, M. Maggi, A. Guay, L. Torres, "Testosterone deficiency in men: Systematic review and standard operating procedures for diagnosis and treatment," Journal of sexual medicine Sex Med, 10: 245–284, 2013.
[34] A. Ranjan, A. Mohan, R. Shaun, "Androgen deficiency in the aging man," Australian Family Physician, 39: 10, 2010
[35] M.H. Briggs, "Cigarette smoking and infertility in men," Med J Aust, 1: 616- 617, 1973.
[36] M. Shaarawy, K.Z. Mahmoud, "Endocrine profile and semen characteristics in male smokers," Fertil Steril, 38: 255-257, 1982.
[37] K.M. English, P.J. Pugh, H. Parry, N.E. Scutt, K.S. Channer, T.H. Jones, "Effect of cigarette smoking on levels of bioavailable testosterone in healthy men," Clin Sci (Lond), 100: 661-665, 2001.
[38] K.S. Kendler, M.C. Neale, C.J. MacLean, A.C. Heath, L.J. Eaves, R.C. Kessler, "Smoking and major depression. A causal analysis," Arch Gen Psychiatry, 50:36-43, 1993.
[39] A.H. Glassman, J.E. Helzer, L.S. Covey, L.B. Cottler, F. Stetner, J.E. Tipp, J. Johnson, "Smoking, smoking cessation, and major depression," JAMA, 264:1546–154, 1990.
[40] N. Breslau, M.M. Kilbey, P. Andreski, "Nicotine dependence and major depression. New evidence from a prospective investigation," Arch Gen Psychiatry, 50:31–35, 1993.
[41] B.M. Sharp, H.S. Beyer, "Rapid desensitization of the acute stimulatory effects of nicotine on rat plasma adrenocorticotropin and prolactin," J Pharmacol Exp Ther, 238: 486–491, 1986.
[42] S.G. Matta, K.M. McAllen, B.M. Sharp, "Role of the fourth cerebroventricle in mediating rat plasma ACTH responses to intravenous nicotine," J Pharmacol Exp Ther, 252: 623–630, 1990.
[43] S.G. Matta, C.A. Foster, B.M. Sharp, "Selective administration of nicotine into catecholaminergic regions of rat brainstem stimulates adrencorticotropin secretion," Endocrinology, 133: 2935–2942, 1993.
[44] S.G. Matta, Y. Fu, J.D. Valentine, B.M. Sharp, "Response of the hypothalamo–pituitary–adrenal axis to nicotine," Psycho-neuroendocrinology, 23:103–113, 1998.
[45] E.D. Kirby, A.C. Geraghty, T. Ubuka, G.E. Bentley, D. Kaufer, "Stress increases putative gonadotropin inhibitory hormone and decreases luteinizing hormone in male rats," Proc Natl Acad Sci USA, 106: 11324-11329, 2009.
[46] M. Puder, I. Nir, D. Ayalon, T. Cordova, H.R. Lindner, "Effect of THC on basal and PGE2 or GnRH-induced LH release in female rats," Res Commun Subst Abuse, 1:407–426, 1980.
[47] T. Wenger, V. Rettori, G.D. Snyder, S. Dalterio, S.M. McCann, "Effects of delta-9-tetrahydrocannabinol on the hypothalamic–pituitary control of luteinizing hormone and follicle-stimulating hormone secretion in adult male rats," Neuroendocrinology, 46:488–493, 1987.
[48] I. Chakravarty, P.R. Sheth, A.R. Sheth, J.J Ghosh, "Delta-9-tetrahydrocannabinol: its effects on the hypothalamopituitary system in male rats," Arch Androl, 8:25–27, 1982.
[49] L.L. Murphy, L. Tyrey, "Induction of luteinizing hormone release by electrochemical stimulation of the medial preoptic area in delta-9-tetrahydrocannabinol-blocked proestrous rats," Neuroendocrinology, 43:471–475, 1986.
[50] L. Tyrey, "Delta-9-tetrahydrocannabinol attenuates luteinizing hormone release induced by electrochemical stimulation of the medial preoptic area," Biol Reprod, 47:262–267, 1992.
[51] D. Ayalon, I. Nir, T. Cordova, S. Bauminger, M. Puder, Z. Naor, R. Kashi, U. Zor, A. Harell, H.R. Lindner, "Acute effects of D1 tetrahydrocannabinol on the hypothalamo–pituitary–ovarian axis in the rat," Neuroendocrinology, 23:31–42, 1977.
[52] L. Tyrey, "D9-Tetrahydrocannabinol: A potent inhibitor of episodic luteinizing hormone secretion," J Pharmacol Exp Ther 213:306–308, 1980.
[53] C.G. Smith, N.F. Besch, R.G. Smith, P.K. Besch, "Effect of tetrahydrocannabinol on the hypothalamic–pituitary axis in the ovariectomized rhesus monkey," Fertil Steril, 31:335–339, 1979.
[54] R.W. Steger, L. DePaolo, R.H. Asch, A.Y. Silverman, "Interactions of D9-tetrahydrocannabinol (THC) with hypothalamic neurotransmitters controlling luteinizing hormone and prolactin release," Neuroendocrinology, 37: 361–370, 1983.
[55] R.H. Asch, E.O. Fernandez, C.G. Smith, C.J. Pauerstein, "Precoital single doses of D9-tetrahydrocannabinol block ovulation in the rabbit," Fertil Steril, 31:331–334, 1979.

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Diagnostic participatif de la diversité de morphotypes et des connaissances locales en matière de culture du Voandzou (*Vigna Subterranea* L.) au Niger

[Participatory analysis of the diversity of morphotypes and local knowledge of the culture of Bambara groundnut (*Vigna Subterranea* L.) at Niger]

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ABSTRACT: Bambara groundnut (*Vigna subterranea* l.), third food legume in Africa, is the largest in terms of production and consumption after the peanut (*Arachis hypogeae*) and Cowpea (*Vigna unguiculata* walp.). The valorisation of this culture is one of the best alternatives to ensure the food security of populations faced with the decline in the production of food crops such as millet, sorghum or wheat. To achieve this goal, a better knowledge of the genetic diversity of this culture is more than necessary. Therefore, followed by exploration of accessions collection was made across the country. All the areas visited were geo referenced and a map has been prepared. In total one hundred and fifteen (115) Bambara groundnut accessions were collected within six (6) regions of Niger with fifty (50) locations visited throughout the different growing areas. Fourteen morphotypes numbered Ne-01 to Ne-14 were identified after the collection. Following carried out discussions, the yellow color Ne-01 morphotype is the most appreciated both by producers and consumers. It is also clear that this culture of Bambara groundnut is practiced on small areas by both women and men. The choice of the seedling period is the same as well among women than among men. The production is destined for self-consumption or for sale depending on the quantity harvested. Chemicals, ash, salt, natron, cans are commonly used for the seeds conservation. Several types of dishes are made based of Bambara groundnut. In addition, Bambara groundnut has therapeutic values in some farmer's areas.

KEYWORDS: Groundnut, exploration, collection, morphotype, Niger.

RÉSUMÉ: Le voandzou (*Vigna subterranea* L.), troisième légumineuse alimentaire en Afrique, est la plus importante en termes de production et de consommation après l'arachide (*Arachis hypogeae* L.) et le niébé (*Vigna unguiculata* walp.). La valorisation de cette culture représente une des meilleures alternatives pour assurer la sécurité alimentaires des populations face à la baisse de la production des cultures vivrières comme le mil, sorgho ou le blé. Pour atteindre cet objectif, une meilleure connaissance de la diversité génétique de cette culture s'avère plus que nécessaire. C'est ainsi qu'une prospection suivie de collecte des accessions a été effectuée sur l'ensemble du pays. Toutes les zones visitées ont été géo référencées et une carte a été établie. Au total cent quinze (115) accessions de voandzou ont été collectées dans les six (6) régions du Niger avec cinquante (50) localités visitées à travers les différentes zones de culture. Quatorze morphotypes numérotés de Ne-01 à Ne-14 ont été identifiés après la collecte. Suite aux entretiens effectués, le morphotype Ne-01 de couleur jaune est le plus apprécié tant par les producteurs que les consommateurs. Il ressort également que la culture de voandzou se pratique sur des petites superficies aussi bien par les femmes que par les hommes. Le choix de la période de semis est identique aussi bien chez les femmes que chez les hommes. La production est destinée soit à l'autoconsommation ou à la vente en fonction de la quantité récoltée. Les produits chimiques, la cendre, le sel, le natron, des bidons sont couramment utilisés pour la conservation des graines. Plusieurs types des plats sont confectionnés à base de voandzou. En plus, le voandzou présente des valeurs thérapeutiques dans certains milieux paysans.

MOTS-CLEFS: Voandzou, prospection, collecte, morphotype, Niger.

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1 INTRODUCTION

Le voandzou, *Vigna subterranea* L. est une légumineuse cultivée pour ses graines qui sont hautement caloriques, riches en éléments minéraux, en vitamines et en protéines (Amarteifio et *al.,* 2006; Sévérin et Yao, 2011; Ndiang et *al*., 2012). Il possède également des vertus thérapeutiques bien connues des populations locales (Nacoulma, 1996 ; Sévérin et Yao, 2011). Les protéines contenues dans les graines de voandzou ont une teneur élevée en lysine et leur association avec les céréales dans l'alimentation, constitue un complément nutritionnel pour de nombreuses populations locales qui ne peuvent faire face aux coûts élevés des protéines animales (Massawe et *al.,* 2005).

En Afrique, le voandzou est la troisième légumineuse alimentaire la plus importante en terme de production et de consommation après l'arachide (*Arachis hypogeae* L.) et le niébé (*Vigna unguiculata* L Walp.) (Linnemann, 1992; Howell, 1994; Yaya et *al*, 2013). Elle est utilisée pour la fertilisation des sols grâce à sa capacité de fixation de l'azote atmosphérique et donne des rendements moyens allant de 350 à 800 kg/ha dans les régions où le sol est pauvre et la pluviométrie faible (Sévérin et Yao, 2011; Yaya et *al*. 2013). En outre, certains morphotypes résistent bien aux attaques des insectes, aux maladies et aux conditions difficiles de sécheresse (Mungate, 1997; Yaya et *al*, 2013).

Au Niger, très peu d'informations sont actuellement disponibles sur la distribution, la diversité génétique, la culture et les utilisations du voandzou dans les grandes zones de production. La banque de gènes de l'INRAN (Institut National de la Recherche agronomique du Niger) compte 47 accessions de voandzou qui sont en faible quantité mais aussi nécessite d'être régénérées (MDA, 2007). Cette collection ne semble pas représentée toute la variabilité du territoire national. En effet, la carte de la diversité de cette espèce et de son organisation n'est pas bien connue, alors qu'elle pourrait offrir des opportunités dans la conception des programmes de conservation et d'amélioration. Il y a donc nécessité d'effectuer une collecte sur l'ensemble du territoire national en vue de disposer d'une large base génétique nationale de ce germoplasme. En outre pour promouvoir durablement la culture de cette légumineuse au Niger, il est important de bien maîtriser les pratiques culturales de cette plante, les méthodes de conservation et de gestion des stocks ainsi que les modes d'utilisation des graines dans l'alimentation.

La présente étude vise à faire une collection nationale de voandzou, de déterminer les différents morphotypes actuellement cultivés et consommés, de répertorier les pratiques culturales de la plante et les différentes méthodes des stocks de graines dans sa zone de production, et recueillir toutes les informations sur l'utilisation faite de cette culture au Niger.

2 MATÉRIEL ET MÉTHODES

2.1 MATÉRIEL VÉGÉTAL ET ZONE D'ÉTUDE

Le matériel utilisé a été collecté dans 50 localités pendant les mois de décembre 2013, février et Mars 2014 (Figure 1). La zone de collecte couvre six (6) régions sur huit (8) à savoir Zinder, Niamey, Maradi, Dosso, Tillabéry et Diffa. Ces régions sont réparties sur deux zones agro écologiques, il s'agit, du sud au nord, de la bande Nord soudanienne (1% ou moins, du territoire) qui reçoit 600 à 800 mm de pluies par an et de la bande sahélienne (10% du territoire) avec 350 à 600 mm de pluies par an. Dans chaque Région, le choix des localités à prospecter a été effectué, avec l'aide des services locaux de l'agriculture, sur la base de l'importance des surfaces emblavées et l'expérience des producteurs en matière de culture de cette légumineuse.

Les semences de voandzou ont été collectées sous forme des graines soit dans le stock semencier du producteur, soit au marché, soit enfin au niveau des organisations paysannes.

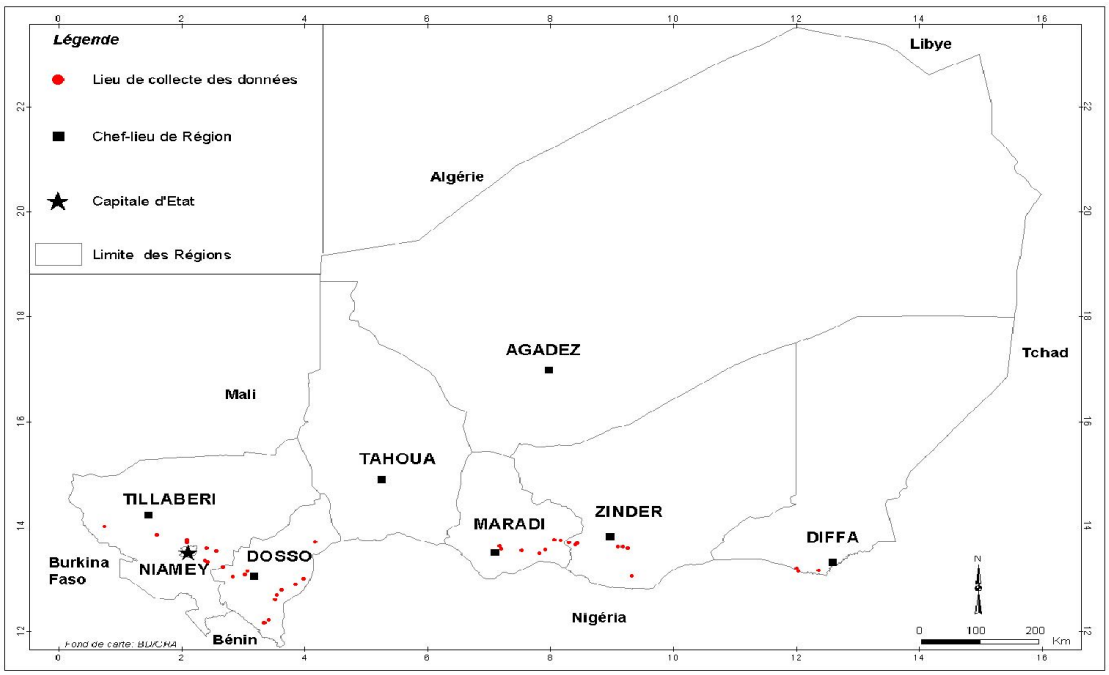

Figure 1 : Carte du Niger indiquant les régions et les différentes localités visitées lors des collectes

2.2 COLLECTE DES DONNÉES

La méthode utilisée pour la collecte des données a consisté en des entretiens de groupe et individuels avec les producteurs de voandzou aléatoirement choisis dans les villages. Dans chaque localité visitée, les entretiens sont organisés par le chef de village qui au préalable demande aux producteurs conviés d'apporter les accessions de voandzou à leur possession. Afin de réunir le maximum d'informations auprès de ces producteurs sur le voandzou, un questionnaire a été établi dans lequel sont indiqués les renseignements généraux, la localisation du lieu de collecte, le nom local, les différents types cultivés, la description des méthodes culturales, la destination de la récolte, les contraintes liées à la culture et la gestion des semences. Ces informations sont complétées par des enquêtes menées auprès des commerçants et des organisations paysannes des différents villages traversés.

Les graines des différentes accessions collectées sont ensuite mises dans les sacs en tissus, et étiquetés. Une partie de ces accessions est codifiée et conservée au laboratoire et une autre partie a fait l'objet d'un tri, pour séparer les différents morphotypes, sur la base de la taille, de la coloration et de la forme des graines.

2.3 ANALYSE DES DONNÉES

Les coordonnées géographiques des localités de collecte à savoir la longitude et la latitude ont été traitées au logiciel ARC VIEW version 3.3 afin d'établir la carte de localisation des accessions. Les données obtenues à partir des enquêtes ont été traitées et analysées à l'aide du logiciel SPHINX Version 5.0

3 RÉSULTAT

3.1 ETAT DE LA DIVERSITÉ DES ACCESSIONS COLLECTÉES

L'examen des résultats obtenus au cours de cette enquête montre que le voandzou est une plante cultivée dans six (6) régions du Niger sur les huit (8) que compte le pays. Au total, 115 accessions ont été collectées dans les cinquante (50) localités prospectées. Cependant, la Région de Dosso avec près de 50% des accessions collectées semble être la principale zone productrice de cette légumineuse au Niger (Tableau 1).

Tableau 1 : Nombre de sites prospectés par région et nombre d'accessions collectées

Régions	Nombre de villages /et marchés prospectés	Nombre d'accessions collectées
Dosso	18	55
Maradi	6	21
Zinder	7	14
Niamey	1	3
Tillabéri	14	14
Diffa	4	8
Total	50	115

Sur la base de la couleur et des différents traits sur les graines, les accessions ont été regroupées en quatorze (14) Morphotypes (Figure 2). Ces morphotypes sont ainsi tous caractérisées par leur appellation locale, leur forme, leurs couleurs et leur distribution (Tableau 2). Cinq (5) de ces morphotypes, se retrouvent dans toutes les localités prospectées où ils sont cultivés et consommés. Il s'agit des morphotypes Ne-01, Ne-02, Ne-03, Ne-04 et Ne-07. Les morphotypes Ne-01 et Ne-03 sont le plus souvent consommés ou vendus seuls sans mélange contrairement aux trois autres.

Figure 2 : Présentation des 14 morphotypes de voandzou recensés au Niger

Tableau 2 : Quelques caractéristiques de 14 morphotypes de voandzou recensés du Niger

Morphotypes	Nom local	Caractéristiques	Distribution-importance
Ne-01	Bahillata, foulan	Couleur jaune Bon goût, très apprécié par les consommateurs	Partout et en grande quantité. Toujours seul
Ne-02	Baka, ninebi, doûna	Noir Moins apprécié	Partout, en mélange et en petite quantité
Ne-03	Annia, ninebi, Kiri	Jaune avec œil coloré en forme de papillon, apprécié par les consommateurs.	Partout et en grande quantité. Le plus souvent seul
Ne-04	Babarbara, maouro, karassou kindaou	Jaune avec rayures en marron et œil noir	Un peu partout, en mélange ou seul et en quantité rarement grande
Ne-05	Jan kâssa, ninebi, bidou kimé	Rouge tâchété de noir	Un peu partout, en mélange et en quantité faible
Ne-06	Jâ, ninekiré, Fir kafia	Rouge sombre	Un peu partout, en mélange et en quantité faible
Ne-07	Jan bahillata, ninekiré, Fir	Rouge clair	Un peu partout, en mélange et en quantité faible
Ne-08	Jâ, ninekiré, Fir	Marron clair	Un peu partout, en mélange et en quantité faible
Ne-09	Babarga, ninebi, Kilandji	Jaune tâchété de noir avec œil en forme de papillon, coloré en marron	Un peu partout, en mélange et en quantité faible
Ne-10	Koyin zabo, Bossa	Jaune avec petits points marron sur le tégument, œil marron	Rare, toujours en mélange et en petite quantité, facilement rencontré dans le Manga
Ne-11	Jan kourégué	Jaune avec un ou deux traits marron et œil noir	Un peu partout, en mélange et en quantité faible
Ne-12	Babban annia, ninebi, Kiri Koura	Grosses graines et même couleur que C	Rare et se trouve en petite quantité
Ne-13	Kâssa, ninebi	Jaune fortement coloré en noir avec œil marron	Un peu partout, en mélange et en quantité faible
Ne-14	Ninebi, n'guirou	Grise tachetée à œil bronzé	Un peu partout, en mélange et en quantité faible

3.2 MODES DE CULTURE DU VOANDZOU ET RÉPARTITION DES EXPLOITANTS PAR SEXE

L'examen des résultats obtenus montre que 73% de producteurs de voandzou enquêtés pratiquent la culture pure contre 27% qui associent le voandzou avec d'autres plantes telles que le mil et le sorgho (figure 3). Cette culture est pratiquée aussi bien par les hommes que par les femmes, avec une proportion relativement plus élevée de femmes. En effet, il ressort de l'analyse que 55% des producteurs de voandzou sont des femmes (figure 4).

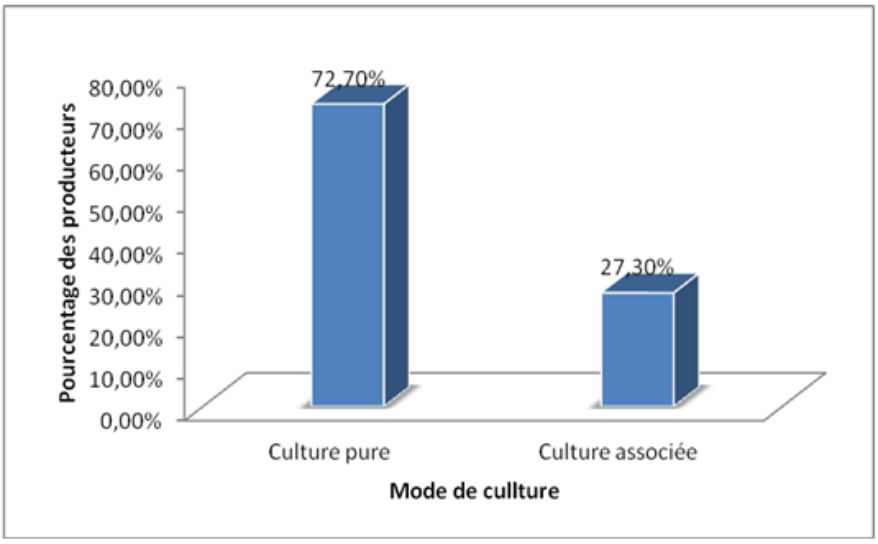

Figure 3 : Répartition des exploitants en fonction du mode de culture

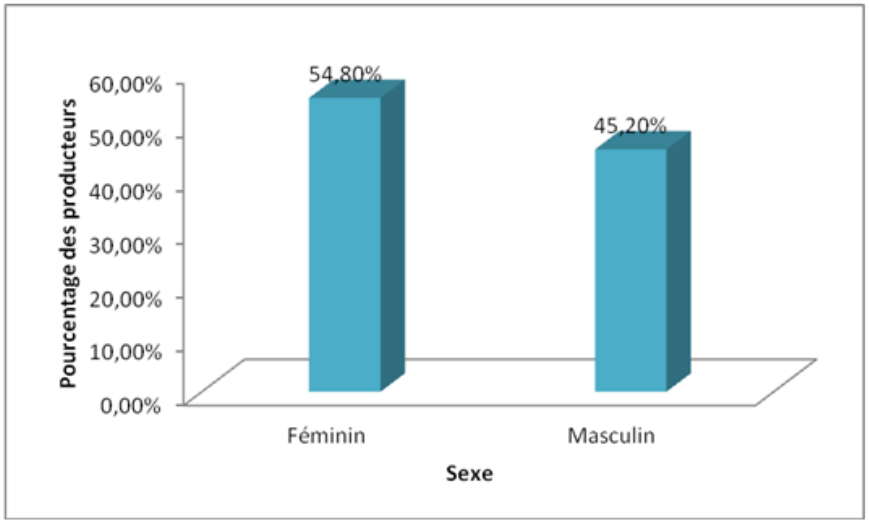

Figure 4 : Nombre d'exploitants de voandzou en fonction du sexe

Les enquêtes réalisées auprès des producteurs ont montré qu'au Niger la culture du voandzou se fait exclusivement pendant la saison des pluies. Toutefois, Il existe des disparités dans le semis, les producteurs n'effectuent pas leur semis à la même période (figure 5). C'est ainsi que pour pallier à l'insuffisance des pluies pouvant compromettre le cycle de voandzou ou pour minimiser les dégâts causés par certains ennemis de cultures, certains paysans (environ 7%) procèdent à des semis à sec, juste avant les premières pluies. Cette situation a été observée dans certaines localités des départements de Mirriah (région de Zinder) et de Tessaoua (région de Maradi). D'autres producteurs (25%) préfèrent semer dès la première pluie mais la majorité des paysans (environ 68%) sèment le voandzou à la deuxième ou troisième pluie pour éviter les dégâts causés par les animaux en divagation au début de la campagne.

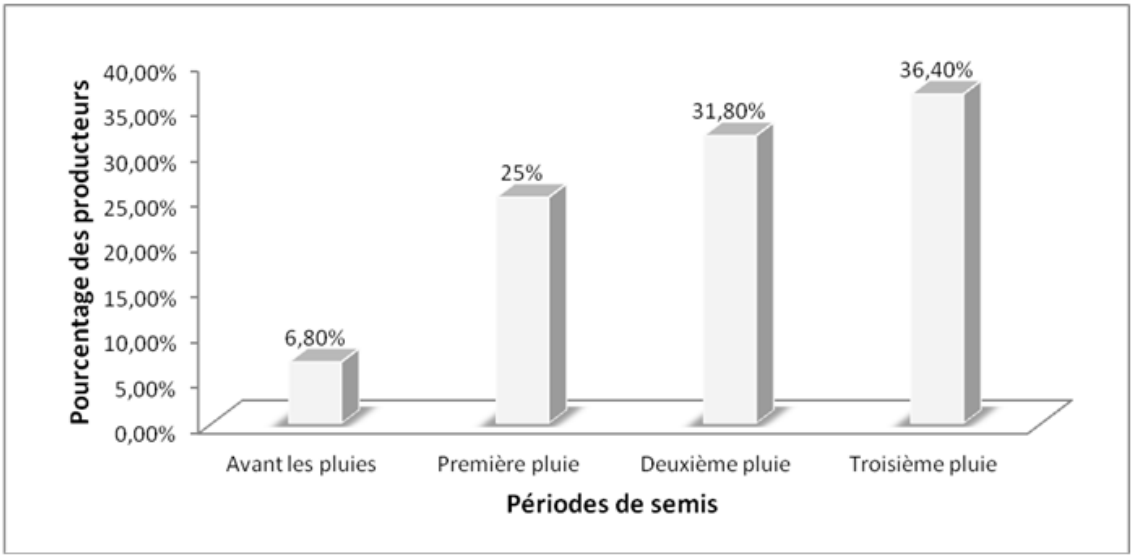

Figure 5 : Choix de la période de semis par les producteurs

3.3 DESTINATION DE LA PRODUCTION POST-RÉCOLTE ET UTILISATION DU VOANDZOU

Consommation et vente de la production pos-récolte

Une fois récoltées, les graines sont destinées à l'autoconsommation et à la vente (Figure 6). Tous les paysans enquêtés (100%) auto-consomment une partie ou l'intégralité du produit récolté. Ainsi, 63% des paysans enquêtés vendent une partie de leur récolte. La quantité destinée à la vente dépend du rendement obtenu; plus il est important plus le producteur dispose d'une quantité importante pour la vente. Certains paysans vendent le produit récolté frais tandis que d'autres préfèrent le vendre à sec après une période de conservation.

Formes de consommation

Au Niger la consommation de voandzou est faite principalement en faisant bouillir les gousses fraîches. Une multitude des mets est confectionnée à base de voandzou à savoir du loubatou (16%), bara-bara (21%), dawalé (14%), appellation en langue locale selon le groupe ethnique

Vertus médicinales

Dans certaines localités du Niger, 14% des populations enquêtées (Figure 6) affirment que le voandzou est exploitée pour ses vertus thérapeutiques. Ainsi selon des exploitants interrogés, le voandzou est utilisé dans le traitement des hémorragies ou pour sa vertu aphrodisiaque.

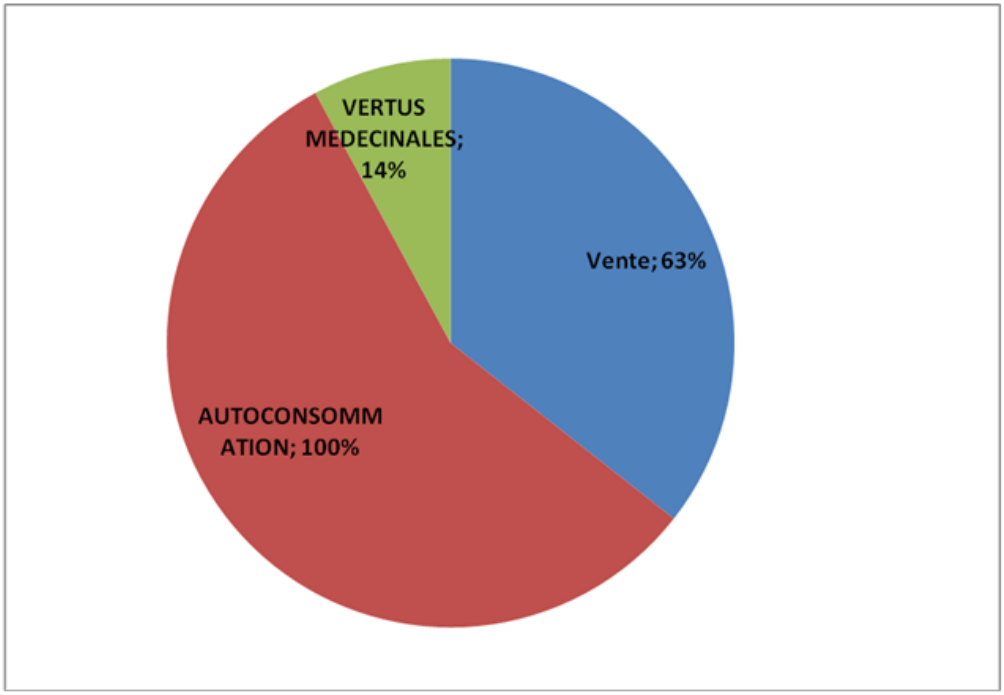

Figure 6: Destination des produits après récoltes

3.4 MÉTHODES DE STOCKAGE ET DE PROTECTION POST-RÉCOLTE DES GRAINES

Il ressort de l'analyse des données collectées auprès des producteurs que diverses méthodes sont utilisées pour le stockage et la protection des semences de voandzou au Niger. Le plus souvent, les semences sont conservées sous forme des graines.

Une fois récoltées, la plupart des producteurs interrogés (65%) utilisent la méthode de stockage hermétique qui consistera à stocker les graines dans des bidons, des tasses, des canaries ou tout autre récipient hermétiquement clos pour éviter toute infestation. Certains gros producteurs (16% des personnes interrogées) utilisent la méthode de triple ensachage.

Cette méthode de stockage hermétique est combinée à des méthodes de protection des graines contre les insectes des stocks notamment les bruches qui consistent à l'utilisation de produits comme le sel de cuisine, la cendre, le natron et l'insecticide. Mais 53% des personnes interrogées affirment que ce sont les produits chimiques sous forme des comprimés ou de liquide insecticide (Malathion, Deltaméthrine etc.) qui sont utilisés pour la protection post-récolte des graines. Malgré l'utilisation des produits chimiques, il a été constaté une infestation des graines stockées de l'ordre de 50% chez certains producteurs, probablement due au mauvais dosage ou à la résistance de l'insecte face au produit utilisé.

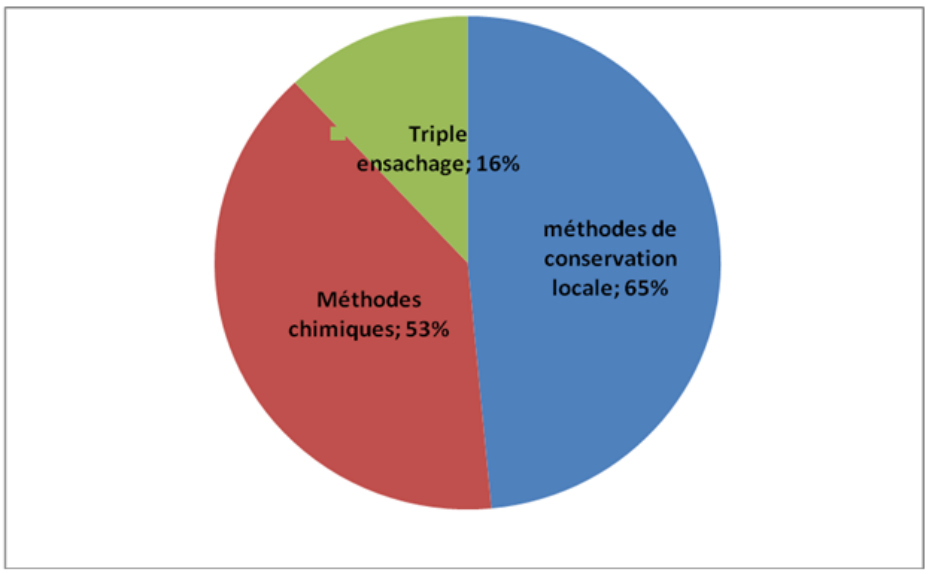

Figure7: Différentes méthodes de conservation utilisées

4 DISCUSSION

La prospection et la collecte des accessions de voandzou à travers toutes les zones de culture au Niger a permis de mettre en évidence la diversité des cultivars de voandzou au Niger. Cent quinze (115) accessions collectées avec quatorze (14) morphotypes identifiés en fonction de la couleur des graines. Les morphotypes Ne-01 et Ne-03 (couleur jaune) sont les plus consommés au Niger et on les retrouve dans toutes les zones de production de voandzou. Il ressort des interviews que ces morphotypes sont appréciés par les consommateurs. Ces informations corroborent les observations de Ramolemana et *al.* (2004) qui ont montré que dans la majorité des régions d'Afrique où le voandzou est cultivé, les graines de couleur jaune sont les plus consommées.

Les noms locaux attribués à l'espèce voandzou varient en fonction de la région et du groupe ethnique (gangala en béribéri, damsi kukurku ou gundé beri en djerma, el kuruga en haoussa), ceci a été reporté par plusieurs auteurs (Tamiru et *al*. 2008, Oto et *al.* 2009, Yaya et *al*. 2013). Certaines appellations des accessions de voandzou ou de certains morphotypes sont liées à la couleur des graines (baka ou fara qui veulent dire respectivement « voandzou noir » ou « voandzou blanc » en haoussa), à la région ou au groupe ethnique (Mahama Ouedraogo et *al.* 2008). Par exemple le morphotype Ne-04 appelé à l'Ouest du Niger (Dosso, Tillabéry) 'Maouro' en Djerma à cause des différents traits se trouvant sur la graine, faisant allusion aux cicatrices d'une des ethnies du Niger, les Maouri de Doutchi (Dosso). Ces mêmes observations sont rapportées par Habsatou et *al*. (2012) sur les écotypes locaux de l'oignon au Niger. Les interviews réalisées lors de la mission de prospection ont prouvé que les producteurs utilisent plus la méthode de monoculture que celle des cultures associées. Cette préférence de la monoculture par les producteurs de voandzou par rapport à l'association culturale a été rapportée par plusieurs auteurs. Seasy et *al.* (1999) ont rapporté que dans plusieurs régions de Swaziland, la monoculture représente 98% des parcelles occupées par le voandzou. Les associations réalisées (2%) sont généralement faites avec le maïs, le sorgho et le mil. Yaya et *al*. (2013), rapportent que la monoculture est pratiquée par 54% des producteurs dans la zone savanicole de Côte d'Ivoire et les associations (46%) sont réalisées avec l'arachide, le maïs, le niébé et l'igname. Comparativement à tous ces pays, excepté les régions de Swaziland, l'association voandzou avec les autres cultures comme méthode culturale reste faible (27,3 %). La pratique de la monoculture au détriment de la culture associée peut être expliquée par l'effet d'ombre qui agit défavorablement sur voandzou en cas de l'association avec les principales cultures céréalières du Niger. Dans le temps la culture pure de voandzou est pratiquée dans des champs en jachère.

Les missions de prospection dans les zones de culture de voandzou révèlent une forte implication des femmes dans la culture du voandzou au Niger. Dans la région de Dosso et de Tillabéry, la culture de voandzou est essentiellement dévolue aux femelles. Par contre dans les régions comme Maradi, Zinder et Diffa, cette culture est pratiquée aussi bien par les femmes que par les hommes (enquêtes). Les travaux de Yaya et *al*., (2013) dans la savane de Cote d'Ivoire révèlent chez les Gnaraforo, groupe ethnique de Ferkessédougou, la culture de voandzou est exclusivement dévolu aux hommes. Il faut souligner qu'en fonction de la récolte, environ 98% des producteurs conservent une partie de leur récolte comme semence pour la saison prochaine. Indépendamment des régions ou des groupes ethniques, diverses méthodes sont adoptées pour la conservation des semences dans les zones de productions au Niger. Généralement, les semences sont conservées sous forme

de graines ou de gousses. Les produits utilisés pour la conservation des graines sont la cendre, du sable fin, les produits chimiques et le sel de cuisine. Toutefois, l'utilisation exclusive de la cendre pour la conservation des graines a été rapportée par 2/3 des paysans interviewés. Selon Drabo et *al*, (1997), ce mode de conservation est plus répandu au Burkina Faso. Les feuilles séchées des plantes telles que le neem (*Azadirachta indica*) et d'autres plantes non identifiées, sont utilisées pour la conservation des graines (Yaya et *al.* 2013). Les propriétés insecticides de ces plantes ont été mises en évidence par de nombreux auteurs (Bamaiyi et *al.,* 2006; Bambara et Tiemtoré, 2008). Le piment est aussi utilisé pour la conservation des graines, le plus souvent en mélange avec la cendre. Au moins 12% des paysans interrogés au cours de cette étude conservent leurs semences par la méthode de triple ensachage. Cette nouvelle méthode est de plus en plus pratiquée par les paysans dans certaines localités de la région de Dosso où la production de voandzou est relativement importante. Elle présente l'avantage de conserver des quantités importantes de graines sans faire recours aux produits chimiques. Quel que soit le produit utilisé pour la conservation, les graines sont stockées dans les greniers, les bidons ou dans des endroits hermétiquement clos pour éviter toute infestation.

5 CONCLUSION

Cette étude a permis de mettre en évidence une grande diversité des cultivars de voandzou exploités par les producteurs au Niger. En effet, l'étude a recensé cent quinze (115) accessions et quatorze (14) morphotypes de voandzou. Ces accessions actuellement stockées au laboratoire de Biologie de l'Université Abdou Moumouni de Niamey au Niger et constituent un embryon de collection nationale de voandzou mise à la disposition de tous les chercheurs. Pour une meilleure valorisation du Voandzou au Niger, cette collection mérite d'être caractérisée à travers une évaluation génétique.

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REFERENCES

[1] J.O. Amarteifio, O.Tibe, and R.M. Njogu, The mineral composition of Bambara groundnut [*Vigna subterranea* (L.) Verdc.] grown in Southern Africa. *African Journal of Biotechnology 5(23): 2408-2411, 2006.*

[2] B. Sévérin and D. Yao, Variabilité morphologique et agronomique des variétés traditionnelles de voandzou (Vigna subterranea I. verdc.) de Côte d'Ivoire. Journal of Applied Biosciences,41 :2820-2835 ISSn 1997-5902, 2011

[3] N. Zénabou, B. J. Martin, M.A. Didier, F. P. Ernest, Amougou Akoa, Etude de la variabilité morphologique de quelques variétés de voandzou (Vigna subterraneae L. Verdc.) au cameroun ; Journal of applied Biosciences 60 :4410-4420 ISSN 1997-5902. 2012

[4] Nacoulma-Ouédraogo OG (1996). Plantes médicinales et pratiques médicales traditionnelles au Burkina-Faso: cas du plateau central, Thèse de Doctorat es Sciences naturelles, Université de Ouagadougou, Burkina-Faso.

[5] F.J. Massawe, S.S. Mwale, S.N. Azam-Ali, J.A. Roberts, Breeding in Bambara groundnut (Vigna subterranea L. Verdc.): strategic considerations. African Journal of Biotechnology 4(6): 463-471, 2005

[6] Linnemann A.R., 1992. Bambara groundnut (Vigna subterranea). Literature: a revised and updated bibliography. Tropical Crops Communication 17 Wageningen Agricultural University, Department of Tropical Crop Science Netherlands 124 p.

[7] J.A. Howell, Commons names given to Bambara groundnut (Vigna subterranea) in central Madagascar. Economic Botany 45: 217-221, 1994

[8] T. Yaya, M. Koné, S. Silué, J. Yatty,. Prospection, collecte et caractérisation agromorphologique des morphotypes de voandzou de la zone savanicole en Côte d'Ivoire, European scientific journal edition vol.9, No 24 ISSN:1857-7881, 2013

[9] Mungate D, 1997. Bambara groundnut [Vigna subterranea (L.) Verdc.]. In: Heller J, Begemann F, Mushonga J, eds. Promoting the conservation and use of underutilized and neglected crops. 9. Proceedings of the workshop on Conservation and Improvement of Bambara Groundnut (Vigna subterranea (L.) Verdc.), 14-16 November 1995, Harare, Zimbabwe. 3-4.

[10] MDA, Ministère de développement agricole du Niger. Rapport national sur l'état des ressources phytogénétiques pour l'alimentation et pour l'agriculture, 43 Pages, 2007.

[11] G.H. Ramolemana, B.C. Kwerepe, T.V Balole, E.B khonga, S.K. Karikari,. Farmer and consumer perception of the Bambara groundnut (Vigna subterranea) ideotype in Botswana. In: Sesay A, Edjé OT. and Cornelissen R. eds. Increasing the

productivity of Bambara groundnut (Vigna subterranea) for sustainable food production in semi-arid Africa. Proceedings of the International Symposium on Bambara Groundnut. Botswana College of Agriculture, 8-12 September 2003. 17-24, 2004

[12] M. Tamiru, H.C. Becker, B.L. Maass . Diversity, distribution and management of yam landraces (Dioscorea spp.) in Southern Ethiopia. Genet Resour Crop Evol 55:115–131, 2008

[13] E. Oto, R.Akromah, M. Kololesnikova-Allen, R. Asiedu . Ethno-botany and morphological characterisation of the yam pona complex in Ghana. Afr Crop Sci Conf Proc 9:407–414, 2009

[14] O. Mahama, T. Jeremy OUEDRAOGO, T. Jean Baptiste, Didier BALMA, Clémentine B. DABIRE & Gnissa KONATE, Characterization and evaluation of accessions of Bambara groundnut (Vigna subterranea (L.) Verdcourt) from Burkina Faso. Sciences & Nature Vol. 5 N°2: 191 – 197. 2008

[15] B. Habsatou, A. Roumba, T. Adam, M. Baragé et M. Saadou, Interactions entre variabilité des écotypes de l'oignon (Allium cepa L.) et les facteurs agro-climatiques au Niger. Tropicultura, 30, 4, 209-215, 2012.

[16] A. Sesay , I.S. Kunene, D.M. Earnshaw, Farmers' knowledge and cultivation of Bambara groundnut (Vigna subterranea L. Verdc.) in Swaziland. UNISWA. Research Journal of Agricuture, Sciences and Technology 3(1): 27-37, 1999

[17] I. Drabo, P. Sérémé, C. Dabire, Bambara groundnut (Vigna subterranea L. Verdc.): Country reports. In: Heller J, Begemann F, Mushonga J, eds. Promoting the conservation and use of underutilized and neglected crops. 9. Proceedings of the workshop on Conservation and Improvement of Bambara Groundnut (Vigna subterranea (L.) Verdc.), 14-16 November 1995, Harare, Zimbabwe. 19-26. 1997

[18] L.J. Bamaiyi, I.S. Ndams, W.A. Toro, S. Odekina, Effect of mahogany Khaya senegalensis seed oil in the control of Callosobruchus maculatus on stored cowpea. Plant Protection and Science 42(4): 130-134, 2006

[19] D. Bambara and J. Tiemtoré, Efficacité biopesticide de *Hyptis spicigera* (Lam.), *Azadirachta indica* A. (Juss.). et *Euphorbia balsamifera* (Ait.) sur le niébé (*Vigna unguculata* L. Walp.). *Tropicultura 26(1): 53-55, 2008*

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Effect of greenhouse cover spectral properties on rose yield for Ethiopia highland

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ABSTRACT: In different agro-climates the greenhouse horticulture are making use of various types of plastic cover where its influence on production in relation to crop, indoor climate and outside climate not considered in selection. In this study, major spectral properties of mainly used greenhouse cover for Ethiopian highland and their effect on yield were investigated. Cover spectral properties such as cover near-infrared (NIR) transmission, photosynthetic active radiation (PAR) transmission and cover longwave emission coefficient were major parameters that are considered in this study to determine their effect on dry matter harvest. To examine the influence of the cover parameters on biomass production, a generic tool or a model constructed in Matlab software was used. The model comprises energy balance equations, mass balance equations and growth model. The measured greenhouse indoor temperature data was considered for validation of the model. Simulations of indoor temperature, canopy temperature and vapor concentration were conducted for the existing greenhouse configuration.

The result of the simulation showed that in Ethiopian greenhouse for highland, high and low temperature, night time high humidity and low CO_2 during day time are major problems which inhibit the growth and on the other hand create favorable condition for well know disease in the region that is botrytis. According to sensitivity analysis output of the model, 1% increase in PAR transmission resulted 0.009% increase dry matter harvest, whereas a percent increase in cover NIR transmission has caused 0.259% reduction in yield. Moreover, increment of cover long wave emission coefficient by 1 percent positively influences (0.044%) the rose production. The resulted depicted that as compared to low temperature problem during rainy season (2-3 months), high temperature problem during summer season (9-10 months) would become a foremost problem in Ethiopian highland greenhouse horticulture. Thus, plastic cover with lower NIR transmission and higher PAR transmission and long-wave emission coefficient is desirable for Ethiopian highland greenhouses.

However, the study revealed that night time low temperature particularly during rainy season should be studied to incorporate in respective growth model.

KEYWORDS: longwave emission, PAR transmission, NIR transmission, sensitivty analysis, spectral properties.

1 BACKGROUND

Floriculture in Ethiopia is a young industry and started in 1999 in the highland of the country near the capital, Addis Ababa and exporting mainly started in 2000 [11], [2].

Addis Ababa is located at latitude 8^0 N of Equator; longitude 38^0 E of Greenwich, place for some growers at the vicinity.

In Ethiopian highland due to low temperature and high RH% in the greenhouse, there has been a botrytis problem, which affects the growth performance of the rose. According to data obtained from highland greenhouse, Lafto Rose farm PLC, at night time during winter at least for two months the mean temperature gets below 10^oC and mean relative humidity greater than 80%, which might greatly affect the rose productivity in addition to favoring the disease even though net profit remains.

Danse et al.,[5] pointed out that downy mildew and botrytis are the major problems in Ethiopian greenhouse cultivation during the rainy season and mainly induced by low temperature.

In Ethiopian floriculture companies there are three major problems: undesirable greenhouse indoor climate, pest-disease and environment linked problem. Environmental problem can be either due to water use and/ or high chemical application which is the result of pest-disease infestation.

Production or yield loss in greenhouse rose cultivation can occur due to pest-disease infestation, undesirable high and low temperature and relative humidity.

Therefore, though the growers in this region still produce profitable, it is possible to bring up the production to a higher level by improving indoor climate conditions as well as reducing environmental load owing to the fact that high chemical application for pest-disease. Production loss in the region due to undesirable indoor climate is not clearly identified or quantified yet.

Minimizing extreme greenhouse temperature and relative humidity will improve the number of harvested stems per unit area and also minimize the incidence of pest-diseases. High temperature and low temperature problems in highland of Ethiopia and undesirable relative humidity can be solved by applying the knowledge of climate control techniques, which include the use of appropriate cladding material, best possible ventilation area, passive heating or cooling strategies and/or ventilation control strategy. To analyze and improve the indoor climate of the greenhouses and increase the yield per unit area, a tool or model which takes into account the influence of all the important design parameters on crop yield will be crucial.

Predicting the temperatures of air, plant, cover and soil, relative humidity, transpiration and evaporation based on either conducting experiments or simulation models essentially can help greenhouse designers to improve the greenhouse design to obtain an environment suitable for crop growth. As compared to conducting experiments, simulation methods provide a quick, less expensive and more flexible and repeatable way provided that the model is reliable. In the past there have been different simulation or mathematical models developed that rely on the energy balance analysis. Principally, these models were used to predict the greenhouse indoor climate as function of outdoor climate and parameters of the greenhouse elements [1].

Jensen [10] explained structural design, the environment control system and the growing or plant culture system are equally important in the design of greenhouse. However, attention is given to one or two of the key components but fails owing to the lack of importance given to any one of the components.

Local technical, legal and economic conditions are the key aspects influencing the choice of greenhouse type by growers. By and large, local tradition and thought of compatibility with existing greenhouses play an important role in the decision making [7].

Frausto and Pieters [8], Ganguly and Ghosh [9] pointed out that, greenhouse climate models with high degree of complexity and lots of parameters that should be determined by calibration have been built in the past ten years . On the contrary to these deterministic models, there are also black box models which do not experience from the need to determine appropriate values for lots of parameters.

Now a day, it is clearly seen that there is no straightforward solution for designing a greenhouse which instigate continuous improvements originating from both experience and scientific research. This explains that most important types of greenhouses have vital functional and structural advantages and disadvantages [7].

In this regard, greenhouses that have been constructed in different locations of the world are very different in construction and cover materials, climate regulating mechanisms and crop growing media (soil or soiless).

The main factors for the variation are crop response, local climate, availability of water, soil and water quality, labor, availability of materials, expenditure (cost) and legislation.

A model or generic tool which takes into consideration the influence of cover properties, passive heating/cooling and ventilation area on greenhouse climate and yield, regarding passive optimal greenhouse design introduced by Wageningen University and Plant Research International (PRI) was employed in this paper. The tool was set up as an integral approach and constructed in Matlab to execute sensitivity analysis of selected design parameters and simulation of indoor climate and yield.

OBJECTIVE

The purpose of this research to determine the effect of cover properties on yield that means on indoor climate. The output of this research will enable to growers and greenhouse horticulture designer to look for best possible or optimum type of cover material.

2 MATERIALS AND METHOD

For major varieties of rose grown in Ethiopian highland their response to temperature, RH%, light and CO_2 were reviewed so as to make set point. For specific variety grown in Ethiopian PAR requirements is 700-900µmol/m^2/s [16], temperature requirements is 17-25^{0}C [17] and relative humidity requirements should be 60-80% [14].

The model comprises of state variables that vary with time (greenhouse air temperature, canopy temperature, soil temperature, vapor concentration of greenhouse air, greenhouse CO_2 concentration and total biomass), control inputs (shade screen, white wash and ventilation opening control) and external inputs (solar radiation, wind speed, outdoor temperature, outdoor air vapor concentration and outdoor air CO_2 concentration). The model output is in hourly values and thus the external inputs were in hourly basis. Hence, hourly sky global radiation value was calculated and other external inputs except CO_2 were collected from Ethiopian meteorological agency. Outdoor CO_2 concentration was assumed to be constant that is 340ppm.

The various equations which were used in the model and computed by ode (15) of Matlab:

2.1 ENERGY BALANCE IN GENERIC TOOL

According to Bot, (1983) as quoted by El Ghoumari et al., [6] the dynamic behavior of state variables (temperature, humidity and CO_2) within the greenhouse is governed by the energy and mass balances. The energy balance which influences greenhouse temperature is affected by the energy contribution of the heating system, the energy losses caused by the energy exchange between the cover and the outside environment as well as through the natural ventilation provided by the windows, and finally the energy contribution of the solar radiation.

The heat fluxes among different components of the greenhouse (cover, soil, crop and air) were introduced in the generic tool indicated in the equations below. Radiative and convective heat exchanges among the components were described in the energy balances of the states.

ENERGY BALANCE FOR THE GREENHOUSE AIR TEMPERATURE

To compute the greenhouse temperature at different time instant, the differential equation which contains the different convective heat fluxes has been stated as shown below (eq.1).

$$Cap_{Air}\frac{dT_{Air}}{dt} = H_{canair} - H_{AirOut} - H_{Airflr} - H_{air\,\mathrm{cov}} \ldots\ldots [Wm^{-2}] \quad (1)$$

ENERGY BALANCE FOR THE COVER TEMPERATURE

To compute the cover temperature at different time instant, near infrared and PAR components of the solar radiation, longwave radiation fluxes and convective heat fluxes among different bodies were listed out in the differential equation stated below (eq.2):

$$Cap_{\mathrm{cov}}\frac{dT_{\mathrm{cov}}}{dt} = R_{sun\,\mathrm{cov}} + H_{air\,\mathrm{cov}} + L_{air\,\mathrm{cov}} + R_TIR_{can\,\mathrm{cov}} + R_TIR_{flr\,\mathrm{cov}} - H_{\mathrm{cov}\,out} - R_TIR_{\mathrm{cov}\,Ssy} \ldots\ldots\ldots\ldots [Wm^{-2}] \quad (2)$$

ENERGY BALANCE FOR THE CANOPY TEMPERATURE

Similar to cover temperature computation, the differential equation of canopy temperature comprises near infrared and PAR portion of solar radiation, longwave heat fluxes and convective heat fluxes among various greenhouse components indicated in the equation below (eq.3).

$$Cap_{can}\frac{dT_{can}}{dt} = R_PAR_{suncan} + R_NIR_{suncan} - H_{canair} - L_{canair} - R_TIR_{can\,\mathrm{cov}} - R_TIR_{canflr} - R_TIR_{cansky} \ldots\ldots\ldots\ldots [Wm^{-2}] \quad (3)$$

ENERGY BALANCE FOR GREENHOUSE FLOOR TEMPERATURE

To calculate the greenhouse soil temperature at different time instant, in the same manner, near infrared and PAR portion of solar radiation, longwave heat fluxes and convective heat fluxes among greenhouse components were taken into account, described in the equation below (eq.4):

$$Cap_{flr}\frac{dT_{flr}}{dt} = R_PAR_{sunflr} + R_NIR_{sunflr} + H_{airflr} + R_TIR_{canflr} - R_TIR_{flr\,\mathrm{cov}} - H_{flrso1} - R_TIR_{flrsky} \ldots\ldots\ldots [Wm^{-2}] \quad (4)$$

2.2 VENTILATION FLUX

Natural ventilation is caused by pressure differences between the indoor and outdoor air which are induced by two main forces: wind action and buoyancy or stack effect [3], [4].

VENTILATION FLUX FOR ROOF OR SIDE OPENING ONLY

This module of ventilation flux computation is used when the greenhouse is equipped with either roof or side opening only [15].

$$f_{vent} = \frac{A}{2}C_d\sqrt{2g(h/4)\frac{(T_{air} - T_{out})}{T_m} + C_w * V_{speed}{}^2} \ldots\ldots\ldots [m^3 m^{-2} s^{-1}] \quad (5)$$

2.3 VAPOR BALANCE AND TRANSPIRATION

Vapor balance in the greenhouse should take into account crop transpiration, vapor loss due to ventilation and condensation on the cover. The, equation stated below (eq.6) was used to compute the vapor pressure in the greenhouse at different instant of time.

$$con_VP_{air}\frac{dVP_{air}}{dt} = MV_{canair} - MV_{air\,\mathrm{cov}} - MV_{airout} \ldots\ldots\ldots\ldots [kg.m.^{-3} s^{-1}] \quad (6)$$

Transpiration from the canopy is calculated based on the vapour pressure difference between the canopy and greenhouse air as stated below (eq.7):

$$MV_{canair} = VEC_{canair}(VP_{can} - VP_{air}) \ldots\ldots\ldots\ldots [kg.s^{-1}.m^{-2}] \quad (7)$$

2.4 CARBON DIOXIDE BALANCE

Concerning carbon dioxide balance within the greenhouse, plants respiration and air exchange due to window ventilation affect carbon dioxide equilibrium [6].

Consequently, the following relationship was used to calculate the greenhouse carbon dioxide concentration. In the generic tool the carbon dioxide balance depends on the crop assimilation rate, respiration rate and flux through ventilation opening.

$$Gh_h * \frac{dCO_{2air}}{dt} = MC_{crpair_m} + MC_{crpair_g} - MC_{aircrp} - MC_{airout} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots [kgm^{-2}s^{-2}] \quad (8)$$

2.5 GROSS PHOTOSYNTHESIS RATE FOR ROSE OR GROWTH MODEL

Obtaining a growth model which can fit the generic tool was investigated.

GENERIC TOOL GROWTH RATE CALCULATION APPROACH

The approach in generic tool to compute photosynthesis was performed by introducing inhibition factors for light and carbon dioxide. Here, the inhibition factors are introduced based on parameters p1 and p2 respectively as illustrated below. For each factor, these parameters are crop specific which would enable to fit the response of photosynthesis calculated by this approach with respect to response of rose to these factors obtained from literature, particularly the result of [12]. That means the trend of the inhibition factors should at least be similar to the trend of photosynthesis versus these factors.

$$MC_{aircrp} = h_R_{can} * h_CO_{2_{air}} * MC_{aircrp_pot} \ldots\ldots\ldots [g(CO_2)m^{-2}hr^{-1}] \quad (9)$$

$$h_R_{can} = \frac{R_{can}}{p1 + R_{can}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots [-] \quad (10)$$

$$h_CO_{2air} = \frac{CO_{2air}}{p2 + CO_{2air}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots [-] \quad (11)$$

$$MC_{aircrp_h} = h_Tcan * h_Tcan24 * MC_{aircrp} \ldots\ldots\ldots\ldots [g(CO_2)m^{-2}hr^{-1}] \quad (12)$$

$$\frac{dYield}{dt} = HI * \beta_CO_2_CH_2O * \beta_CH_2O_DM * (MCaircrp - MCcrpair) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots [kg(DM)m^{-2}s^{-1}] \quad (13)$$

For temperature, a trapezoidal temperature filter was used for mean and instantaneous temperature of the canopy. The generic tool has these temperature inhibition factors based on the crop response to temperature, thus rose response to mean temperature and instantaneous temperature were considered as indicated in the figure 1**Erreur ! Source du renvoi introuvable.**. The inhibition factor ranges between one and zero, and when the temperature is in the optimal range, then the inhibition factor becomes one or there is no punishment. Otherwise there is a punishment when the temperature is out of the optimal range in both cases.

By taking into consideration MCaircrp_pot as canopy photosynthesis, it is possible to use this approach for this research work to compute net photosynthesis. And finally yield was calculated as harvested number of stems.

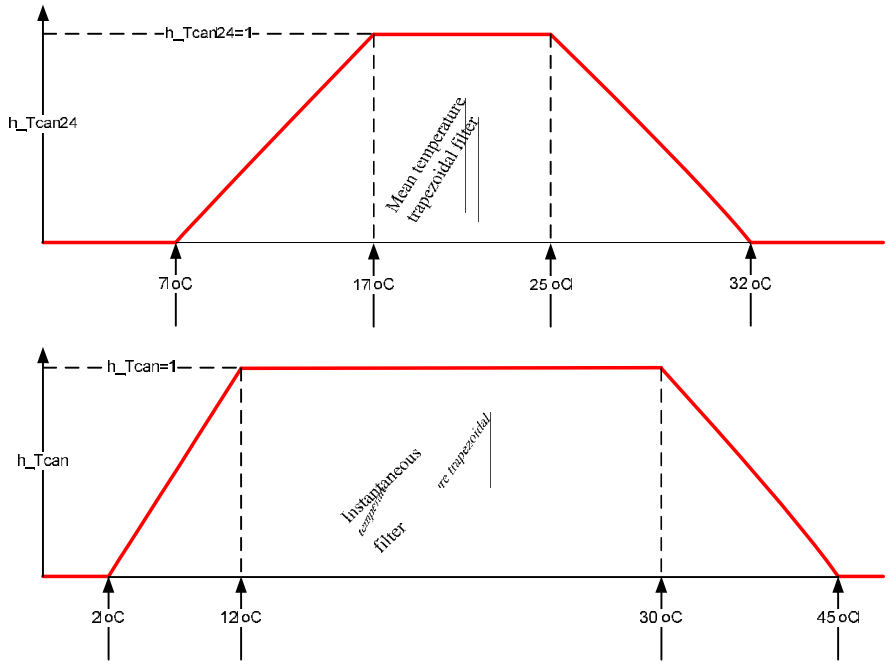

Figure 1.Temperature growth inhibition factor computation method

2.6 SENSITIVITY ANALYSIS FOR GREENHOUSE COVER PROPERTIES

In the sensitivity analysis, the extent of influence of selected parameters (cover PAR transmissivity, cover NIR transmissivity and cover longwave emission coefficient) on rose yield was calculated. This helps to analyze which parameter(s) influence the greenhouse indoor climate and dry matter production and extent of influence. Specifically, small change in design parameters and the resulting change in crop yield were computed.

In this analysis, the values of the existing Ethiopian greenhouse cover PAR and NIR transmissivity were considered as nominal value, then the percent change in dry matter production when these design parameters increased by 1% was calculated. The greenhouse cover which has been used by Ethiopian rose growers is assumed to be LDPE (a low-density polyethylene film) film, and it has 0.83 PAR transmissivity and 0.87 NIR transmissivity (nominal value) [13]. Also the ventilation area per span is 60 meter square per 960 m^2 floor area was considered. Moreover, cover nomial value for longwave emission coefficient is 0.67.

According to van Henten (1994) as cited by Vanthoor et al., [18], the relative sensitivity of yield for the design parameters is calculated as described below.

$$S_r(t) = \frac{Yield_{Pnom+\Delta p}(t) - Yield_{Pnom}(t)}{Yield_{Pnom}(t)} * \frac{P_{nom}}{\Delta P} \qquad (14)$$

$$\Delta P = h * P_{nom} \qquad (15)$$

Where, h is perturbation factor (0.01), $Yield_{Pnom}$ is the yield at nominal value of the design parameters, $Yield_{Pnom+\Delta P}$ is the increase in yield when the design parameter increased by 1 percent (h) and P_{nom} is the nominal value of the design parameters.

3 RESULT AND DISCUSSION

The validation of the model showed that there is little difference between simulated and measured greenhouse air temperature (Figure 2).

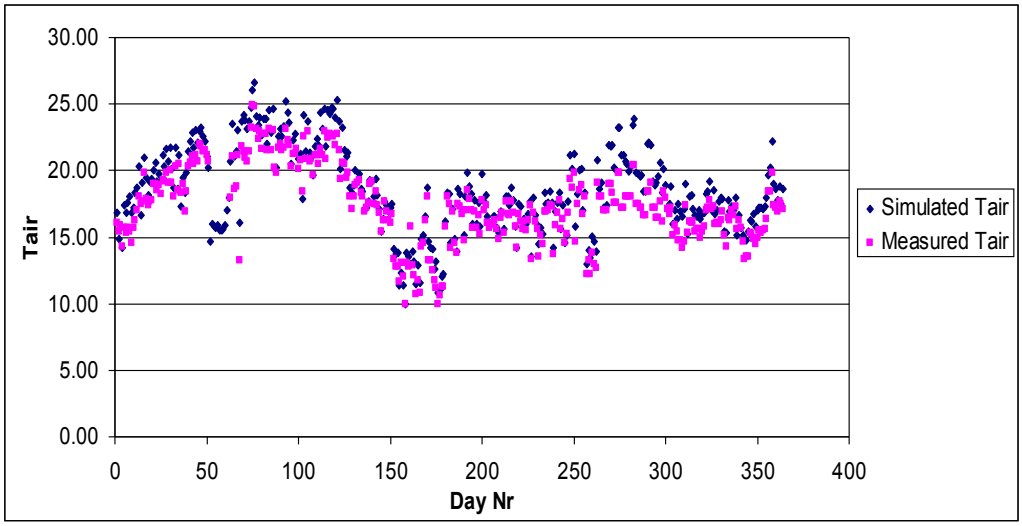

Figure 2. Comparison of simulated and measured mean daily greenhouse temperature

According to the sensitivity analysis executed, the influence of the parameters on dry matter production during summer and winter is quite different. As indicated in the table 2, the increase in PAR transmission by one percent during winter (rainy season) results in 0.647 percent increment in dry matter production, whereas a percent increase in PAR transmission in summer (dry season) results in 0.398 percent decrease in dry matter (table 1), where its impact is lower in reference to winter period. As figure shows, PAR transmission has high influence on canopy temperature, thus during winter period since the surrounding temperature is very low, higher PAR transmission would enable higher canopy temperature, consequently favors better photosynthesis. On the other hand, during summer period since the surrounding temperature is relatively high, higher PAR transmission would again result higher canopy temperature (figure 3), hence inhibits photosynthesis.

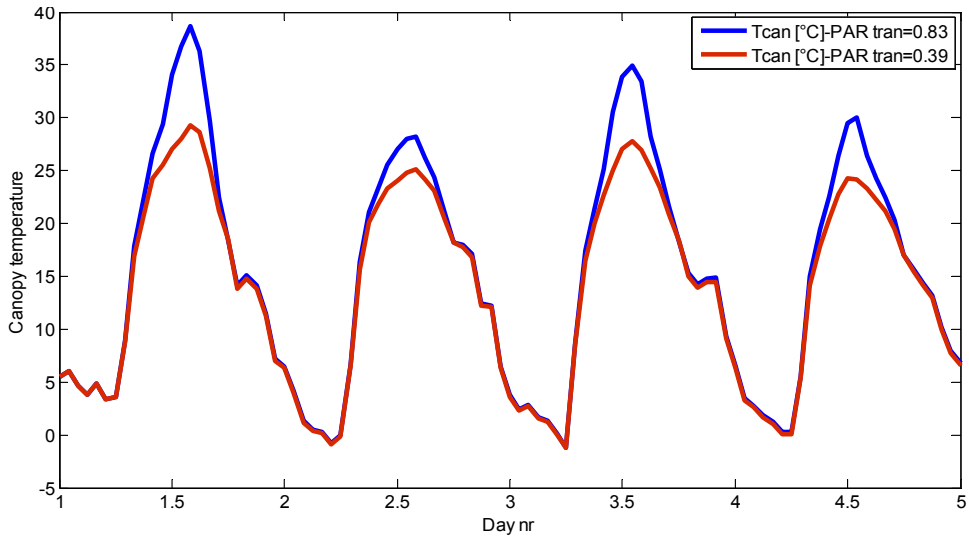

Figure 3. The effect of cover PAR transmissivity on canopy temperature

Moreover, the simulation result showed that (Figure 4) there is significant difference in the number of rose stems harvested per unit area for different PAR values.

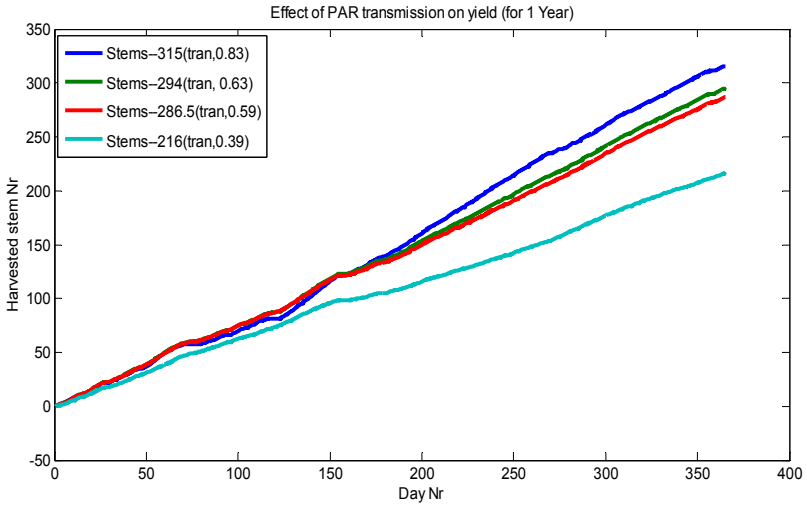

Figure 4. The effect PAR in the greenhouse on yield for one year

Concerning cover NIR transmissivity (table 1), during summer period it has high negative influence on dry matter harvest, that is, a percent increase in NIR transmissivity results in 0.409 percent decrement in dry matter, similarly, during winter the increase in NIR transmissivity lower the yield, but with small amount (0.009). From figure 5, the increase in NIR transmission resulted an increase of greenhouse air temperature, however, during summer period in particular, such increment would result a temperature range beyond the crop requirement in which it negatively influence the photosynthesis. Despite the increase in NIR resulted a decrease in yield for winter season, figure 5 clearly illustrated that low temperature is still a problem particularly during night time. Such night time undesirable climate punishment in production not yet included in any growth model.

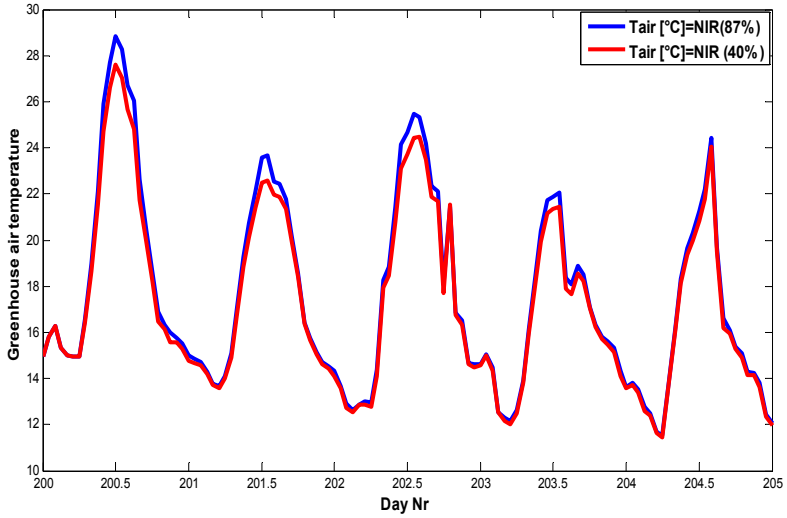

Figure 5. The effect of NIR transmissivity on greenhouse air temperature

Cover longwave emission coefficient has less influence on dry matter harvest when compare to the previous cover spectral properties. The sensitivity analysis illustrated that a percent increase in longwave emission coefficient during winter and summer season (table 1 and 2 respectively) has little positive influence on dry matter harvest. The positive influence of cover longwave emission coefficient during summer period (0.068% yield increment) due to the fact that high canopy temperature which adversely affect photosynthesis can be reduced by higher value of emission coefficient, that is, reducing the heat load would be possible. Similarly, during winter period since the canopy and indoor temperature are relatively lower, increased emission coefficient can further lower these temperatures, consequently production is negatively affected. Thus, this can be linked with its influence on the range of temperature that inhibits or favors production.

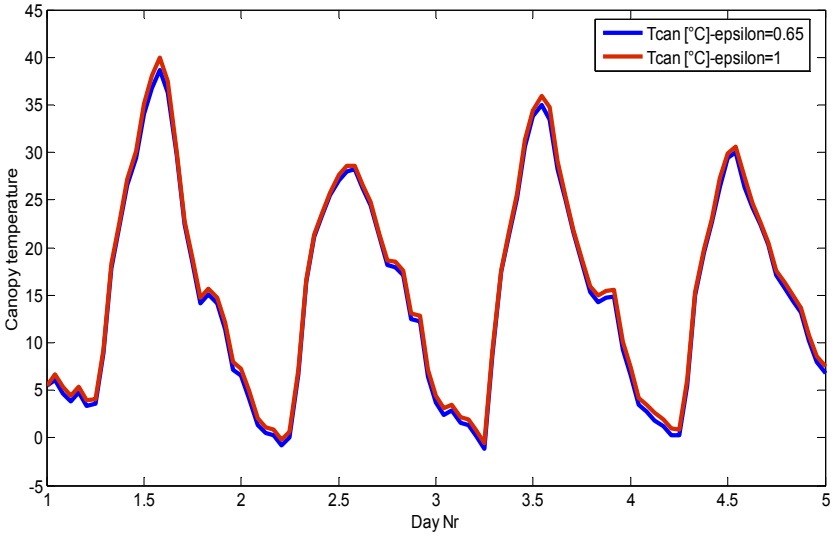

Figure 6. The effect of cover longwave emission coefficient on canopy temperature

In a yearly base assessment of integrated mean relative sensitivity (table 3), PAR transmission by 1% has resulted 0.009% increment on rose yield. The dry matter increment is notably low owing to the fact that PAR transmission has high influence on canopy temperature (table 3 and figure 1) which would consequently affect dry matter harvest.

However, percent increment in NIR transmission has significant influence in dry matter harvest (reduced by 0.25%). This is because of longer summer period in Ethiopia resulted higher indoor and canopy temperature and hence increment of NIR transmission would further increase these temperatures beyond crop requirement. Concerning cover longwave emission coefficient, its increment resulted in 0.044% higher production. As discussed by since heat load is high during longer period (summer), reduction of this heat load can be achieved by increasing the emission coefficient, thus, production can be favored.

Table.1 Integrated relative mean sensitivity analysis for summer season

	Integrated mean relative sensitivity/Summer period		
States	tau-PARcov	tau-NIRcov	epsilon-covup
Tcov	0.081	0.036	-0.125
Tair	0.104	0.047	-0.024
Tcan	0.19	0.079	-0.029
Tflr	0.15	0.117	-0.024
VPair	-0.024	-0.008	0.001
CO_2air	-0.002	0.003	-0.001
DM_{hararv}	-0.398	-0.409	0.068

Table 2 Integrated relative mean sensitivity analysis for winter season

Integrated relative mean sensitivity analysis/Winter period			
States	tau-PARcov	tau-NIRcov	epsilon-covup
Tcov	0.045	0.021	-0.119
Tair	0.062	0.029	-0.022
Tcan	0.109	0.047	-0.024
Tflr	0.09	0.086	-0.021
VPair	0.021	0.009	-0.006
CO2air	-0.007	0.002	-0.001
DM_{harv}	0.641	-0.009	-0.013

Table 3 Integrated relative mean sensitivity analysis for one year

	Integrated relative mean sensitivity analysis/One year		
States	`tau-PARcov	tau-NIRcov	epsilon-covup
Tcov	0.071	0.032	-0.13
Tair	0.093	0.042	-0.026
Tcan	0.166	0.07	-0.029
Tflr	0.133	0.11	-0.024
VPair	-0.002	0	-0.002
CO_{2air}	-0.005	0.002	-0.001
DM_{harv}	0.009	-0.259	0.044

4 CONCLUSION

To assess the influence of cover spectral properties growth model which encompasses effect of night time adverse climatic condition is very crucial

The study revealed that the existing cover NIR transmission has negative influence on production particularly during summer season. Thus, for this cover use of white wash would be advisable to reduce high indoor temperature.

For Ethiopian highland greenhouse horticulture cover with higher PAR transmission, relatively lower NIR transmission and higher long-wave emission coefficient will enhance rose production.

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SYMBOLS

Abbreviation/ symbol	*Description*	*Value*	*Unit*
$\beta_CO_2_CH2O$	Conversion factor from CO_2 to CH_2O	30/44	-
$\beta_CH_2O_DM$	Conversion factor from CH_2O to Dry matter	0.8	-
MCaircrp_h	Photosynthesis rate	-	$kg(CO_2)\ m^{-2}\ s^{-1}$
MCcrpair_m	Maintenance respiration rate		$kg(CO_2)\ m^{-2}\ s^{-1}$
tau_NIR	Cover near infrared transmissivity	0.87	-
tau_PAR	Cover PAR transmissivity	0.83	-
epsilon-covup	Cover long-wave emission coefficient	0.67	
A	Roof ventilation opening area	60	m^2
Cap_{Air}	Heat capacity of the air	10^3	$J\ m^{-2}\ K^{-1}$
Cap_{can}	Heat capacity of the canopy	$1.2*10^3$	$J\ m^{-2}K^{-1}$
Cap_{cov}	Heat capacity of the cover	$2.5*10^3$	$J\ m^{-2}\ K^{-1}$
Cd	Discharge coefficient	0.705	-
con_VP_{air}	Vapor pressure constant	-	$kg.m^{-3}.J^{-1}$
Cw	Global wind coefficient		-
DM_{harv}	Percent dry matter harvest	-	%
fvent	Ventilation flux	-	$m^3m^{-2}s^{-1}$
g	Acceleration due to gravity	9.8	$m\ s^{-2}$
h_CO_2air	Inhibition factor for CO2	-	-
h_Rcan	Inhibition factor for radiation	-	-
h_Tcan	Inhibition factor for temperature	-	-
h	vertical height of ventilation opening	6.2	m
Haircov	Sensible heat greenhouse air to cover	-	$W\ m^{-2}$

Hairflr	Sensible heat greenhouse air to the floor	-	$W\ m^{-2}$
Hairout	Sensible heat greenhouse air to the surrounding due to ventilation	-	$W\ m^{-2}$
Hcanair	Sensible heat canopy to air	-	$W\ m^{-2}$
Hcovout	Sensible heat cover to the surrounding	-	$W\ m^{-2}$
HEC	Convective heat exchange	-	$Wm^{-2}K^{-1}$
HECaircov	Convective heat exchange air to cover	-	$Wm^{-2}K^{-1}$
HECairflr	Convective heat exchange air to floor	-	$Wm^{-2}K^{-1}$
HECcanair	Convective heat exchange canopy to air	-	$Wm^{-2}K^{-1}$
Hflrsol	Sensible heat floor to soil	-	$W\ m^{-2}$
HI	Harvest Index	65	%
Laircov	Latent heat greenhouse air to cover	-	$W\ m^{-2}$
Mcaircrp	Crop CO_2 assimilation rate	-	$kg\ (CO_2)\ m^{-2}s^{-1}$
MCcrpair	Maintenance respiration		$kg\ (CO_2)\ m^{-2}\ s^{-1}$
Mcaircrp_pot	Potential crop CO_2 assimilation rate	-	$kg\ m^{-2}s^{-1}$
MVcanair	Vapor flux from canopy to air	-	$kg.s^{-1}.m^{-2}$
MVaircov	Vapor flux air to cover	-	$g\ m^{-2}\ s^{-1}$
PAR	Photosynthetic active radiation	-	$\mu mole\ m^{-2}s^{-1}$
NIR	Near Infrared	-	$\mu mole\ m^{-2}s^{-1}$
P1	Crop parameter for radiation inhibition	-	-
P2	Crop parameter for CO_2 inhibition	-	-
R_TIRcancov	Longwave radiation canopy to cover	-	$W\ m^{-2}$
R_TIRcanflr	Longwave radiation canopy to the soli	-	$W\ m^{-2}$
R_TIRcansky	Longwave radiation canopy to sky	-	$W\ m^{-2}$
R_TIRcovsky	Longwave radiation cover to sky	-	$W\ m^{-2}$
R_TIRflrcov	Longwave radiation the soil to the cover	-	$W\ m^{-2}$
R_TIRflrsky	Longwave radiation floor to sky	-	$W\ m^{-2}$
Tair	Greenhouse air temperature	-	^oC
Tcan	Canopy temperature	-	^oC
Tcov	Greenhouse cover temperature	-	^oC
Tflr	Floor temperature	-	^oC
Tm	Mean temperature	293	^oK
Tout	Surrounding temperature	-	^oC
Vspeed	Wind speed	-	$m\ s^{-1}$
VP_{can}	Vapor pressure on canpy	-	Pa
VP_{air}	Vapor pressure of greenhouse air	-	Pa
VEC_{canair}	Vapor exchange coefficient	-	$kg.s^{-1}.Pa^{-1}.m^{-2}$

REFERENCES

[1] Abdel-Ghany, A.M. and Kozai, T. Dynamic modeling of the environment in a naturally ventilated, fog-cooled greenhouse. *Renewable Energy* 31, 1521–1539, 2006.

[2] Bank, W. (2004a). "Opportunities and Challenges for Developing High-Value Agricultural Exports in Ethiopia. Poverty Reduction and Economic Management 2, Country Department for Ethiopia Africa Region."

[3] Boulard,T., Feuilloley,P. and Kittas,C. Greenhouse Ventilation Rate: Theory and Measurement With Tracer Gas Techniques. J. *agric . Engng Res* . 67, 249 – 266, 1997.

[4] Baptista,F.J., Bailey, B.J., Randall, J.M. and Meneses, J.F. Greenhouse Ventilation Rate: Theory and Measurment with Tracer Gas Techniques. *J. Agric. Engng Res.* 72, 363-374, 1999.

[5] Danse,M.,Maden, E.v.d. and Valkman,S. "Development of the EHPEA Code of Practice;Results of fieldwork conducted." Wageningen University, Wageningen, 2007.

[6] El Ghoumari, M.Y., Tantau., H.-J. and Serrano,J. Non-linear constrained MPC: Real-time implementation of greenhouse air temperature control. *Computers and Electronics in Agriculture* 49, 345–356, 2005

[7] Elsner, B. von. , Briassoulis, D., Waaijenberg, D., Mistriotis, A., Zabeltitz, C.V., Gratraud,J., Russo, G. and Suay-Cortes,R. Review of Structural and Functional Characteristics of Greenhouses in European Union Countries :Part II, Typical designs. *Agric. Engng Res* 75, 1-16, 2000.

[8] Frausto, H.U. and Pieters, J. G. Modelling greenhouse temperature using system identification by means of neural networks. *Neurocomputing* 56, 423 – 428, 2004.

[9] Ganguly,A. and Ghosh,S. Modeling and analysis of a fan–pad ventilated floricultural greenhouse. *Energy and Buildings* 39, 1092–1097, 2007.

[10] Jensen, H. M. Controlled Environment Agriculture in Deserts, Tropics, and Temperate Regions-A World Review. *In* "International Symposium on Design and Environmental Control of Tropical and Subtropical Greenhouses". Controlled Environment Agricultural Center, University of Arizona Tucson, AZ 85721, Taichung, Taiwan, 2001.

[11] Kass,N. "Floriculture Industry in Ethiopia:Trends, Prospects and Challengs." Jimma University College of Agriculture and Veterinary Medicine, Ethiopia., Jimma, 2006.

[12] Kim S-H. and Leith, J. H. A coupled model of Photosynthesis, Stomatal conductance and Transpiration for rose leaf (Rosa Hybrida L.). *Annals of Botany* 91, 771-781, 2003.

[13] Kittas C. and Baille, A. Determination of the Spectral Properties of Several Greenhouse Cover Materials and Evaluation of SpeciÞc Parameters Related to Plant Response *J. agric. Engng Res.* 71, 193-202, 1998.

[14] Larson, R. A. "Introduction to Floriculture " 2/Ed. Harcourt Brace Jovanovich, 1992

[15] Parra, J.P., Baeza, E., Montero, J.I. and Bailey, B.J. Natural Ventilation of Parral Greenhouses. *Biosystems Engineering* 87(3), 355-366, 2004.

[16] Samartzidis, C., Awada,T., Maloupa,E., Radoglou, K. and Constantinidou, H.-I.A. Rose productivity and physiological responses to different substrates for soil-less culture. *Scientia Horticulturae* 106, 203-212, 2005.

[17] Salinger, J. P. "Commercial Flower Growing," 1/Ed. Butterworths of New Zealand, Wellington, 1985.

[18] Vanthoor B., Stanghellini, C., Henten, E.v. and Garrido, J.C.G. The Combined Effect of Cover Design Parameters on Production of a Passive Greenhouse. Wageningen University, 2008.

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Phytoremediation study of Copper-Contaminated Soil Using Soybean (*Glycine Max* (L) Merril) with Compost Addition

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ABSTRACT: Phytoremediation study of Cu-contaminated soil using soybean (*Glycine Max* (L) Merril) with compost addition was conducted. This study was aimed to determine the Cu concentration in soil and soybean plant, to examine the feasibility of soybean plant (*Glycine Max (L)* Merril) as a hyperaccumulator plant for Cu metals with compost addition. Analysis methods used in this study included voltammetry, translocation factor, and enrichment factor. Study results indicated that Cu concentration in soil and plant was 87.363 mg/g and 68.509 mg/g, respectively. Soybean plant (*Glycine Max* (L) Merril) was classified as Cu hyperaccumulator with EF value > 1 and total accumulated Cu for control and compost treatment group was 80.444 mg/g and 63.234 mg/g, respectively. The addition of compost was capable of inhibiting the heavy metal Cu rate in the soil.

KEYWORDS: Phytoremediation, Copper, *Glycine max* (L) Merril, compost.

1 INTRODUCTION

Soil is the habitat for many living organisms including plants and human. The contaminated soil will jeopardize the survival of living organisms including human. Soil contamination can be resulted from excessive and perpetual use of fertilizers and pesticides containing specific chemical agents, particularly heavy metals. The contaminants such as heavy metals that get into soil water are naturally less degradable and toxic to organisms. Among the heavy metals potentially to contaminate environment are cadmium (Cd), chromium (Cr), iron (Fe), lead (Pb), nickel (Ni), copper (Cu) and others. According to [5], environmental pollution sources can be from industrial wastes and anti-corrosion paint manufacturers. Those wastes will be decomposed gradually into leachate. The leachate formation process can transfer the heavy metals from rooting layer to underlying soil layer, making the soil contaminated and potentially to retard the plant growth [13].

Copper (Cu) has been found in abundant numbers in water, soil, and air either in its ionic or compounding forms. Despite its toxicity, Cu is highly needed by human in trace level. [7] suggested that copper pollution sources are metal welding waste, industrial or domestic wastes, mineral mining and leaching. Copper is derived also from pulp industrial wastes [4]. The toxicity of Copper will be activated when this metal gets into organism body in big quantity or exceeding the organism tolerance level threshold. In high concentration of copper can damage the liver organ [2].

Various attempts have been made to control the heavy metal pollutions, either physically such as electrolysis and electrodialysis or chemically such as precipitation [3]. These methods are considered less effective with relatively expensive operational cost. The use of biological material, therefore, is a proposed alternative solution in managing the heavy metal wastes. It can remove or reduce the pollutants, organic or inorganic, in an environment is known as phytoremediation [9]. According to [11], phytoremediation is a technology that utilizes plants to clean up environmental pollution and some advantages in its application are relatively low cost, environmentally friendly, and cost saving up to 90%. In addition, Indonesia has a large plants and microorganisms biodiversity and capable of degrading and immobilizing heavy metal compounds and other organic compounds [8]. Phytoremediation was implemented in various research fields from the

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management of alkaline soil, oil spills until researches on agricultural plants that absorb and accumulate heavy metals. Some of the plants that have been reported as phytoaccumulators for heavy metals are land cress (*Ipomea reptans* Poir) and *Brassica rapa* that are potential as hyperaccumulator for nickel with phytoextraction ability of 699.9 mg/Kg and translocation factor of 1.25 and 2.15, respectively [9]. *Brassicaceae, Asteraceae, Pteridaceae, Thlaspi sp, Halophytes* [1] and *Ipomoea* species *Ipomoea alphine* have been found to accumulate 12,300 mg/Kg copper (Cu) in its leaves [6,10].

Soils contaminated by heavy metals has a very limited ability in providing nutrients needed by plants. This situation requires the addition of organic materials that are able to enrich nutrients in the soil. Organic materials enrichment can be made by, for example, compost addition [12]. In addition to enriching nutrients in the soil, compost is also useful in improving the soil physical structure, increasing and stabilizing soil pH, inhibiting the heavy metals movement to prevent leaching into the soil [13]. Microorganisms in the soil degrade the compost inhibiting heavy metal rate. Thus, in long period,these metals will be fee elements (nutrients) that will be absorbed by plants for growing process of plants such as soybean. Soybean plant is one of the important vegetables with high economic value and suitable to be developed in tropical region like Indonesia. A study by [13] found that vetiver plant (*Vetiver zizanioides*) can restore the mercury-contaminated soil by 65.252% using compost with contaminated-soil to compost ratio of 90%:10%. Based on this result, it is considered important to conduct a phytoremediation study of Cu-contaminated soil using soybean (*Glicine max* (*L*) Merril)with compost addition.

2 MATERIAL AND METHOD

2.1 MATERIALS

Materials were used in this study consisted of contaminated soil (laboratory waste), *Glycine max* (L) Merril seeds, aquadest, $CuSO_4$, HNO_3 65%, H_2O_2 30%, HCl, NPK fertilizer, and compost.

2.2 METHOD

The study was conducted in an experimental and greenhouse setting and samples were analyzed using voltammetry method. This study was conducted in four steps: preparation of Cu-contaminated growing medium, seeding and planting of the plants, growth observation during growing period, and harvesting. The contaminated soil was put into both of control and treatment lysimeter added with compost in the ratio of 9:1 kg contaminated soil and compost. The used plants were soybean plants *Glycine max (L) merril* that had been pre-planted for 4 month. After the specified growing period elapsed, the soybean plants were harvested and separated based on its morphology (roots, stems, leaves, and fruits). they were cleansed and dried in oven for 24 hours at 100^{o}C. Before analysis, the dried biomass of the samples was destructed by 9 mL aquaregia. The obtained filtrate was analyzed using Ingsen 1030 voltammeter. To identify the plant potential as a hyperaccumulator plant, the Translocation Factor (TF) and the Enrichment Factor (TF) were calculated with the following formula:

$$\textit{Translation Factor (TF)} = \frac{\textit{[Metal] Leaves mg/g}}{\textit{[Metal] Roots}} \quad (1)$$

$$\textit{Enrichment Factor (EF)} = \frac{\textit{[Metal] Leaves mg/g}}{\textit{[Metal] Soil}} \quad (2)$$

3 RESULTS AND DISCUSSION

3.1 SOIL PHYSICOCHEMICAL PARAMETERS TEST

The first step in this study was the test of physicochemical parameters to determine the composition and fertility level of the soil used in this study. The results of physicochemical analysis areshown in Table 1. The important chemical properties of the soil medium included pH, cation exchange capacity (CEC), and essential nutrients. The pH of soil is very important to know because it dictates the absorbability of nutrient ions by the plant.

Table 1. Physicochemical properties of the soil

Parameter	Level	Parameter	Level
Water content	8.52 %	C	-
Clay	45 %	N	0.24 %
Dust	35 %	P_2O_5(ppm)	15.68
Sand	20 %	K	0.8 %
Texture class	Clay	Zn	0.058 %
CEC (cmol/Kg)	32.24	Ca	5.82%
Soil pH	6.8	Mg	-
		Na	-
		Al	10.45

According to the texture analysis results, the medium soil was found to have relatively high clay fraction (45%). According to Hanafiah, K.A., (2012), such texture condition is categorized as clay. The soil pH measurement in lysimeter during growing period indicated average pH of 6.8 and 6.7,either in control or compost-treated plot. They were normally for plants to absorb nutrients in the medium despite the available nutrients. CEC value of the medium has a very important role in term of nutrients supply and has an effect on medium buffering capacity. The soil sample used in this study has a high ability in storing and releasing cations and high buffering capacity. Nutrient analysis in the soil sample indicated that the essential nutrients content such as K, Ca, and Mg were categorized as low and less fertile.

3.2 COPPER (CU) CONCENTRATION IN SOIL AND SOYBEAN PLANT

Analysis was repeated three times for more accurate results. Table 2 and Figure 1 show the comparison of total Cu concentration in soil and those in plants, where the Cu concentration was higher in plant compared to in soil, either in control or compost-treated lysimeter.

Table 2. Comparison of Cu concentration in soil and plant

Sample	Cu concentration (mg/g)	
	Control	+ compost
Soil	6.91	5.27
Plant	80.44	63.23

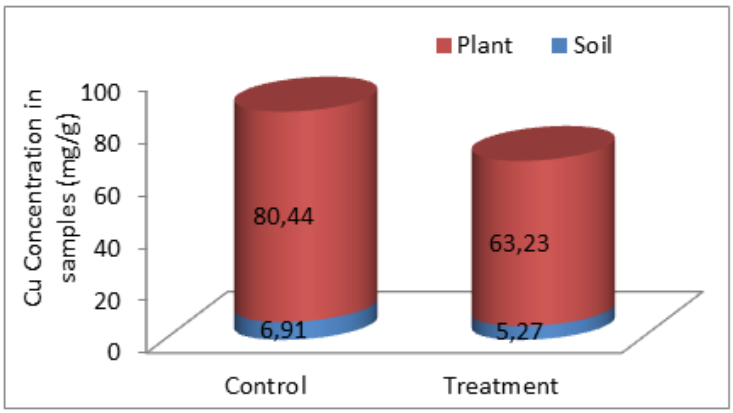

Figure 1. Comparison of Cu in soil and plant

The results of this study (Figure 1) indicate that Cu concentration in plant is higher than in soil, either in control or compost-treated lysimeter. This indicates that soybean plants have a high ability to accumulate Cu in soil. In addition, compost addition in lysimeter inhibited and retardedthe influx rate or accumulation of Cu into plant as shown in Figure 1, where the concentration of accumulated Cu by plant in compost-treated lysimeter was lower compared plant in control lysimeter. The Cu concentration was 62.23 mg/g (compost-treated lysimeter) and 80.44 mg/g (control lysimeter).

3.3 COPPER (CU) DISTRIBUTION IN SOYBEAN PLANTS

Data on Cu distribution were presented in Table 3 and Figure 2.

Table 3. Cu distribution in plants according to control and compost treatment groups

Plant organ	Control (mg/g)	Treatment (mg/g)
Root	36.2	42.86
Stem	11.15	5.85
Leave	6.44	7.72
Fruit	26.63	6.79

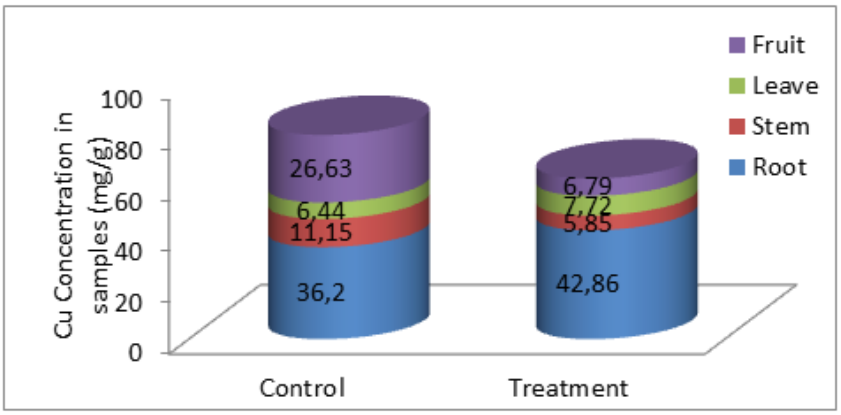

Figure 2. Comparison of Cu distribution in plant parts of control and compost treatment group.

Table 3 and Figure 2 indicate Cu concentrate more on roots of soybean (36.20 mg/kg for control and 42.86 mg/g for compost treatment) compared to stem, leaves, and fruits. This was related to the plant that localize metal elements by accumulating them in roots part as a way to anticipate toxicity by metal elements to plant cell, thus not inhibiting the plant metabolism process (Collins, 1999).

3.4 IDENTIFICATION OF PHYTOREMEDIATION MECHANISM AND HYPERACCUMULATOR PLANT

Phytoremediation mechanism can be established by determining the translocation factor and enrichment factor value (Lorestani et. al., 2011 and Branquinho, et. all., 2006). Translocation factor was determined by calculating the comparison between metal concentration in leaves and roots. Whereas the enrichment factor was determined by calculating the comparison between metal concentration in leaves and in soil. According to Lorestani (2011), when a plant has TF >1 and EF >1, it is categorized as a hyperaccumulator plant. The determination of TF and EF value for Cu by soybean plants is presented in Table 4 and Figure 3.

Table 4. Relationship between Cu metal TF and EF in soybean plant

Lysimeter	**Cu**	
	TF	**EF**
Control	0.18	0.93
+ compost	0.18	1.46

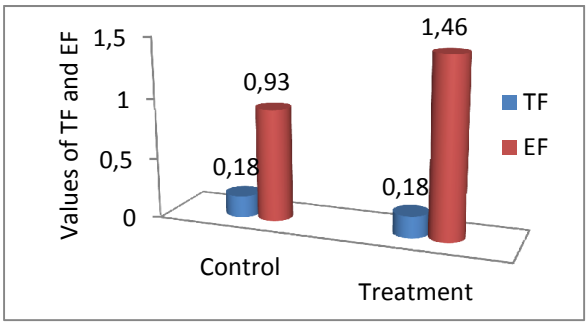

Figure 3. Relationship between TF and EF according to Cu concentration

According to Table 4 and Figure 3, they were found that TF of Cu in control and compost-treated plant were 0.175 and 0.180, respectively. The data showed phytoremediation mechanism of Cu using soybean plant, either in the both of control or compost treatment lysimeter, tended to follow phytostabilization mechanism. This was due to Cu that concentrates more in roots than in leaves.

EF value of Cu for control soybean plant was lower than EF value for compost-treated plant, namely 0.93 and 1.46, respectively (Figure 4). Based on these values, soybean plant with compost treatment is categorized as Cu hyperaccumulator plant.

4 CONCLUSION

Copper (Cu) concentration in soil and plant were 87.763 mg/g and 68.509 mg/g, respectively. Soybean plant (*Glycine max* (L) Merril) could be categorized as Cu hyperaccumulator plant with EF value > 1 and total accumulated Cu 80.444 and 63.234 mg/g, respectively. Compost can inhibit the Cu rate in soil.

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REFERENCES

[1] Aiyen, 2005. *Remediation Science to Overcome Soil Contamination in Aceh and North Sumatera,* (online) available: http:/www.kompas. Com/kompas-cetak/0503/04 /ilpeng/ 1592821. htm, (November 20, 2013)

[2] Darmono, 1995. *Metal in Living Organism Biological System,* Jakarta: Indonesian University Press.

[3] S., Fardiaz, 1992, *Water and Air Pollution*. Kanisius yogyakarta

[4] H., Hardiani, 2009, *The Plants Potential in Accumulating Cu in Soil Medium Contaminated with Solid Wastes of Pulp Industries*. *BS, Vol. 44, No. 1, June 2009:* Bandung

[5] Kartika, 2010, Water Pollution Paper (online) available: http:k4rti3k4.student.umm.ac.id/2010/ 01/22/makalah polusi air (December 17, 2013).

[6] M., Lasat, 2000, The Use of Plants for the Removal of Toxic Metals from Contaminated Soil (online), (htt://clu-in.org/dounload/remed/lasat.pdf

[7] A. Lutfi, 2009, Water Pollutants, (online) (http://chem-is-try.org.situs kimia indonesia, (May 22, 2014).

[8] M., Moenir, 2010, *Phytoremediation Study as an Alternative for heavy metal contaminated soil restoration. Industrial Pollution Prevention Technology*Vol. 1 No. 2.

[9] Muliadi, et all, 2013, *Phytoremediation and potential of nickel photomining in post-mining Land.* Proceedings of the National Seminar, the ministry of research and technology, Republic of Indonesia, ISBN. 978-602-18926-6-4, page 130-138

[10] Onrizal, 2005, Contaminated Restoration of Heavy metals, Faculty of Forestry and agriculture, University of North Sumatera.

[11] B.,Robinson, et all, 2003, *Phytoremediation : using plants as biopomps to improve degraded environments. www.publish. Csro. Au/journals/ajsr.* Australia Journal Of Soil Research, Vol 41, page 599-611.

[12] R., Sutanto, 2002, *The Application of Organic Agriculture (Socialization and Development)*.Kanisius Yogyakarta

[13] Y.,Triastuti 2013, Phytoremediation of Contaminated Soil withMercury (Hg^{2+}) using Vetiver Plant(Vetiver Zizanioides) in former landfill area, (online) Accessed in 14/01/2014, (*http://digilib.its.ac.id/public/ITSUndergraduate15478-3306100014-Abstract_id.pdf*

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Propriétés physico chimiques de lipide et quantification des protéines de graines des fruits Citrullus Colocynthis

[Physicochemical properties of lipid and quantification of proteins of Citrullus Colocynthis seed oil]

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ABSTRACT: To contribute to the development of local medicinal plants for their therapeutic properties, we are interested in the study of *Citrullus Colocynthis* plant known in traditional medicine. The *Citrullus Colocynthis* is a desert plant encountered on sandy soils in the region of Ghardaia and also very well known for its medicinal virtues. In the present work we have characterized the seed oil of the plant with a yield of 17,854%, for the determination of different chemical indicators such as the acid value (AV), iodine (II), of saponification (IS), peroxide (IP) and physical indicia as the refractive index (RI) and the density. The result shows that this oil is rich in fatty acids such as palmitic acid (C16) and stearic (C18)**.** The defatted seed contain a very large amount of proteins studied by three methods: Biuret, Lowry and Kjeldahl method.

KEYWORDS: *Citrullus Colocynthis*, fatty acids, Physicochemical properties, Protein.

RÉSUMÉ: Afin de contribuer à la valorisation des plantes médicinales locales pour leurs vertus thérapeutiques, nous nous sommes intéressés à l'étude de la plante *Citrullus Colocynthis* connue en médecine traditionnelle. La *Citrullus Colocynthis* est une plante saharienne rencontrée sur les terrains sablonneux de la région de Ghardaïa qui est aussi très réputée pour ses vertus médicinales. Dans le présent travail nous avons caractérisé l'huile des graines de cette plante qui présente un rendement de 17,854%, par la détermination des différents indices chimiques tels que l'indice d'acide (I_A), d'iode (I_I), de saponification (I_S), de peroxyde (I_P) et par des indices physiques comme l'indice de réfraction (I_R) et la densité. Le résultat obtenu montre que cette huile est riche en acides gras tels que les acides palmitiques (C16) et stéarique (C18). Les tourteaux renferment une quantité très importante des protéines étudiées par trois méthodes : méthode de Biuret, de Lowry et de Kjeldhal.

MOTS-CLEFS: *Citrullus Colocynthis*, Acides gras, Properties physique-chimiques, Protéine.

1 INTRODUCTION

Sur une superficie de 7 à 8 millions de kilomètres carrés, le Sahara ne compte guère que 3 à 4 millions d'habitants, cette population est presque condensée dans la partie septentrionale [1]. L'homme du Sahara a utilisé les plantes spontanées depuis les temps anciens bien que leur importance dans l'alimentation humaine est négligeable, mais il n'en va pas de même pour celle des animaux domestiques. Par ailleurs, certaines de ces plantes sont utilisées dans la médecine indigène ou dans le petit artisanat ; enfin elles représentent la source du bois de construction et chauffage [1] .

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Les corps gras sont des matières organiques fluides d'origine végétale ou animale, onctueuses insolubles dans l'eau et dans l'alcool. Les végétaux qui les produisent sont très variés. Chez les végétaux fournisseurs d'huiles « les oléagineux », les réserves lipidiques se rencontrent le plus souvent dans les graines ou dans la pulpe qui entoure le noyau des fruits. Les pistaches, les noix, les amandes etc… sont considérées comme des graines à fruits oléagineux, du fait de leur faible teneur en eau environ 5 % et de leur teneur élevée en lipides et en protéines, puisqu'elles contiennent 50 à 60 % de lipides et 14 à 21 % de protéines. Le taux élevé de glucide est en moyenne de 17 % dont 3 % de cellulose [2].

La présente étude s'intéresse à l'une des espèces spontanées, *Citrullus colocynthis* (L) c'est une plante herbacée vivace de la famille des *cucurbitacées*, à longue tiges rampantes qui s'étalent sur le sol pouvant ainsi atteindre 1 m de long, elle est entièrement hérissée de poils raides. Ces fruits sont sphériques et lisses ressemblant à des petites pastèques, colorées de vert foncé ou de jaune selon la maturité. [3]

2 MATERIELS ET METHODES

2.1 MATERIEL VEGETAL

La plante utilisée dans cette étude a été collectée le mois de février 2013 dans la région de « Al Mansourah » qui se situe dans la wilaya de Ghardaïa. Cette dernière se trouve dans la partie nord du Sahara Algérien, entre 32º28'60'' Nord et 3º40'00'' Est en DMS (degrés, minutes, secondes) ou 32.4833 et 3.66667 (en degrés décimaux).Celle-ci se limite au Nord par la wilaya de Laghouat ;au nord-est par la wilaya de Djelfa ; à l'est par la wilaya d'Ouargla ;au sud par la wilaya de Tamanrasset ; au sud-ouest par la wilaya d'Adrar ; et à l'ouest par la wilaya d'El Bayadh. La station d'étude «Al Mansourah », se situe à 70km au sud de Ghardaïa [4]. L'identification de cette plante a était confirmée au niveau de laboratoire de chimie à l'université Ammar TELIDJI de Laghouat.

2.2 EXTRACTION DES LIPIDES

Les fruits matures ont été coupés pour récupérer les graines qui ont été broyés finement puis menés à une extraction à chaud en utilisant le montage de SOXHLET et l'hexane comme solvant. Après trois heures, l'hexane récupéré est évaporé sous une pression réduite à 50°C à l'aide d'un rotavapeur [5], une huile visqueuse de couleur jaune ayant une odeur fétide a été obtenue.

2.3 TESTS PHYSICO-CHIMIQUES

Les normes internationales (International Organisation for Standardisation (ISO)) ont été utilisées pour déterminer les propriétés physico-chimiques tel que les indices d'acide, de saponification, d'iode, peroxyde et d'estérification [6]. L'indice de réfraction a été déterminé en utilisant un réfractomètre à une température de 20°C (ABBE 2WAJ), le lipide est mené à un test de pesé pour déterminer la densité.

2.4 EXTRACTION DES PROTEINES

A partir d'un gramme de tourteaux délipidés, les protéines sont extraites par une macération à froid pendant 24 heures et en utilisant 25 mL de trois solvants (NaCl 0,5 M, une solution tompan pH= 7,4 et l'eau distillée). Après filtration, le volume de l'extrait est ajusté à 100 mL par chaque solvant.

2.5 DOSAGE DES PROTEINES

Le dosage des protéines des trois extraits a été effectué par trois méthodes différentes :

2.5.1 MÉTHODE DE BIURET

Le dosage des protéines par la méthode de biuret a été effectué en utilisant le réactif de Gornall (Gornall et al 1949) qui a été ajouté à l'échantillon, après une incubation de 30 minutes. L'absorbance a été déterminée à une longueur d'onde égale à 540 nm [7].

La courbe d'étalonnage est faite à l'aide d'une solution mère de sérum albumine d'œuf à10g/l, puis on prépare des dilutions 1, 3, 5, 7 et 9 g / l, et on trace les variations de l'absorbance A en fonction de la concentration C du protéine (Figure 1), on obtient une droite de coefficient de corrélation $R^2 = 0,981$

2.5.2 METHODE DE LOWRY

Le dosage par la méthode de Lowry (Lowry et al 1951) est basé sur une combinaison d'une réaction entre la protéine et le biuret et une réaction du réactif de Folin-Ciocalteu.

Après une incubation de 40 minutes, la lecture de l'absorbance a été effectuée à une longueur d'onde égale à 750 nm [8].

La courbe d'étalonnage est faite à l'aide d'une solution mère de sérum albumine d'oeuf à 2 g/l, puis on prépare des dilutions 0.1, 0.2, 0.3 et 0.4 g / l et on trace A = f (C), on obtient une droite de coefficient de corrélation R^2 = 0.988

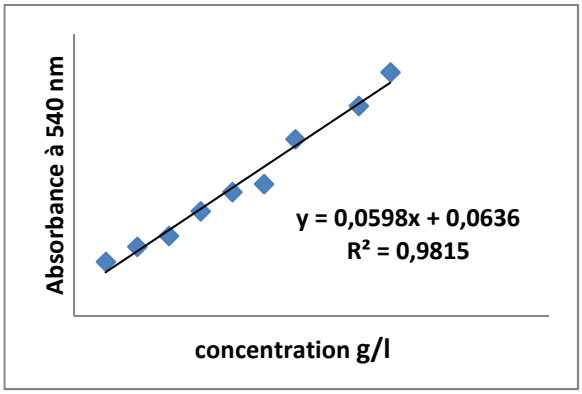

Fig.1 . La courbe d'étalonnage de l'albumine méthode de Biuret

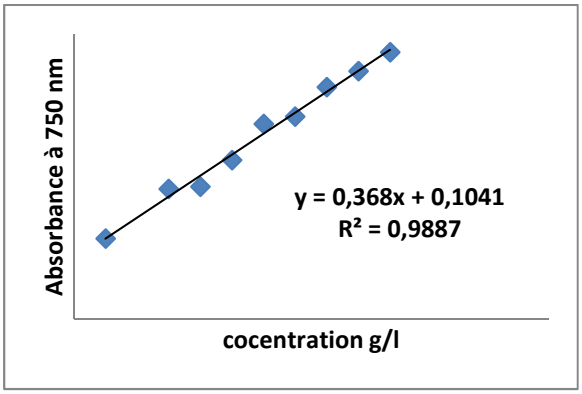

Fig.2 . La courbe d'étalonnage de l'albumine méthode de Lowry

2.5.3 METHODE DE KJELDAHL

La méthode de Kjeldahl (Helrich, 1990) est utilisée pour doser la totalité de l'azote, pour cela il faut détruire les composés organiques de manière à obtenir tout l'azote sous une même forme minérale. On effectue pour cela une minéralisation. L'azote est ensuite dosé par dosage acide-base.

Le calcul du pourcentage de protéine et de nitrogène est effectué par les formules suivantes [9] :

$$\text{Protéine } \% = \frac{(A-B)\times N\times 14{,}007\times 6{,}25\times 100}{m(mg)\text{d'échantillon}} \quad (1)$$

$$\text{Nitrogène}\% = \frac{(A-B)\times N\times 14{,}007\times 100}{m\ (mg)} \quad (2)$$

Avec :

A : V (ml) HCl titrant l'échantillon.

B : V (ml) HCl titrant (le blanc).

6,25 : Facteur de Kjaldahl.

100 : Le facteur de pourcentage.

3 RESULTATS ET DISCUSSIONS

3.1 LES PROPRIETES PHYSICO-CHIMIQUES

Le tableau suivant résume tous les résultats des indices physico-chimiques effectués dans cette étude ainsi Le rendement de la teneur en huile de ces graines.

Tableau 1. Propriétés physico-chimiques d'huiles des graines de C. colocynthis

Propriétés physico-chimiques	Huiles des graines
Teneur (%)	17,854
Etat physique à température ambiante	Liquide
Couleur	Jaune clair
Indice d'acide	5,46 ± 0,056
Indice de saponification (mgKOH /g)	197,78 ±0,17
Indice d'iode (g/100gde huile)	145,029 ± 0,25
Indice de peroxyde	16,38±0,18
Indice de réfraction à 20°C	1,4716 ± 0,001
Indice d'ester (mg KOH/1g de huile)	192 ,32±0,11
Densité	0,957±0,001
Masse molaire (g/mol)	875,10±0,92

Les graines de *Citrullus Colocynthis* présentent un bon rendement d'huile (17,854%) , comparant avec des résultats publié de la même plante [10] on trouve des valeurs proches de celles indiquées dans ce travail. Cette huile est utilisée pour déterminer quelques propriétés physico-chimiques qui donnent des informations sur cette matière végétale. La valeur élevée de l'indice de saponification (197,78 mg KOH /g) est associé à la présence des chaînes d'acides gras tels que les acides palmitiques (C16) et stéarique (C18).

Cependant, l'indice d'iode élevé indique (145 g/100g de huile) que l'huile est riche en doubles liaisons (des insaturations). Les acides gras libres (AGL) contenu dans l'huile montrent une valeur faible (5,46) cela est due aux AGL qui sont le résultat de l'hydrolyse de l'huile. En outre, il est bien connu que les acides gras libres sont plus sensibles à l'oxydation des lipides. Cela peut expliquer la valeur de peroxyde relativement élevé (16,38), cet indice permet d'évaluer le degré d'oxydation des acides gras insaturés de la matière grasse.

L'indice d'ester permet de déterminer la masse molaire (donc la structure) des triglycérides, pour l'huile des graines de *CitrullusColocynthis* la valeur de cet indice (192 ,32 mg KOH/g d'huile) est élevée. D'après cette valeur est calculé la masse molaire de triglycérides laquelle est égale à 875,10 g/mol.

L'indice de réfraction et de la densité de *C. colocynthis* présentent des valeurs proches de celles publié pour cet huile [11].

3.2 DOSAGE DES PROTEINES

A l'aide des courbes d'étalonnages de l'albumine des deux méthodes Biuret et Lowry (Figure 1 et 2), et la formule de calcul du pourcentage massique de protéine et nitrogène d'après la méthode de Kjeldahl (équation 1 et 2) on détermine les concentrations des solutions protéiques, Tableau 2.

Tableau 2 . Teneur des protéines par les trois méthodes

Méthode	protéines dans Solution Tampon g/100g	protéines dans solution de NaCl g/100g	Protéines dans solution aqueuse g/100g
Biuret	0,645±0,083	0,131±0,035	ND
Lowry	2,77±0,33	1,366 ±0,12	0,388±0,05
Kjeldahl	21,8 ±0,021	13,13 ± 0,043	4,3±0,013
Concentration de Nitrogéne	3,5 ±0,07	2,1 ±0,053	0,7±0,012

ND : non déterminer

D'après les valeurs du tableau, on remarque que la teneur en protéines atteint une valeur importante dans le cas de la méthode de Kjeldahl par les trois méthodes d'extractions, un peu moins importante dans la méthode de Lowry que la méthode de Biuret. En comparant les méthodes d'extraction, on remarque que l'extraction des protéines par la solution tampon a donné les grandes teneurs suivies par le cas où le chlorure de sodium est utilisé comme solvant. De faibles teneurs sont obtenues lorsque l'extraction est réalisée avec de l'eau distillée.

La réaction du biuret est basée sur la formation d'un complexe pourpre entre le biuret (NH2-CO-NH-CO-NH2) et deux liens peptidiques consécutifs en présence de cuivre en milieu alcalin, cette méthode est simple et facile à réaliser mais est cependant moins précise; la grande sensibilité de la méthode de Lowry est due à la combinaison de la réaction du biuret et une réaction au réactif de Folin-Ciocalteu. Ce dernier, à base de phosphomolybdate et de phosphotungstate, réagit avec les tyrosines et les tryptophanes, pour donner une coloration bleue qui s'ajoute à celle du biuret et donne une grande absorbance.

Les résultats de la méthode de Kjeldahl sont les plus distincts parce que cette méthode mesure la quantité d'azote organique total dans un échantillon.

Si on compare nos résultats avec ceux de la littérature [12] (24.37g/100g).on trouve qu'il y a une différence importante. Cette différence attribuée aux : origines géographiques, climat, espèce étudiée, méthodes d'extraction et aux méthodes d'analyses et de quantification.

Les protéines extraites par la solution tampon sont les plus notables car ce dernier fournit un milieu idéale pour extraire toutes les protéines.

4 CONCLUSION

La préservation et l'utilisation des plantes médicinales ont suscité un large intérêt au cours des dernières années. Celles-ci ont été utilisées dans le monde entier par les communautés locales pour guérir diverses maladies de l'Antiquité.

La plupart des espèces de plantes sont également utilisés comme complément alimentaire avec ses décoctions orales. Cependant, peu a été fait jusqu'à présent pour vérifier l'utilisation appropriée de ces plantes. La présente recherche est un effort à faire dans ce sens.

Le contenu chimique des graines de *Citrullus colocynthis*, était jusqu'à présent moins connu. Les résultats expérimentaux rapportés dans cet article ont montré que ces graines peuvent être des sources potentielles d'éléments nutritifs principalement des protéines et des acides gras essentiels (C16, C18).

Pour enrichir ce travail au futur, une étude GC /MS de cette huile est proposée pour faire une détermination exacte des contenu de ce échenillant.

REFERENCES

[1] P. Ozenda : *Flore du Sahara*, Deuxième édition du CNRS. Paris, ISBN 2-222-00292-3, p 87, 1983.

[2] P. Ozenda : *Flore du Sahara*. Deuxième Edition du CNRS. Paris, ISBN 2-222-00292-3, p 622, 1983.

[3] A .Chehma : *Cataalogue des plantes spontanées du Sahara septentrional algérienne*, DarElhouda Ain M'lila, Algérie . p 75, juin 2006.

[4] http://fr.wikipedia.org/wiki/Ghardaia

[5] J Folch, M Lees, GHS Stanley, *Journal Biol Chem*,226:497–509, 1957

[6] M .Olle, "Analyse des corps gras", *Technique de l'Ingénieur*, Paris . P5, P3325 décembre 1996 .

[7] B. Hainque,B.Baudin et P.Lefebvre: *Apareils et Méthodes en Biochimie et Biologie Moléculaire, Ed.Médecine-Science Flammarion*, ISBN 978-2-2571-6545-9, p.304-306 ,2008.

[8] D.A.Skoog, D.M. West et F.J.Holler *: Chimie analytique,Traduction et révision scientifique de la 7e édition américain*e, Chapitre 12, De Boeck Université, Paris ,1997.

[9] K. Neide et al, "Determination of total proteins in cow milk powder samples: a comparative study between the Kjeldahl method and spectrophotometric method" *Journal of Food Composition and Analysis* 16 ,507–516, 2003.

[10] H. Sadou, " Chemical content of the seeds and physico-chemical characteristic of the seed oils from *Citrullus Colocynthis*, *Coccinia grandis*, *cucumis metuliferus* and *cucumis prophetarum* Of Niger", bull. *Chem. Soc. Ethiop*, 21(3), 323-330 , 2007.

[11] I.A. Nehdi et al," Evaluation and characterisation of Citrullus colocynthis (L.) Schrad seed oil: Comparison with Helianthus annuus (sunflower) seed oil", *Journal of Food Chemistry* 136 ,348–353, 2013.

[12] J.O. Ogundele et al, "Comparative Study of Amino Acid and Proximate Composition of Citurllus colocynthis and Citrullus vulgaris Seeds", *Pakistan Journal of Nutrition* 11 (3): 247-251, 2012.

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Caractérisation physicochimique et bactériologique des effluents liquides de deux grands hôpitaux de la région de Rabat Salé Zemmour Zaer

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ABSTRACT: Hospitals could be the cause of pollution that must be considered in an overall assessment of the health and environmental risk approach. This study is part of the characterization of hospital liquid discharges from a region in Morocco, whose objective is to evaluate their physicochemical quality, biological. The physico-chemical analyzes of 72 samples taken during one year showed a large fluctuation of certain parameters such as BOD5, COD, TSS, PH, temperature, and significant bacterial load: Total coliforms, E. coli, fecal streptococci, pathogens such as Salmonella, Staphylococcus, 10% multi-resistant, virulent germs character to emerge as: Pseudomonas aeruginosa, the end of this study, it turned out that the hospital effluents are loaded with pollutants. We hope in the light of the results from this study have led to a real awareness of the competent authorities on strengthening and improving hospital for the treatment of liquid waste as developed countries view the impact of these effluents on human and environmental health is harmful and can extend to the spread of emerging diseases.

KEYWORDS: hospital effluents, physicochemical and bacteriological parameters, pathogens, regional hospitals Rabat Salé.

RESUME: Les hôpitaux pourraient être à l'origine d'une pollution dont il faut tenir compte dans une démarche générale d'évaluation du risque sanitaire et environnemental. Cette étude s'inscrit dans le cadre de la caractérisation des rejets liquides hospitaliers d'une région au Maroc, dont l'objectif est d'évaluer leur qualité physicochimique, bactériologique. Les analyses physicochimiques effectuées sur 72 échantillons prélevés pendant une année ont montré une grande fluctuation de certains paramètres tel que : DBO5, DCO, MES, PH , T°, ainsi qu'une charge bactériologique importante : Coliformes totaux, E coli, Streptocoques fécaux, des germes pathogènes tel que : Salmonella, Staphylocoque, à 10% multi résistantes, des germes virulents à caractère émergent comme : Pseudomonas aéruginosa, Au terme de cette étude, il s'est avéré que les effluents hospitaliers sont très chargés en polluants. Nous espérons donc à la lumière des résultats fournies par cette étude avoir suscité une véritable prise de conscience des autorités compétentes sur le renforcement et l'amélioration destinée au traitement des effluents liquides hospitaliers comme les pays développés, vue que l'impact de ces effluents sur la santé humaine et environnementale est néfaste et peut s'étendre à la propagation des maladies émergentes.

MOTS-CLEFS: effluents hospitalier, paramètres physicochimiques et bactériologiques, germes pathogènes, hôpitaux régionaux Rabat Salé.

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1 INTRODUCTION

Le management environnemental est au centre des débats nationaux et internationaux.

Elle devient donc une priorité dans les politiques de beaucoup de pays. Des structures étatiques cherchent de plus en plus à atteindre un bon niveau de performance environnemental en maitrisant les impacts des activités industrielles, produits et services sur l'environnement. Tout comme les déchets solides, les établissements de soins doivent maitriser la gestion et le traitement de leurs rejets liquides.[1]

Le présent travail a pour objectif de déterminer à travers les résultats obtenus des analyses des différents paramètres physico-chimiques et bactériologiques les degrés de pollutions des eaux usées des hôpitaux de la région de Rabat Salé Zemmour Zaer.

2 MATÉRIELS ET MÉTHODES

2.1 SITUATION GÉOGRAPHIQUE

La région de Rabat Salé Zemmour Zaer est l'une des seize régions du Maroc. Elle se trouve au nord-ouest du pays, sa superficie est de 9 580 km² (soit1, 3°/° de la superficie totale du pays) et elle est peuplée de 3123595 habitants avec une densité de 247,02hab/ km². Chef-lieu Rabat.et son climat de type méditerranéen ; doux et humide en hiver et chaud et sec en été, les précipitations dans la région dépassent largement la moyenne nationale.

La région est composée de quinze hôpitaux , trois centres hospitaliers universitaires et un grand centre provincial de Salé.

La région est limitée :

A l'Ouest par l'Océan Atlantique ;

Au Nord par la région de Tanger-Tétouan ;

A l'Est par les deux régions : Taza-Al Hoceima-Taounate et Fès-Boulemane ;

Au Sud par les deux régions : Marrakech-Tensift- Al Haouz et Gand Casablanca.

Fig. 1. Carte géographique de La région de (Rabat Salé Zemmour Zaer)

Source : wikipedia

3 MÉTHODE D'ÉTUDE

Dans cette étude on a choisi des collecteurs bien précis au sein de deux grands hôpitaux comme :

- Les collecteurs de l'hôpital 1 :
  - le collecteur de la cuisine ;
  - le collecteur qui relie les services d'urgence et de traumatologie ;
  - le collecteur qui relie la lingerie et le laboratoire ;
  - le collecteur de la maternité.
- Les collecteurs de l'hôpital 2:
  - Le collecteur principal ;
  - Le collecteur d'urgence.

- L'échantillonnage des effluents des deux hôpitaux qui ont fait l'objet de l'étude, a été effectué six fois par saison et trois fois par jour aux exutoires des collecteurs des eaux usées choisies sur une période d'une année, à raison de 72 échantillons.
- Les prélèvements ont eu lieu dans la zone d'écoulement de l'égout où la circulation de l'eau est la plus active.[3] ;
- Les prélèvements des rejets ont été réalisés selon les normes marocaines et internationales.
- Les analyses ont été effectuées à l'Institut National d'Hygiène
- Les paramètres recherchés :
  - Physicochimiques: T°c, PH, Cond, DCO, DBO5, MES,…
  - Microbiologiques : germes pathogènes (Salmonella, E coli…,…), germes d'origine hospitalier (Pseudomonas, Staphylococcus aureus, entérocoques intestinaux,…)
- Les analyses microbiologiques ont été réalisées par La méthode de filtration sur membrane selon les normes marocaines
- La température, le pH et la conductivité ont été mesuré sur place en utilisant un ph-mètre portable à lecture directe de type HANNA et un conductimètre de type CONSORT 535 exprimé en µs/cm.

4 RÉSULTATS ET DISCUSSIONS

4.1 PARAMÈTRES PHYSICOCHIMIQUES

❖ **Conductivité électrique**

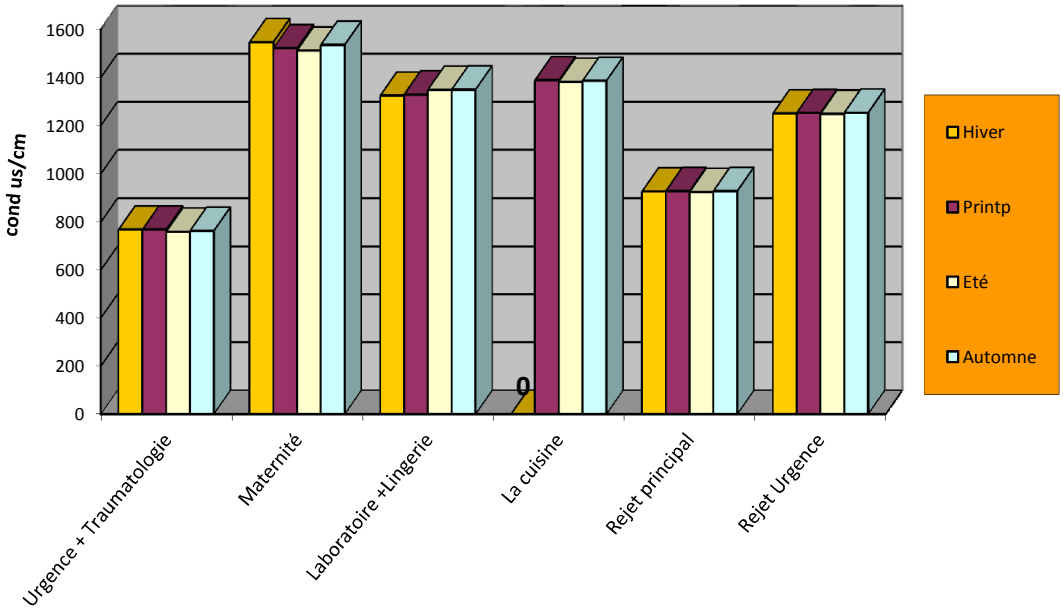

Fig. 2.

La valeur moyenne de la conductivité est 1500 µs/cm dans le rejet de la maternité de l'hôpital 1.

Ceci est du à:

- L'utilisation abusive des détergents et des injections ionisantes

Cette valeur classe le rejet dans la catégorie 3 (grille de qualité des rejets)[2]

❖ **Turbidité**

La valeur moyenne de la turbidité est comprise entre 18 et 194 NTU (Valeur maximale observée au niveau des collecteurs de laboratoire et de lingerie de l'hôpital 1, Ceci empêche la propagation de la lumière, par conséquent La clarification des eaux usées hospitaliers s'avère nécessaire. [5] ;

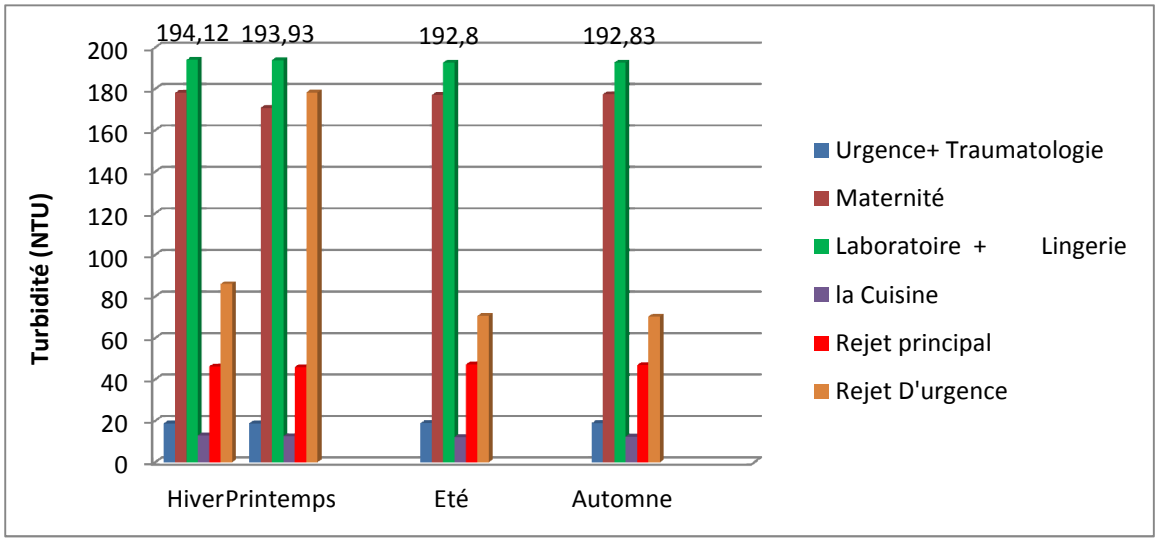

Fig. 3. Variation de la turbidité (NTU) en fonction des saisons

❖ **DCO/DBO5**

Les valeurs moyennes durant la période des prélèvements pour les six rejets des deux hôpitaux sont comprises entre 6.5 et 8.21mg/l, indiquant une mauvaise biodégradabilité due à la nature chimique des rejets hospitaliers.

4.2 PARAMÈTRES MICROBIOLOGIQUES

❖ **Indicateurs de contamination fécale**

La valeur maximale d'E. Coli est remarqué pendant la période de forte activité des services hospitaliers, ceci indique une contamination fécale récente.

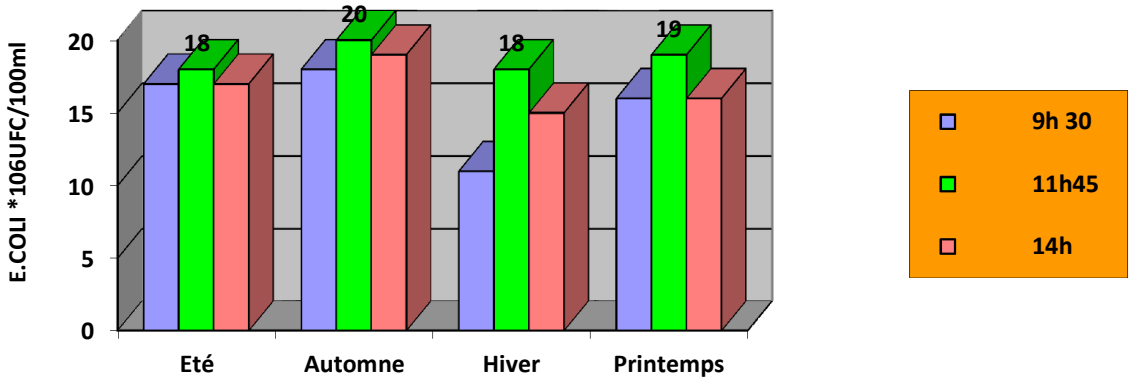

Fig. 4. Variation temporelle d'Escherichia coli

❖ **Germes pathogènes**

Notre étude a permis de démontrer que La charge de Staphylococcus aureus augmente pendant l'été, surtout pendant la période de forte activité (11h 45mn).Cette bactérie atteint 4.5 10^6 UFC/100 ml. Nos résultats sont concordantes avec celles de Hartemann et al [2005] [4] .

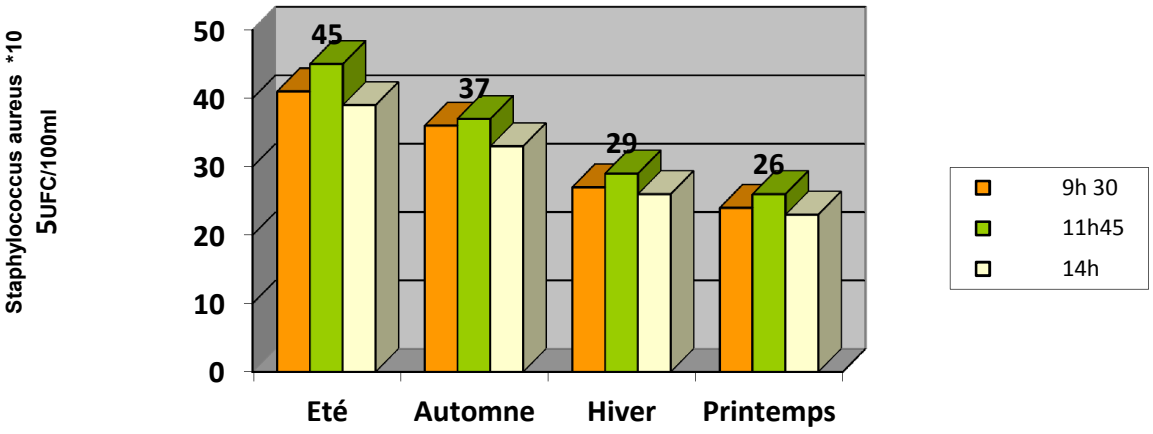

Fig. 5. Variation temporelle de Staphylococcus aureus

❖ **Germes virulentes**

8 salmonelles ont été identifiées dans Les collecteurs principal et d'urgence de l'hôpital 2 : Salmonella chester, entertidis (multiresistantes), et 2 salmonelles multiresistantes dans les collecteurs de l' l'hôpital 1.

Fig. 6. Identification de Salmonella (INH Rabat)

5 CONCLUSION

Les résultats des analyses que nous avons effectué durant la période d'une année, ont montré que les effluents hospitaliers présentent un taux élevé de pollution aussi bien physicochimique et bactériologique; en effet les résultats des analyses ont dépassé les seuils fixés par les normes nationales des rejets directs et indirects (CNS 1994), et pourraient avoir un effet néfaste sur la santé de la population de la région d'étude, et de son environnement direct. Aussi, la concentration de DBO5 (259,55 mg/l) classe les rejets liquides des deux hôpitaux selon les normes en vigueur (Grille de qualité) dans la catégorie de mauvaise qualité.

RÉFÉRENCES

[1] Evens EMMANUEL 4février 2004.
[2] CNS, grille de qualité des eaux de surface.1994.
[3] O.N.E.P. (1999). Caractérisation quantitative et qualitative des eaux usées. Guide de bonne pratique. Direction laboratoire de la qualité des eaux, Rabat.
[4] Hartemann et al [2005] ;
[5] Rodier et al, 1996
[6] Mara D.D. et Cairncross S (1989): Guideline for the safe use of wastewater and excreta in agriculture and aquaculture; OMS et PNUE, Geneve, 202p.
[7] Ait Melloul A. (1999): Etude épidémiologique de Salmonella chez les enfants de la zone d'El azzouzia en comparaison avec les enfants d'une zone témoin (Sidi moussa). Étude de l'antibiorésistance. Diplôme de Doctorat Es-Sciences Fac.Sc.Sem., (U.C.A), Marrakech, 14 -15, 29-30 p.
[8] Blum D. et Feachem R.G. (1985): Health aspects of night soil and sludge en agriculture and aquaculture. Part III: An epidemiological perspective*. International Reference Center for Waste Disposal, Due bendorf, Switzerland. Report N°05/85.*
[9] Boeglin .J.C (1989) : caractérisation classification de la pollution industrielle rapport de la communication ONEP.
[10] Boussaid A. (1987): Evolution des bactéries pathogènes : Salmonella et Aeromonas en comparaison avec les bactéries témoins de contamination fécale dans des bassins éxparimentaux d'épur tion par lagunage sous climat aride à Marrakech . Thèse de 3eme cycle, Fac. Sc. Sem., (U.C.A.), Marrakech, 124 p.
[11] Drapeau A.J. et JANKOVIC S. (1997) : manuel de microbiologie de l'environnement Ed. geneve .OMS.
[12] Ecosse D. (2001) : Techniques alternatives en vue de subvenir à la pénurie d'eau dans le monde. Mém. D.E.S.S. « Qualité et Gestion de l'Eau ». Fac. Sc. Amiens, 62 p.
[13] Faby J.A. ; Brissaud F. (1997): L'utilisation des eaux usées épurées en irrigation. *Office International de l'Eau*, 1997, 76 p.
[14] Fakidi H. (2004): Contribution au traitement des lixiviats de la décharge(Cas de la ville de Mohammedia, MAROC). Thèse de3ème cycle, Fac. Sc. Sem., (U.C.A), Marrakech, 36p
[15] Gloyana F.F. (1972): Bassin de stabilisation des eaux usées .Genève, OMS, 178 p.
[16] LUE-HING C., ZMUDA 3.T., SEDITA S.3., TATA P. Indigenous levels of HIV in wastewater: an empirical estimate and discussion. In. WEF : HIV in wastewater, presence, survivability, and risk to wastewater treatment plant workers. Water Environment Federation, Alexandria, Virginia, 1999, 80 p. LRINGSTROM 3., CASTOR B. Immune response to Giardia lambia in a waterborne outbreak of giardiasis in Sweden. J. Med. Microbiol., 1992, vol. 36, 5:347-352.
[17] MACLER, B.A. AND REGLI, S. Use of microbial risk assessment in setting United States drinking water standards. International Journal of Food Microbiology, 1993, vol. 18, 4:245-256.
[18] MANSOTTE F., 3EsnN E. Les rejets liquides des établissements de santé : Caractérisation à la source et impact sur l'environnement marin côtier. Direction Départementale des Affaires Sanitaires et Sociales de la Seine Maritime, Agence de l'Eau de la Seine Normandie, Nanterre, 2000, 73 p.
[19] Mara D.D. et Cairncross S (1991): Appréhension des risques sanitaires liés à la réutilisation des eaux résiduaires et des excretats en agriculture et aquaculture ; OMS et PNUE, Geneve, 202p.
[20] Mezrioui N. (1995): Dynamique et antibiorésistance de certaines bactéries d'intérêt sanitaires au cours de l'épuration des eaux usées par lagunage naturel (Marrakech) et étude expérimental de leur survie dans différents milieux aquatiques. Doctorat d'état Es-Sciences. Fac. Sc. Sem., (U.C.A), Marrakech.
[21] O.M.S. (1989): L'utilisation des eaux usées en agriculture et en aquiculture : recommandation à visées sanitaires. Rapport techniques n° 778, Genève, 79 p.
[22] OMS (2000) : directives de qualité pour l'eau de boisson ; volume 2- critères d'hygiène et documentation à l'appui organisation mondiale de la santé 2e édition, 1050p. accessible à : www. Who.int/water sanitation health/GDWQ/Summary_tables/
[23] Robertson, W. : (1995) utilités et limites des indicateurs microbiologiques de la qualité de l'eau potable dans air intérieur et eau potable sous la direction de Pierre Lajoie et Patrick Levalois , Presses de l'université Laval ,p. 179-193.
[24] Rodier J. 1986 : l'analyne de l'eau naturelle eau résiduaires eau de mer 7eme édition Paris.

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Fixation des tiques sur les bovins en fonction de la robe de leur pelage et de leur zone agro écologique dans les territoires de Kabare, Walungu et Uvira, Province du Sud-Kivu, République Démocratique du Congo

[Fixation of ticks on the cows in function of their colours and in their agro ecology areas in Kabare, Walungu and Uvira territories, Province of south Kivu, Democratic Republic of Congo]

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ABSTRACT: This study has been carried out during 12 mounths, successively in three districts: Walungu, Kabare and Uvira in south Kivu Province. Its object was to know exactly which colour between Broun, Black, White and Purple attracts the most ticks. On 204 cows we have got 53.6% Purple, 18,1% Brown, 16.7% Black and 11.4 White. Our study has shown that cows colored Purple are the most vulnerable to ticks.

KEYWORDS: Paraziting, Ticks, Cows, colour, Ecology, Districts.

RESUME: Cette étude a été réalisée pendant douze mois successivement dans trois territoires à savoir Walungu, Kabare et Uvira en province du Sud-Kivu. Elle avait pour objectif de connaitre avec précision lesquelles parmi les colorations de pelage de robe de bovins attirent plus les tiques parmi celles Kaki, Noire, Cendrée et Blanche. Sur 204 bovins répartis équitablement en cette coloration par territoire, nous avons trouvé que les bovins de coloration Cendrée ont été plus favorable avec 43,6% suivis de ceux de coloration Kaki avec 21,9% puis de ceux de robe noire avec 20,5% et enfin de ceux de Pélage à teint blanc avec 13,4%.Cet état de coloration de pelage les prédispose à l'afflux de tiques et partant des maladies

MOTS-CLEFS: Fixation, Bovins, Tiques, Ecologie, couleur, Territoire.

1 INTRODUCTION

Les tiques sont des arthropodes hématophages obligatoires et représentent l'une des contraintes majeures au développement de l'élevage en Afrique comme partout ailleurs dans le monde (Ogden. 2004). Parmi celles-ci, certaines sont spécifiques aux bovins et leur transmettent des maladies parasitaires, virales, bactériennes et peuvent provoquer leur (Scott et al. 2001).Selon Chartier *et al*. 2000, Darghouth *et al*. 2003 le dommage attribué à l'infestation par les tiques à travers leur action hématophage combinée à la transmission d'agents pathogènes chez les animaux constitue une contrainte

majeure à l'augmentation de la production bovine en Afrique. Les tiques disposent des organes de sens très développés cela leur permet de connaître l'approche des animaux sur lesquels elles se fixent pour s'approvisionner en sang.

Les principales maladies transmisses par les tiques dans les régions tropicales (Thélèriose, Babésiose … Anaplasmose) sont responsables de plus de 63% de mortalité des bêtes dans plusieurs pays et la baisse de productivité (D'Haese et al 1999). Le montant total des pertes annuelles liées aux maladies à tiques accusées par 11 pays d'Afrique centrale, orientale et australe a été estimé en 1989 à 168 millions de dollars américains (Darghouth et al. 2003). Toutefois la vision de la tique reste non fonctionnelle, objet qui a fait le nœud de notre étude. Comment alors la tique reconnaît- elle l'animal sur lequel elle va s'agripper. Cette étuve vise alors de connaitre par quel moyen la tique choisie son hôte. Principalement entre les bovins à pelage à teint blanc, noir, kaki et cendré.

Certaines études ont déjà été réalisées dont celles: Douze prairies naturelles, étagées entre 1500 m et 1800 m d'altitude (sauf Tshibati à 2000m) et fréquentées régulièrement par les bétails de Katana et Bugorhe ont été prospectées et indiquent l'importance de l'altitude sur la diversité floristique et la distribution de différentes espèces des tiques.

D'autres études concernaient la bio écologie des tiques vectrices des maladies et l'épidémiologie des malades transmises par les tiques. Celles réalisées par Kasereka et ses collaborateurs en (2009) dans la province du Nord-Kivu montrent que la Thélèriose, maladie très aigue et létale de bovin est la plus fréquemment rencontré (43,3%) suivie de l'Anaplasmose (35,5 %) et la Babésiose (16,16 %).Une étude transversale réalisée dans 29 troupeaux de bovins de Lubero- Béni a trouvé que la tique *Rhipicephalus appendiculatus* vecteur reconnu de *Theileria parva* est plus fréquente (64,26%) suivis de *Boophilus decoloratus* (35,4%) et de *Amblyomma variegatum* (0,25%) (Kasereka et al. 2010)et une étude sur la distribution saisonnière des tiques a été faite au Nord-Kivu prouve que la saisonnalité joue sur leur distribution (Kalume 2012) aussi bien que leur distribution altitudinale (Bisusa et al.2014).Aucune étude n'a était réalisée jusque là sur la fixation des tiques sur les bovins en fonction de leur coloration de pelage, pendant que ce teint jouerai sur la qualité et la consistance de la peau du bovin.

La présente étude consiste à donner la lumière sur la fixation des tiques sur les bovins de colorations différentes non par l'utilisation de la vue mais plutôt de tactisme ou du tropisme de la tique.

2 MATÉRIELS ET MÉTHODE

Cette étude se déroule dans les localités de Bugorhe et Irhambi Katana dans le territoire de Kabare Mushinga dans le territoire de Walungu et à Bwegera, Kiliba en territoire d'Uvira pour permettre de donner la connaissance originale sur la coloration du pelage des bovins à élever, qui sont moins hantés par les tiques et pourtant qui seront peu infestés et moins malades. Nos enquêtes sur terrain ont été réalisées pendant 12 mois (de janvier 2013 à décembre 2013). Les sites de prospection ont été choisis en fonction de la tranche altitudinale, de la présence d'animaux et de leur accessibilité. Les échantillons des tiques ont été prélevés sur un total de 204 bovins, répartis en fonction des coloration du pelage, dont 17 pour ceux de pelage noir,17 pour le Kaki,17 pour le pelage Blancs et 17 pour le pelage cendré par territoire. Les tiques ont été récoltées par extraction manuelle par organes anatomiques, dont la queue, les oreilles, l'ano génital et le fanon et encolure. Aussitôt recueillies, elles ont été directement placées dans des tubes à essai ou dans des boites de pétri pour être examinées au laboratoire d'entomologie vétérinaire du Centre de recherche en sciences naturelles de Lwiro, suivant la méthode d'observation à la loupe binoculaire après avoir été tuées par l'alcool et comparé à la clé de détermination de ELBEL et Anatos (1966) , (Walker et al.2003).

3 RÉSULTATS ET DISCUSSION

3.1 RECOLTE DES TIQUES SUR BOVINS A WALUNGU/MUSHINGA

Coordonnées GPS S : 02° 40' 31'', E. ; 02°44'44 ,5'', Alt 1663m

TABLEAU 1.POUR LES BOVINS À PELAGE KAKI(KALINGA)

La récolte des tiques sur les bovins à Pélage kaki (Kalinga) a été réalisée sur les organes anatomiques dont Conque auriculaire (les oreilles), le fanon et encolure, l'anneau génital et la queue. Cette récolte nous a prouvé que les tiques disposent des endroits privilégiés sur les bovins ; car étant uniformément.

Tableau A. 1.Pour les bovins a pelage Kaki (Kalinga)

Teint du pelage	organes	Rh.app.	Rp.Com	Boo.de.	Ambl.v.	H.L.L.	Total /org	%
KAKI	COA	177	0	24	0	0	201	31 ,4
	F&E	84	0	60	2	1	147	22,9
	ANGE	77	0	84	2	0	163	25 ,4
	QUE	109	0	20	1	0	130	20, 3
Total		447	0	188	5	1	641	
Charge à tiques	38							

Légende : COA= Conque Auriculaire, F&E=Fanon et Encolure, ANGE=Anneau génital, QUE=Queue.

Ce tableau 1 montre que le *Rhipicephalus appendiculatus* reste majoritaire avec 69,8% suivi de *Boophilus decoloratus* 29,2% puis d'*Amblyomma variegatum* avec 0,78% et enfin de *Haemaphysalis leachi leachi* avec 0,15%. Pour les bovins de pelage à couleur Kaki, les organes les plus préférés sont les oreilles 31,4% suivi de l'anneau génital 25,4% puis de fanon et encolure avec 22,9%.La charge à tique est de 38.Le nombre total de tiques récoltées sur les 17 bovins est de 640 tiques.

Tableau A.2 Pour les bovins à Pélage blanc (Keru).

Teint du pelage	organes	Rh.app.	Rp.Com	Boo.de.	Ambl.v.	H.L.L.	Total /org	%
BLANC	COA	133	0	13	0	0	146	39 ,1
	F&E	73	0	45	0	0	118	31 ,6
	ANGE	45	0	23	4	0	72	19 ,3
	QUE	27	0	6	0	0	33	0,8
Total		278	0	87	4	0	369	
Charge à tiques	17							

Légende : COA= Conque Auriculaire, F&E=Fanon et Encolure, ANGE=Anneau génital, QUE=Queue.

Ce tableau 2 montre que le *Rhipicephalus appendiculatus* reste majoritaire avec 75,5% suivi de *Boophilus decoloratus* 23,3% puis de *Haemaphysalis leachi leachi* avec 1,08%. Pour les bovins de pelage à couleur blanche, les organes les plus préférés sont les oreilles 39,1% suivi d'anneau génital 19,3% puis de fanon et encolure avec 31,6%.La charge à tique est de 22 tiques par bovin. Un nombre total de tiques récoltées sur 17 bovins est de 368 tiques.

Tableau A.3.Pour les bovins à pelage Noir (Cibogo)

Teint du pelage	organes	Rh.app.	Rp.Com	Boo.de.	Ambl.v.	H.L.L.	Total /org	%
Teint du pelage	COA	129	0	26	0	0	155	42,1
NOIR	F&E	37	0	18	1	0	56	15,2
	ANGE	62	0	36	1	0	99	26 ,9
	QUE	37	0	21	0	0	58	15,7
Total		265	0	101	2	0	368	
Charge à tiques	23							

Légende : COA= Conque Auriculaire, F&E=Fanon et Encolure, ANGE=Anneau génital, QUE=Queue.

Ce tableau 3 montre que le *Rhipicephalus appendiculatus* reste majoritaire avec 72% suivi de *Boophilus decoloratus* 26% et enfin de Haemaphysalis leachi leachi avec 0,54%. Pour les bovins de pelage à couleur noire, les organes les préférés

sont les oreilles 42,1%, suivi anneau génital 26,9% et fanon et encolure avec la queue avec successivement 15,7% et 15,2%. La charge à tique est de 23 tiques par bovins et le nombre total de tiques récoltées est de 368.

Tableau A.4.Pour les bovins à pelage Cendre (Lwirungu)

Teint du pelage	organes	Rh.app.	Rp.Com	Boo.de.	Ambl.v.	H.L.L.	Total /org	%
Teint du pelage	COA	272	0	0	0	0	272	15,4
	F&E	384	0	48	0	0	432	24,5
CENDRE	ANGE	440	0	3	0	0	443	25,1
	QUE	144	0	368	0	0	512	29,1
Total		1240	0	419	0	0	1659	
Charge à tiques	45							

Légende : COA= Conque Auriculaire, F&E=Fanon et Encolure, ANGE=Anneau génital, QUE=Queue.

Les bovins de robe à teint cendré sont moins nombreux comme aussi ceux à teint blanc. La tique *Rhipicephalus appendiculatus* reste très dominante avec 74,7 % suivie de *Boophilus decoloratus* avec 25,2% puis enfin de Haemaphysalis leachi leachi 30%. Sur les 17 bovins suivis nous avons récolté 1659 tiques, cela donne une charge à tique de 98 et les organes les plus fréquentés sont F&E et ANGE

Tableau synthèse 1 : Synthétique des données de récolte du territoire de Walungu.

Robe du bovin	Espèces tiques prédominante	Total tique récoltées	% pour le Rhi.app.	Charge à tiques	Organes préférés
Kaki(Kalinga)	*Rhip. app.*	641	69,7	38	COA, ANGE
Blanc(Keru)	*Rhip.app,*	369	75,5	17	COA, F&E
Noir(Cibogo)	*Rhip.app,*	368	72	23	COA, ANGE
Cendré(Lwirungu)	*Rhip.app,*	1569	79	45	QUE, AG

Légende : COA= Conque Auriculaire, F&E=Fanon et Encolure, ANGE=Anneau génital, QUE=Queue.

Ce tableau résume les résultats du territoire de Walungu et prouve que les bovins de teint cendrés sont plus prisés par les tiques avec un total de 1659 tiques sur 17 bovins .La charge à tiques reste la plus élevées pour ces quatre colorations différentes de bovins soit 45 tiques par bovins ; pour l'unique espèce en tête ; *le Rhipicephalus appendiculatus*

Dans cette région nous avons demandé aux fourreurs laquelle de différentes colorations des bovins est facile à cuir, à mâcher et tendre .Sur 32 personnes auditionnées dont 22 femmes parmi lesquelles 6 vendent les produits finis à base de peaux de vaches, elles nous ont prouvé que la vache à robe cendrée dispose d'une peau contenant beaucoup de lipide, moins dure et tendre. Cela pouvait être une de raison de l'attrait de tique sur leur robe. Car les tiques se fixent plus sur des organes faciles à perforer .Mais pour les éleveurs de Kamanyola les bovins de robe cendrée et blanche sont les plus attaqués par les tiques, par suite de leur peau qui est moins dures à des piqures lors de la fixation des tiques sur le bovin pour son alimentation.

3.2 RECOLTE DES TIQUES DANS LE TERRITOIRE D'UVIRA /BWEGERA

Coordonnées GPS : Alt. 890m, S : 2° 52' 05'' et E : 02°03' 11, 3''

Dans le territoire d'Uvira nous avons rencontré les grands éleveurs dans la plaine de la Ruzizi qui nous ont beaucoup aidé dans la fourniture des informations car étant spécialistes dans le domaine de l'élevage de bovins.

Tableau B. 1. Pour les bovins a pelage Kaki (Ugajo)

Teint du pelage	organes	Rh.app.	Rp.Com	Boo.de.	Ambl.v.	H.L.L.	Total /org	%
KAKI	COA	96	0	7	4	0	107	6,2
	F&E	68	0	11	2	0	81	4,7
	ANGE	131	0	3	4	0	138	8,1
	QUE	59	0	8	2	0	69	4
Total		354	0	29	12	0	395	
Charge à tiques							29	

Légende : COA= Conque Auriculaire, F&E=Fanon et Encolure, ANGE=Anneau génital, QUE=Queue.

Les résultats de ce tableau b.1 présente le *Rhipicephalus appendiculatus* comme étant resté majoritaire avec 89,6% vient ensuite *Boophilus decoloratus* avec 7,3% et enfin *Amblyomma variegatum* avec 3%. Pour les bovins de pelage à couleur Kaki le nombre total de tiques récoltées est de 395 avec une charge à tique de 29 tiques par bovin. Les organes les plus préférés sont l'ANGE et COA.

Tableau B. 2.Pour les bovins a pelage Blanc (Ikitare)

Teint du pelage	organes	Rh.app.	Rp.Com	Boo.de.	Ambl.v.	H.L.L.	Total /org	%
BLANC	COA	51	0	0	17	0	68	4
	F&E	17	0	0	34	0	51	3,5
	ANGE	30	0	17	36	0	83	4 ,8
	QUE	75	0	0	0	0	75	4
Total		173	0	17	87	0	277	
Charge à tiques							16	

Légende : COA= Conque Auriculaire, F&E=Fanon et Encolure, ANGE=Anneau génital, QUE=Queue.

Nos résultats montrent que *Rhipicephalus appendiculatus* reste dominante avec 62,4%, pour *Boophilus decoloratus* 6%% et pour *Amblyomma variegatum* 31,4%. La récolte totale de tique ayant était de 277 sur 17 bovins, la charge à tique de 16 et les organes anatomiques prisés sont QUE et COA.

Tableau B.3.Pour les bovins a pelage Noir (Umukara)

Teint du pelage	organes	Rh.app.	Rp.Com	Boo.de.	Ambl.v.	H.L.L.	Total /org	%
NOIR	COA	93	0	61	17	0	171	10
	F&E	85	0	10	34	1	129	7,5
	ANGE	51	0	21	23	0	95	5 ,5
	QUE	44	0	17	0	0	61	3 ,5
Total		273	0	109	74	0	456	
Charge à tiques							26	

Légende : COA= Conque Auriculaire, F&E=Fanon et Encolure, ANGE=Anneau génital, QUE=Queue.

Nous trouvons beaucoup de bovins de cette coloration pour leur robe .*Rhipicephalus appendiculatus* reste prédominante avec 59,8% suivi de *Boophilus decoloratus* 23,9% puis de 16,2% pour *Amblyomma variegatum*. La récolte a donnée au totale de 456 tiques sur 17 bovins, dont la charge à tique est de 27. Pour les organes prisés nous avons COA et F&E.

Tableau B.4.Pour les bovins à pelage cendre (Kavuzo)

Teint du pelage	organes	Rh.app.	Rp.Com	Boo.de.	Ambl.v.	H.L.L.	Total /org	%
NOIR	COA	187	0	62	12	0	261	15,3
	F&E	96	0	71	0	11	178	10,4
	ANGE	156	0	45	3	6	210	12 ,3
	QUE	158	0	17	3	0	178	10,5
Total		597	0	195	18	17	827	
Charge à tiques	49							

Légende : COA= Conque Auriculaire, F&E=Fanon et Encolure, ANGE=Anneau génital, QUE=Queue.

Dans ce tableau 4 le *Rhipicephalus appendiculatus* reste majoritaire avec 72,1% suivi de *Boophilus decoloratus* avec 23,5 % , *Amblyomma variegatum* 2,1% et enfin de *Haemaphysalis leachi leachi* avec 0,20%.Pour les bovins de pelage à couleur cendré, les organes les plus préférés sont COA et ANGE et la charge à tique est de 49 tiques par bovins. La récolte a donnée au 827 sur un total de 17 bovins.

Tableau synthèse 2 : Synthèse des données de récolte du territoire d'Uvira

Robe du bovin	Espèces tiques prédominante	Total tique récoltées	% pour Rhi.app.	Charge à tiques	Organes préférés
Kaki	*Rhip .app,*	395	89	29	ANGE, COA.
Blanc	*Rhip, app,*	277	62,4	16	QU, COA.
Noir	*Rhip, app,*	466	59,8	26	COA, F&E.
Cendré	*Rhip,app,*	827	72,1	49	COA, ANGE

Légende : COA= Conque Auriculaire, F&E=Fanon et Encolure, ANGE=Anneau génital, QUE=Queue.

Le tableau de synthèse de récolte dans le territoire d'Uvira prouve que la tique Rhipicephalus appendiculatus est majoritairement récolté sur les bovins à robe blanche soit 827 tiques sur 17 bovins, soit une charge à tique de 49.Lorsque nous comparons pour la même coloration avec les récoltes de Walungu, nous avons une charge à tique de 45 avec une récolte de 1659 tiques .Pour les organes anatomiques préférés COA vient en premier lieu et qui du reste se retrouve partout chez les bovins de robes différentes dans le même territoire.

3.3 RÉCOLTE DES TIQUES DANS LE TERRITOIRE KABARE

Coordonnées GPS : Alt. 1470 à 2200 m, situés entre 2°15' à 2°30' de latitude Sud et 28°48' à 28°85' de longitude Est, sur les flancs Est du massif de Kahuzi –Biega dans le territoire de Kabare au Sud-Kivu. Dans ce territoire, nous récoltions les tiques sur les bovins en les suivants dans leur lieu de pâturent qui du plus souvent sont communautaires .Mais aussi par suite de recherche de certaines robe de bovins nous allions dans des fermes privées cela par suite de manque de bovins dans le milieu, c'est qui était le contraire de la plaine de la Ruzizi.

Tableau C. 1. Pour les bovins à pelage kaki (Cirhale)

Teint du pelage	organes	Rh.app.	Rp.Com	Boo.de.	Ambl.v.	H.L.L.	Total /org	%
Kaki	COA	116	0	11	2	0	129	23,8
	F&E	92	0	9	21	0	132	24,3
	ANGE	172	0	20	43	4	239	44
	QUE	39	0	3	0	0	42	7,7
Total		419	0	43	66	4	542	
Charge à tiques	32							

Légende : COA= Conque Auriculaire, F&E=Fanon et Encolure, ANGE=Anneau génital, QUE=Queue.

Nos récoltes montrent que le *Rhipicephalus appendiculatus* reste majoritaire avec 77,3% suivi de Amblyomma variegatum 12,1%, puis de Boophilus decoloratus 7 ,7% et enfin de *Haemaphysalis leachi leachi* 0,73% .Pour les bovins de pelage à couleur Kaki, les organes les plus préférés sont l'ANGE et F&E et la charge à tique est plus élevée ,31 tiques par bovins .La récolte a donnée au total 542 tiques sur 17 bovins

Tableau C .2. Pour les bovins a pelage Blanc(Keru)

Teint du pelage	organes	Rh.app.	Rp.Com	Boo.de.	Ambl.v.	H.L.L.	Total /org	%
Blanc	COA	110	0	18	1	0	129	36,5
	F&E	41	0	28	13	0	82	23 ,2
	ANGE	65	0	20	24	2	111	31 ,4
	QUE	19	0	11	1	0	31	8 ,7
Total		235	0	77	39	2	353	
Charge à tiques	21							

Légende : COA= Conque Auriculaire, F&E=Fanon et Encolure, ANGE=Anneau génital, QUE=Queue.

Ce tableau 2 montre que le Rhipicephalus appendiculatus reste prédominante avec 65,7% suivi de *Boophilus decoloratus* 21,8% ,puis de Amblyomma variegatum 11% et de *Haemaphysalis leachi leachi* 0,56%.Pour les bovins de pelage a couleur blanche, les organes préférés sont COA et F&E et la charge à tiques est de 21 tiques par bovin. La récolte totale a donnée 353 tiques sur les 17 bovins

Tableau C. 3. Pour les bovins a pelage noir(Cibogo)

Teint du pelage	organes	Rh.app.	Rp.Com	Boo.de.	Ambl.v.	H.L.L.	Total /org	%
NOIR	COA	79	0	30	3	0	109	15,8
	F&E	125	0	9	47	2	184	28 ,3
	ANGE	194	0	35	69	1	298	45 ,8
	QUE	48	0	12	2	3	65	10
Total		446	0	86	121	6	656	
Charge à tiques	39							

Légende : COA= Conque Auriculaire, F&E=Fanon et Encolure, ANGE=Anneau génital, QUE=Queue.

Ce tableau 3 montre que le Rhipicephalus appendiculatus reste prédominante avec 68,7%, suivi d'Amblyomma variegatum 18,6% puis de Boophilus decoloratus 13,2% et enfin de Haemaphysalis leachi leachi 0,92%. Pendant que pour la récolte totale nous avons 650 tiques sur 17 bovins. Ainsi pour la charge à tique, elle est de 38 tiques et pour les organes préférés nous avons ANGE et F&E.

Tableau D. 4.Pour les bovins a pelage Cendré (Civuyé)

Teint du pelage	organes	Rh.app.	Rp.Com	Boo.de.	Ambl.v.	H.L.L.	Total /org	%
CENDRE	COA	119	0	5	0	0	124	19,6
	F&E	150	0	48	41	0	239	34
	ANGE	108	0	46	63	2	219	34 ,6
	QUE	43	0	29	1	1	74	11,7
Total		420	0	128	105	3	656	
Charge à tiques	39							

Légende : COA= Conque Auriculaire, F&E=Fanon et Encolure, ANGE=Anneau génital, QUE=Queue.

En tête de file dans c tableau 4 se trouve *Rhipicephalus appendiculatus* reste majoritaire avec 66,4% suivi de *Boophilus decoloratus* 19,4%, puis de *Amblyomma variegatum* 16,6% et puis enfin de *Haemaphysalis leachi leachi* 0,47%. Pendant que pour la récolte totale nous avons 632 tiques sur 17 bovins .Ainsi pour la charge à tiques, est de 37.Pour les organes préférés nous avons ANGE et F&E.

Tableau synthèse 3 : Synthétique des données de récolte du territoire de Kabare

Robe du bovin	Espèces tiques prédominante	Total tique récoltées	% pour Rhi.app.	Charge à tiques	Organes préférés
Kaki	*Rhip., app,*	542	77,3	31	ANGE, F&E,
Blanc	*Rhip. app,*	353	65,7	21	COA, F&E
Noir	*Rhip. app,*	650	68,7	38	ANGE, F&E
Cendré	*Rhip.app,*	632	64	37	ANGE, F&E

Légende : COA= Conque Auriculaire, F&E=Fanon et Encolure, ANGE=Anneau génital, QUE=Queue.

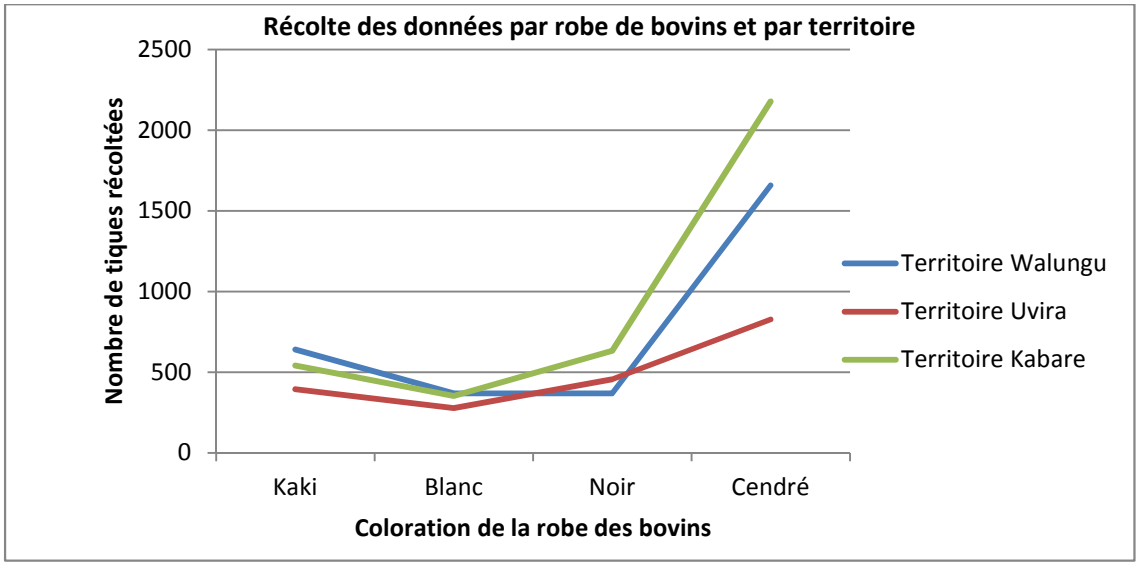
Ce tableau de résultats synthétique du territoire de Kabare montre que la tique d'espèce Rhipicephalus appendiculatus reste prédominante comme dans les deux autres territoires. Pour les organes de fixation les plus préférés par les tiques, l'ANGE reste prisé suivi de F&E.

4 CLASSIFICATION DES RESULTATS PAR TERRITOIRE ET PAR TEINT DU PELAGE DE BOVINS.

Nous avons fait un classement des résultats par territoires dans le tableau ci -dessous

Teint du pelage	TERRITOIRE DE WALUNGU	Territoire d'UVIRA	Territoire de KABARE	TOTAL	%
KAKI	641	395	542	1578	21 ,9 %
BLANC	369	277	353	999	13,8%
NOIR	368	456	656	1480	20,5%
CENDRE	1659	827	656	3142	43,6%
TOTAL	3037	1955	2207	7199	---
%	42,1%	27,1%	30,6%	100%	----

Ce tableau contenant nos résultats prouve que le territoire de Walungu a lui seul nous a donné 3037 tiques, dont 1659 sont récoltées sur les bovins de robe cendrées. Pour le territoire de Kabare nous avons récolté 1955 tiques avec en tète de récolte 2207 tiques pour les bovins à teint cendré et enfin pour le territoire d'Uvira une récolte globale de 1955 dont pour l'unique Pélage cendré 827 tiques. Ces résultats montrent que le pourcentage de tiques trouvées sur les bovins à robe de teint cendré dépasse au loin la moitié de récolte par territoire.



Graphique 1. Représentation des données par territoires.

Ce graphique qui contient la synthèse de notre travail prouve à suffisance que les bovins de robe à coloration cendrée sont les attirant des tiques car le plus grand nombre de tiques y a été récolté dans les trois zones agro écologiques de ces trois territoires. Pour la présence de plus grand nombre de tiques sur ces bovins, la robe cendrée disposent d'une peau très tendre, facile à piquer et avec moins d'épaisseur. Cette opportunité fait que les tiques s'y attèlent avec facilité. La réalité prouvée par les résultats de notre recherche et celle de la situation de l'enquête de Mushinga donnée par les fourreurs rencontre aussi celle des éleveurs de la plaine de Ruzizi à Bwegera.

L'élasticité, la tendresse et la légèreté de la peau des bovins avec robe cendrée reste comparable à la peau des oreilles ou des mamelles chez les autres bovins. Cette situation rend les bovins de cette coloration très fragile tant aux piqures des mouches que de ces autres parasites qui sont les tiques. Ces bovins sont alors victimes des stress, de traumatisme et des maladies (Thélèriose, Babésiose, Anaplasmose….) qui les amènent à devenir moins nombreux.

5 CONCLUSION

La coloration des robes de bovin les prédispose à bien de situation. Pour ceux de la robe blanche, ils sont dans certaines régions exposés à la foudre en période pluvieuse ainsi qu'aux voleurs la nuit car trop visible, cela même au loin. Pendant que ceux de robe noire et kaki se font facilement perdre dans l'obscurité, les empêchant ainsi d'être contrôlés par les bouviers en pleine obscurité. Dans le choix des animaux à élever nous devrions faire une étude sérieuse surtout pour ceux gardés sur parcours libre afin de nous éloigner au maximum de certains incidents, cas de vol, de foudroiement comme ceux cité ci haut. A défaut de cela, nous adopterons un système d'élevage en stabulation qui pourra nous épargner des tiques aussi bien que de leurs retombées.

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REFERENCES

[1] Bisusa M., Amzati S., Bagalwa M. Distribution altitudinale actuelle des tiques (Acarina-Ixodidae) chez les bovins élevés dans les groupements de Bugorhe et Irhambi-Katana en territoire de Kabare, Sud-Kivu RDC, Annales de l'UEA, numéro spécial sur l'environnement pp 69- 80,2014.

[2] BISUSA M., OMBENI B., CHISHIBANJI B. Connaissance sur les tiques des chiens vivants dans les groupements de Bugorhe et Irhambi-katana, Sud-Kivu, République Démocratique du Congo. CERUKI-ISP, 2014, n°44, 65-79 pp.].

[3] Muhimuzi Alphonse Bisusa, B.E. Ombeni, B.W. Chishibanji, and M.B. Masunga Identification des Tiques (*Acarina-Ixodidae*) Parasites des Bovins au Sud-Kivu, République Démocratique Du Congo, International Journal of Innovation and Applied Studies ISSN 2028-9324 Vol. 8 No. 4 Oct. 2014, pp. 1496-1503

[4] Chartier C., Itard J., Morel P.C., Troncy P.M. (Eds.), Editions Médicales internationales, Cachan, Editions TEC et DOC III, 2000, 452-761

[5] Darghouth M. A., Bouattour A. & Kilani M. Theilérioses. In: *Principales maladies infectieuses du bétail: Europe et régions chaudes II*. Lefèvre PC, Blancou J, Chermette R, editors. Editions TEC & DOC, Paris, France, 2003,116 - 1603.

[6] D'Haese L., Penne K. & Elyn R. Economics of theileriosis control in Zambia. *Trop Med Int* Health *1999,* 4: 9, A49-A57.

[7] Elbel, A. et Anastos, G. Ivodid ticks (ACARINA- IXODIDAE) of central Africa. Annales du Musée Royal de l'Afrique Centrale, Tervuren, Belgique.1966.

[8] Kalume M.K. Abondance saisonnière des tiques (Acari : *Ixodidae*) en fonction de système d'élevage des bovins dans la ville de Butembo, Province du Nord-Kivu, République Démocratique du Congo, Ed. Parcours et initiatives, 2012, 9, 56-66.

[9] Kalume M.K., Saegerman C., Mbahikyavolo D.K., Mukunyaviri A.M., Marcotty T., Madder M., Caron Y., Lempereur L., Losson B. Identification of hard tick (Acari: *Ixodidae*) and seroprevalence to *Theileria parva* in cattle raised in North-Kivu Province, Democratic Republic of Congo. *Parasitol. Res.* 2013, 112, 789-797.

[10] Kasereka M.K, Losso B. Byambwera C.G., Mbegumabaya L., .Makumyaviri A.M., Saegerman C.Enquête épidémiologique auprès des vétérinaires concernant trois maladies vectorielles des bovins élevés dans la province d Nord-Kivu en RD Congo, Epidémol. et santé anim. 2009, 56,197

[11] Ogden N., H., Swai E., Beauchamp G., Karimuriboe, Fitzpatrick J.L., Bruyant M.J., Kambarage D., French N.P. Risk factors for ticks' attachment to smollholder dairy cattle in *Tanzania.prev. Vet. Med*. 2004, 67, 157-170.

[12] Walker A.R., Bouattour A., Camicas J.L., Estrada-Peña A., Horak I.G., Latif A.A., Pergram R.G., Preston P.M. – Ticks of Domestic Anim Arthur(D .R). - Ticks of the genus *Ixodes in* Africa. - The Athlone Press, University of London, 1965, 348 pp.

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Infestation par les tiques des prairies naturelles dans les groupements de Bugorhe et Irhambi-Katana en province du Sud-Kivu en, République Démocratique du Congo

[The infestation of natural grasslands by ticks in groups of Bugorhe and Irhambi-katana area in the province of South Kivu, Democratic Republic of Congo]

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ABSTRACT: From March 2012 to March 2013 a study of infestation of natural grasslands by ticks was carried out in groups of Bugorhe and Irhambi-katana in the province of South Kivu, DRC. It identified eight families' plants including: Poaceae, Pteridaceae, Cyperaceae, Malvaceae, Astéraceae, Amaranthaceae, Lamiaceae, and Juncaceae. Species of ticks were collected from these plants are three in number, with a clear predominance of *Rhipicephalus appendiculatus* monitoring *Boophilus decoloratus* and finally *Haemaphysalis Leachi Leachi*. This study showed us the existence and the permanent presence of ticks on natural meadows and outgoing fodder. This confirmed the danger that the cattle are kept in a breeding on free range system (extensive).The danger is the infestation of cows with theileriosis; a dangerous deases of cows.

KEYWORDS: Infestation, Ticks, Prairies, Naturelles, R.D. Congo.

RESUME: De Mars 2012 à Mars 2013 une étude d'infestation des prairies naturelles par les tiques a été réalisée dans les groupements de Bugorhe et d'Irhambi-katana dans la province du Sud-Kivu, en RDC .Elle a permis d'identifier huit familles de plantes dont : Poaceae, Pteridaceae, Cyperaceae, Malvaceae, Astéraceae, Amaranthaceae, Lamiaceae, et Juncaceae. Trois espèces des tiques identifiées, notamment *Rhipicephalus appendiculatus, Boophilus decoloratus et Haemaphysalis Leachi Leachi. Cette* étude a prouvé de l'existence et de la présence permanente des tiques sur les prairies naturelles .Cela nous a confirmé le danger que court les bovins qui sont gardés dans un système d'élevage sur parcours libre (système extensif).celui d'être infecté par la thélèriose, une maladie très dangereuse chez les bovins.

MOTS-CLEFS: Infestation, Tiques, Prairies, Naturelles, R.D. Congo.

1 INTRODUCTION

L'étude des tiques (acarologie) et de leur bio- écologie fait l'objet de très peu d'études au Sud-Kivu. Les tiques sont des ectoparasites responsables de plusieurs maladies, représentent ainsi un réel obstacle au développement de l'élevage des bovins dans les régions qui leurs sont endémique (Gitau et al. 1999 ; Maloo et al. 2001).Le dommage attribué à l'infestation

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par les tiques ,suite à par leur action hématophage combinée à la transmission d'agents pathogènes chez les animaux constitue une contrainte majeure à l'augmentation de la production bovine en Afrique (Morel, 2000).L'habitat des *Ixodes* doit contenir une concentration et une variété suffisantes d'hôtes vertébrés pour pouvoir les nourrir cela leur permettant de passer à leurs différentes stases, qu'il s'agisse des larves, des nymphes, ou des femelles adultes gorgées. Les formes immatures se nourrissent surtout sur les petits vertébrés à sang chaud, de préférence des rongeurs, alors que pour la plupart les adultes se gorgent sur les grands mammifères (Rahm et al .1966).

Une étude rétrospective réalisée au Nord-Kivu auprès des éleveurs concernant trois maladies transmises par les tiques chez les bovins a révélée que la Thélèriose, maladie transmise par la tique *R*hipicephalus *a*ppendiculatus chez 49, 35%, une maladie aigue et létale de bovin est plus fréquemment rencontrée suivie de l'Anaplasmose (35,9%) et par la Babésiose (16,16%) (Kalume ,2009).

Une étude transversale réalisée dans 29 troupeaux des bovins du territoire de Lubero-Beni a rapporté une fréquence plus élevée de la tique Rhipicephalus appendiculatus (64,26%) vecteur reconnu de Theileria parva (Ashford et al. 2OO1) suivie de Boophilus decoloratus (39,4%) et par Amblyomma variegatum (0,25%) (Kalume et al.2010).

Au Sud-Kivu, trois études récentes ont été réalisées sur les tiques, dont une sur la modélisation par enquête rétrospective de l'épidémiologie de la Thélèriose bovine (Amzati, 2011).Une étude sur la distribution altitudinale actuelle des tiques (*Acarina-ixodidae*) chez les bovins élevés dans les groupements de Bugorhe et Irhambi-katana en territoire de Kabare, province du Sud-Kivu, Républiques Démocratique du Congo(Bisusa et al .2014).

Deux plus récente étude viennent d'être publiées en octobre 2014 sur les tiques qui parasitent les chiens gardés tant sur chaine qu'en système de se chercher lui-même à manger et l'autre sur l'identification des tiques (Acarina-Ixodidae) parasites des bovins au Sud-Kivu en République Démocratique du (Bisusa et al., 2014,Bisusa et al.2014).

La présente étude a pour objectifs (1) de préciser la dispersion spatio-temporelle de la population des tiques dans les prairies naturelles à Bugorhe et Irhambi-Katana, (2) de connaitre le nombre moyen de tiques par quadrat de 9 m^2 de surface, soit de 3m X 3m de côté, (3) savoir avec exactitude les espèces de plantes sur lesquelles ces tiques s'accrochent lors de leur quête de l'hôte « Ambush strategy » ou par la chasse afflue de ce dernier selon les différents stimuli« HUNTER STRTEGY »(Sonenshine De 1991).

2 APROCHES METHODOLOGIQUES

2.1 DESCRIPTION DU MILIEU D'ETUDE

La région de Lwiro qui englobe les deux groupements, à savoir Bugorhe et Irhambi-Katana trouve sa dénomination à partir de la rivière Lwiro, un affluent du lac Kivu qui trouve ses sources dans le vaste marais Musisi du parc national de Kahuzi Biega (PNKB). La « Région de Lwiro » a été considérée pour la première fois comme zone écologique par Rahm et Dieterlen (1966 au cours des inventaires des muridés de la région occidentale du lac Kivu (Balagizi et al. 2013)

Cette région (figure 1) se situe, au sein du territoire de Kabare, à 50 km au nord de la ville de Bukavu. Elle regroupe à la fois les localités des groupements d'Irhambi et Bugorhe inondés par la rivière Lwiro et ses affluents telles que les rivières Nyabichesa, Kabindi, Kalengo, Birunga, Choga, Kayumaga, Kisima Ciduha, Kashukabatware, Nkene, Busengura, Kamirihembe. Elle s'étend entre 28° 45' à 28°85' de longitude est et de 2° 15' à 2° 30' de latitude sud avec des altitudes variant entre 1470 m et 2200 m d'altitude (lisière du PNKB), sur une superficie de 41 km^2 (figure 1). Lwiro comprend au total 16 localités, avec une population globale d'environ 152 000 personnes (Rapports annuels de Bugorhe et Irhambi, 2011) et dont 99 % sont des autochtones.

Cette région est couverte d'un sol volcanique et est formée par l'alternance des collines et des vallées et bénéficient d'un climat tropical humide comprenant une longue saison de pluie de 9 mois (septembre à mai) et une courte saison sèche de 3 mois (juin - août). La température annuelle moyenne de l'air est de 19,5 °C et l'humidité relative varie entre 68 % et 75 % offrant un climat favorable à une diversité agricole.

La végétation est constituée d'une savane herbeuse de montagne dominée par des graminées fortement diversifiées et quelques arbustes. Cette végétation a remplacé une végétation primitive constituée de la forêt primaire à *Albizia grandibracteata* dont les reliques sont encore visibles dans les stations de Mugeri, Kakondo et Lwiro (Beatra, 2002).la région apparaît à première vue comme une "forêt" à bananiers à l'intérieur de laquelle la population autochtone de l'ethnie Shi construit des maisons de type traditionnel ou des cases en boue avec la toiture généralement faite avec les lanières de bananiers. Un réseau hydrique incluant aussi des marais dans les bas-fonds inonde le terrain, facilitant ainsi une agriculture permanente.

Les contraintes majeures de la communauté sont liées à la surpopulation, avec une densité humaine d'environs 350 habitants/km^2 ainsi qu'à l'accès difficile à la propriété de la terre : plus de 60 % de citoyens sont des paysans sans terre, forcés au système agricole de type féodal.

Les terres appartiennent exclusivement aux églises, aux institutions gouvernementales, et aux chefs locaux. Cette situation est une des causes majeures de la pauvreté au niveau des ménages malgré les potentialités géo climatiques offertes disponibles (Balagizi, 2010).

Aussi les élevages sont pratiqués sur des moindres superficies, conduisant alors certains éleveurs à disposer de la terre ou plante les fourrages mais aussi bien au contraires a d'autres éleveurs à n'avoir que des bovins mais sans lieu de pâtures. Cette situation entrainant des déséquilibre dans cette activité d'élevage conduit à faire une pâture communautaire facilitant les infestations tant des animaux que de leur lieu de pâture. On observe, dans cette contrée, moins de 25 % des chefs de ménages ont accompli les études secondaires, et plus de 50 % des ménages sont dirigés par des couples analphabètes. Ceci conduit a une importante vulnérabilités des ménages (Klennert, 2006).

Le milieu offre très peu de services publics rémunérateurs (travaux dans les usines et plantations de café, dans l'enseignement public, au sein du centre de recherche de Lwiro et dans les hôpitaux). Pour cela, la majorité de la population s'adonne aux activités champêtres et d'élevage avec des technologies encore traditionnelles, peu rentables. Environ 20 % des revenus des ménages proviennent des activités secondaires de vente de la bière locale et des produits des champs et 10 à 15 % de la vente des animaux d'élevage sans infrastructures favorables à un tel commerce. Actuellement la présence de Banana Xanthomonas Wilt (BXW) , plus rien n'est produit dans les bananeraie, cela accentue la pauvreté de la population de nos deux groupements . Les grands conflits sociaux dans cette région sont liés à essentiellement l'accès au pâturage ainsi qu'à la terre agricole.

Lwiro héberge aussi depuis la période coloniale le centre de recherche en sciences naturelles (CRSN, ex. IRSAC) et une ferme d'expérimentation en élevage qui était localisée à Tshibati. Mais dans le même milieu nous trouvons l'Institut National d'Élevage et de Recherche Agricole (INERA) de Mulungu. A cela s'ajoute des fermes de certains prive telle KAVEA à Bugushu de monsieur MUDUMBI, MALWIMA à Lwiro, à Buloli pour messieurs Safari MUGARUKA et BALUKU BAJOPE, a Buhandahanda pour monsieur NTABOBA Justin et MAHINDU Gustave. Ces fermes qui sont encore plus modèles et qui servent pédagogiquement de références dans les deux groupements.

Jadis les villages voisins disposés de lieu de pâture communautaire, et ainsi les bovins s'y retrouvaient à longueur des journées. Cette action collective de bouviers conduisait à donner à leur bovins les échanges tant des tiques que des maladies. Actuellement avec les insécurités récurrentes, les habitants ce sont concentrés en des lieux plus au moins sécurisés cas de Lwiro ; Katana, Kavumu…cela a eu un impact négatif sur les lieux des pâture qui ce sont réduits considérablement et d'autres devenant privés.

Aussi la situation de réduction des espaces de pâture a fait perdre les animaux à certains éleveurs, les conduisant à les vendre. Pour d'autres éleveurs ayant un sens plus accolés à l'élevage, ils ce sont démenaient afin de pouvoir trouver des prairies où pétré leurs bovins. Ainsi pour certains ils se font adhérer à une prairie dans des plantations moyennant une caution mensuelle faite en argent (100 dollars par an par bouvier),en espèce (3 tôles par vache par an) et à travers certains services (travaux hommes jour par semaines , profit de gardiennage des bovins du propriétaire de la prairie par ceux qui viennent faire prêtent leur bovins aussi bien de leur expérience dans ce domaine d'élevage précis) des prairies communautaires.

La méthode de drapeau n'a pas été trop développée dans notre étude car la hauteur sur laquelle est traîné le drapeau joue un rôle important dans la collecte des tiques. Les tiques adultes qui réalisent un afflux au sommet de la végétation tombent souvent au sol ou se projettent sur des herbes voisines lord du passage du drap .Par contre les formes immatures sont plus abondantes pour des hauteurs des herbes faibles (< 10 à 20 cm) et sur un sol presque glabre (Euzeby et al., 2005).Dans le cas présent ,les pâturages des bovins , le défrichage de la pâture et les hautes herbes en touffes ,les brouissons ne nous ont pas permis de beaucoup utiliser cette méthode

2.2 GESTION DE L'ELEVAGE

L'élevage du bétail était l'une des activités de la population dans ces groupements avant les guerres à répétitions qui avaient surgies au pays (De Failly, 2000). On y trouvait principalement les bovins, les caprin, les ovins et porcins en système extensif, soit en troupeaux pur, soit en troupeaux mélangés. Actuellement le cheptel a sensiblement diminué. Les bovins étaient gardés dans des prairies communautaires, dans des champs qui portaient des reste de culture (mais, sorgho…) qui ce

jour sensiblement ont diminué allant vers la disparition, surtout pour les gens des niveaux moins élevés en moyens financiers.

La cartographie des problèmes environnementaux parmi lesquels se situent au centre celui de la gestion des pâturages comme lieu de gardiennage en système collectif dans la région de Lwiro montre qu'ils sont multiples et touchent des aspects physiques et éco systémiques (Tableau 2). Et dans un contexte de vulnérabilité des ménages, il est possible que des conflits internes soient intenses pour la recherche de la survie. (Balagizi et al. 2013)

Tableau 2. Les problèmes environnementaux et leurs impacts visibles de la région de Lwiro.

Problèmes environnementaux	Distribution spatiale	Causes sous-jacentes	Situation actuelle et impacts
Déforestation	Lisère du parc national de Kahuzi (Maziba, Kahungu, Kabushwa, Mantu).	100 % de la population locale dépend du bois pour la cuisson des aliments Déboisement massif entre 1994 et 1996 à cause de l'afflux des réfugiés rwandais.	-85 % de la superficie de la région est dépourvue d'arbres. -Les quelques bosquets restants sont privés et appartiennent au CRSN, du petit séminaire de Mugeri, de la plantation de Kakondo, et de Fomulac avec une superficie totale de 45 hectares de superficie forestière. -Autour de ces boisements vivent 10.000 ménages ayant des besoins de bois-énergie.
Érosions des sols	Buhandahanda, Kabushwa	-Les Pluies et les ruissellements creusent des ravins sur des pentes raides -Les sols arables sont emportés dans le bas-fond par les eaux de pluie.	-10 % de la superficie est menacée par des érosions pluviales. -Les terres sont emportées dans les bas fonds réservés pour les cultures maraîchères.
Inondations	Mwanda, Kakondo, Lwiro, Kankule,	-Intensité de pluie -sol saturé en eau.	-Les inondations sont observées aux pics des pluviosités (novembre-décembre ; mars-avril). -500 ménages des maraichers sont exposés à des pertes économiques graves chaque année sur deux épisodes. -En moyenne 5 % des terres agricoles restent inondées et inexploitables pendant plus de 6 mois, ce qui renforce le chômage et la pauvreté.
Feux de brousse	Nyamakana, Maziba	-Agriculture sur brûlis -Production du fourrage pour animaux.	0,3 % des terres sont soumises aux feux de brousse et ceci n'affecte pas sensiblement les populations
Pénurie alimentaire	Toutes les localités	-Occurrence des maladies graves des cultures (Wilt bactérien du bananier, la cochenille et mosaïque de manioc, striure brune du manioc), le mildiou de la tomate et bruche de haricot, ravageurs des cultures. -Réduction progressive de la fertilité des sols (Balagizi et al., 2009)	-Des conflits sociaux liés à l'accès à la nourriture existent (endettement, troc, vente sur pied) -Les récoltes sont insuffisantes entrainant de longues périodes de crises alimentaires
État du parc national	Tous les villages riverains	-Inexistence de zones tampons : le parc est alors en continuité avec les villages. -Il y a déprédation des cultures par les babouins	-Les comités de conservations communautaires sont opérationnels pour la protection du parc. Ils sont constitués des leaders locaux et des représentants des organisations paysannes
État du climat	Partout	Reste encore doux, cependant il y a des perturbations observées depuis quelques années	La période de semis de sorgho et des courges concordant avec la présence des fourmis rousses a disparu.

Toutefois, l'espace pâturable est très réduit à cause de la densité élevée de la population qui s'élève environ à 350 hab. /km^2) et de la compétition entre l'élevage et l'agriculture par l'affectation des espaces de pâtures à des cultures vivrières. Pendant la saison sèche les troupeaux de bovins font des mouvements de transhumance passant des collines vers les vallées qui sont encore humide c'est à dire disposant des fourrages. Certains éleveurs vont faire paitre leur bovins le long des route, dans des terrains de football cela par tricherie. Pendant que pour très peu ,ils les conduisent très tôt le matin à la prairie pour le faire rentrer entre 9 heure et 10 heurs à l'étable pour le faire sortir le soir entre 15 heure et les ramener vers 19 heure .La stabulation stricte est quasi inexistante, toute fois faute de pâturage, l'idée se développe.

2.3 RECOLTE DES TIQUES DANS LES PRAIRIES

2.3.1 CHOIX DES PRAIRIES, FERMES DE RECOLTE ET FREQUENCE DES RECOLTES

Dans la région de Lwiro, qui est notre milieu d'étude nous avons fait le choix des prairies en fonction de leur localisation, de leur fréquentation par les bovins, cela en fonction de leur position altitudinale et de leur proximité tant au lac Kivu qu'au Parc National de Kahuzi-Biega (PNKB).

Sites contenant les différentes prairies

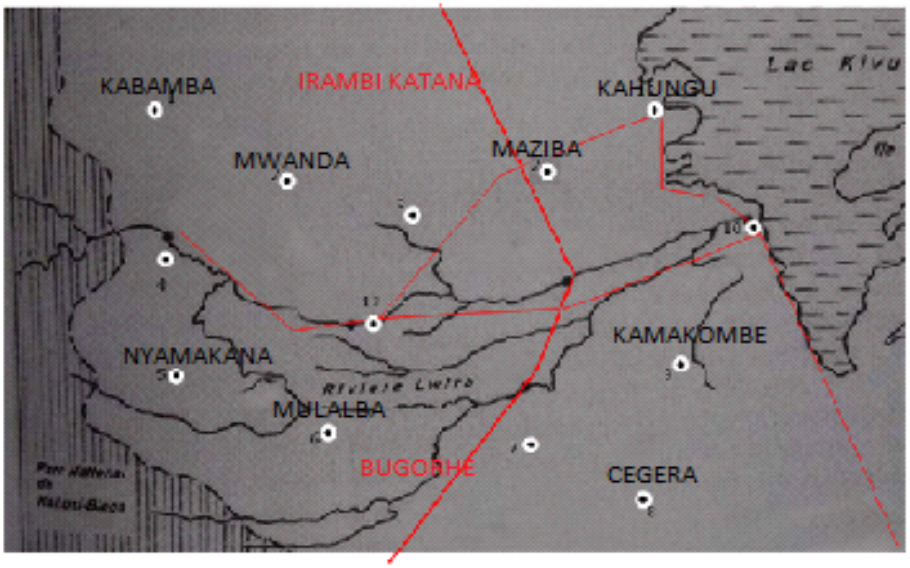

Figure 1.b. Carte de la région de Bugorhe et Irambi-Katana

Ainsi, nous avons tracé les gradients altitudinaux transversaux c.à.d. logeant la région située vers le lac ou celui le long du PNKB dans nos deux groupements Ce gradient a été balayé sur une longueur variable mais avec une largeur de part et d'autre de 2 m .Cette méthode nous a permis de faire un suivi dans la récolte des tiques par troupeaux. Nous avons aussi visité les bovins isolés ne se trouvant pas sur notre parcours

Pour l'inventaire et la récolte des tiques dans les prairies, nous avons utilisé trois méthodes ;

(1) le transect développé par Missouri Botanical Garde (P-BEATRA ,2005).Les transects ont été fixés en utilisant la topographie de la prairie. Ils ont été de 50 m de longueur sur 4 m de largeur, dont deux par prairies, qui sont séquents. Ils nous ont permis de récolter les tiques et les plantes sur lesquelles elles se fixent pour l'attente de leur hôte.

(2) le quadrat ,cette méthode consiste a faire un carré de 3m x 3m, soit sur une surface de 9 m^2, y faire la récolte des tiques, cela en observant, puis en coupant les herbes et en voyant partout, à même le sol.

(3) la méthode de drapeau a été utilisée selon la technique proposée par VASSALO et al. 2000. Elle consiste à trainer sur la végétation un linge blanc de 1,17m^2 sur lequel les tiques en phases d'affut s'accrochent. Ces dernières sont prélevées manuellement ou à l'aide d'un pinceau puis placées dans des tubes et alors acheminées au laboratoire d'entomologie vétérinaire du CRSN/Lwiro pour identification.

3 RESULTATS

La détermination du taux d'infestation des prairies naturelles de Bugorhe et Irhambi –katana, montre que la dispersion spatio-temporelle est effective cela car dans chaque prairie prospectées, nous avons trouvé des tiques sur la végétation. Dans les quadrats pour certaines prairies d'Irhambi-Katana, nous avons récolté 2 à 5 tiques pendant que pour le groupement de Bugorhe nous avons trouvé 3 à 8 tiques. Ainsi pour la moyenne de récolte e tique dans les deux groupements nous avons 3 à 7 tiques par quadrat en moyenne de récolte .Nous avons récolté les tiques sur les plantes dont l'identification a donné neuf familles à savoir : Poaceae avec 10 espèces des plantes, Cyperaceae avec espèces des 3 plantes, Malvaceae avec 1 espèces de plante, Astéraceae avec 2 espèces des plantes, Amaranthaceae avec 1 espèces de plante, Lamiaceae avec 1 espèces de plante, Juncaceae avec 1 espèce de plante et Pteridaceae avec 1 espèce de plante.

3.1 PLANTES SUR LESQUELLES LES TIQUES ONT ETE TROUVEES DANS LES PRAIRIES.

N°	Nom de la prairie	Espèce des plantes trouvées	Familles	Espèces des tiques récolte/ nombre			
				Rhip. app.	Boophilus decoloratus.	Haem. L.L.	Total
1	NYAKADAKA Coordonnées GPS : Alt.1670m, E : 02°15'03,6'' O : 028°49'00''	Digitaria velutina (FORSK.) P.BEAUV.	Poaceae	18	1	1	20
		Hyparrhenia cymbaria (L.) STAPF.	Poaceae	2	2	1	5
		Abidgaardia abortive (STEUD.) LYE	Cyperaceae	0	3	0	3
		Cynodon dactylon (L.) PERS.	Poaceae	39	10	1	50
		Eragrostis tenuifolia (A.RICH.)HOCHST. Ex STEUD	Poaceae	14	3	0	17
		Sida acuta BURM. F.	Malvaceae	32	0	0	32
		Conyza sumatrensis (RETZ) E.H. WALKER	Astéraceae	6	0	0	6
		Hoslundia opposita VAHL.	Lamiaceae	1	0	0	1
		Cyperus distans L.	Cyperaceae	7	0	0	7
		Rynchelytrum repens (Wild.) Hubb.	Poaceae	1	1	0	2
		Pteridium centralis	Pteridaceae	29	1	0	29
		Sous-total		120	20	3	143
2	CEGERA/MPOZI Alt.1683m, E : 02°14'09,6'' O: 028°49'06,6''	Digitaria velutina (FORSK.) P.BEAUV.	Poaceae	9	*0*	1	10
		Pteridium centralis	Pteridaceae	18	*0*	2	20
		Sporobolus pyramidalis P. BEAUV.	Poaceae	0	*0*	2	2
		Sida acuta BURM. F	Malvaceae	4	*0*	0	4
		Brachiaria aff. Serrifolia STAPF	Poaceae	2	*0*	0	2
		Juncus dregeanus KUNTH	Juncaceae	1	*0*	0	1

		Cynodon dactylon (L.) PERS	Poaceae	8	*1*	1	10
		Sous-total :		42	*1*	6	49
3		Digitaria velutina (FORSK.) P.BEAUV.	Poaceae	8	0	2	10
		Hyparrhenia cymbaria (L.) STAPF.	Poaceae	18	1	3	22
		Kyllinga brevifolia ROTTB. subsp. Intricata (CHERM.)J.-P. LEBRUN & STORK	Cyperaceae	1	0	1	2
		Pteridium centralis	Pteridaceae	1	0	0	1
		Dactyloctenium aegyptium (L.) BEAUV	Poaceae	2	1	2	5
		Sous-total :		30	2	8	40
4	MULANGALA Alt.1815m, E : 02°15'43,7'' O : 028°49'20''	Sporobolus pyramidalis P. BEAUV.	Poaceae	7	0	0	7
		Hyparrhenia cymbaria (L.) STAPF.	Poaceae	2	0	0	2
		Digitaria velutina (FORSK.) P.BEAUV.	Poaceae	3	0	1	3
		Sporobolus pyramidalis P.BEAUV.	Poaceae	7	0	0	7
		Pteridium centralis	Pteridaceae	15	0	1	16
		Cynodon dactylon (L.) PERS	Poaceae	4	0	2	6
		Dactyloctenium aegyptium (L.) BEAUV	Poaceae	1	0	2	3
		Sous-total:		39	0	6	45
5	KANYAWANGWA Coordonnées GPS : Alt.1656m, E :02°15'50,3'' O :028°49'25,2''	Milinis minutiflora,	Poaceae	3	0	0	3
		Digitaria scalarum (SCHWEINF.) CHIOV.	Poaceae	10	0	0	10
		Hyparrhenia cymbaria (L.) STAPF.	Poaceae	30	3	0	33
		Digitaria velutina (FORSK.) P.BEAUV.	Poaceae	10	0	0	10
		Kyllinga brevifolia ROTTB. subsp.	Cyperaceae	0	0	1	1
		Intricata (CHERM.)J.-P. LEBRUN & STORK	Poaceae	1	0	0	1
		Rhynchilyctrum repens (Willd.) Hubb.	Poaceae	3	0	0	3

		Sporobolus pyramidalis P.BEAUV.	Pteridaceae	2	2	0	4
		Pteridium centralis		1	1	1	3
		Sous-total :		60	6	2	68
6	KAKONDO Alt.1533,, E : 02°14'23,3'' O : 028°50'56,2''	Cynodon dactylon (L.) PERS	Poaceae	8	0	2	10
		Pteridium centralis	Pteridaceae	22	1	4	27
		Achyranthes aspera	Amaranthaceae	1	0	0	1
		Dactyloctenium aeygyptenium (L.) BEAUV.	Poaceae	0	0	2	2
		Sous-total :		31	1	8	40
7	KAMUNYERERE Alt.1656m, E : 02°12'13,8'' O : 028°49'49,2''	Pteridium centralis	Pteridaceae	3	0	0	3
		Cynodon dactylon (L.) PERS	Poaceae	6	0	5	11
		Hyparrhenia cymbaria (L.) STAPF.	Poaceae	3	1	0	4
		Sporobolus pyramidalis P.BEAUV.	Poaceae	3	0	0	3
		Sous-total :		15	1	5	21
8	YANGWIRA Alt.1976m, E : 02°15'34,6'' O : 028°49'15''	Sporobolus pyramidalis P.BEAUV.	Poaceae	7	0	0	7
		Hyparrhenia cylindrica (L.) STAPF	Poaceae	2	0	0	2
		Cynodon dactylon (L.) PERS	Poaceae	4	0	0	4
		Dactyloctenium aegyptium (L.) BEAUV	Poaceae	1	0	2	3
		Digitaria velutina (FORSK.) P.BEAUV.	Poaceae	3	0	1	4
		Pteridium centralis	Pteridaceae	15	0	1	16
		Sous-total :		32	0	4	36
9	KABUSHWA Alt.1845m, E : 02°15'43,6'' O :028°49'10,6''	Pteridium centralis	Pteridaceae	3	0	0	3
		Hyparrhenia variabilis STAPF.	Poaceae	4	0	0	4
		Achyranthes aspera L.	Amaranthaceae	3	0	0	3
		Sporobolus pyramidalis (L.) PERS	Poaceae	16	0	4	20
		Ageratum conyzoides	Astéraceae	8	0	0	8
		Sous-total :		34	0	4	38

11	MULAMBA Coordonnées GPS : Alt.1638m, E : 02°15'56,1'' O : 028°49'29 ,8''	Digitaria scalarum (SCHWEINF.) CHIOV.	Poaceae	9	0	2	11
		Pteridium centralis	Pteridaceae	2	0	1	3
		Dactyloctenium aegyptium (L.) BEAUV	Poaceae	2	0	0	2
		Eragrostis tenuifolia (A.RICH.)HOCHST. Ex STEUD	Poaceae	4	0	0	4
		Cynodon dactylon (L.) PERS	Poaceae	5	0	0	5
		Digitaria velutina (FORSK.) P.BEAUV.	Poaceae	9	2	1	12
		Sporobolus pyramidalis P.BEAUV.	Poaceae	2	2	0	4
		Sous-total :		33	4	4	41
11	LWAMINYANBWE Alt.1654m, E : 02°12'17,0'' O: 028°19'35,9''	Hyparrhenia variabilis STAPF.	Poaceae	12	0	0	12
		Pteridium centralis	Pteridaceae	2	0	0	2
		Digitaria velutina (FORSK.) P.BEAUV.	Poaceae	3	0	0	3
		Eragrostis tenuifolia (A.RICH.)HOCHST. Ex STEUD	Poaceae	2	0	1	3
		Sous-total :		19	0	1	20
12	LWAMALENGOKO Alt.1712m, E : 02°12'02,1'' O :028°49'46,0''	Digitaria scalarum (SCHWEINF.) CHIOV.	Poaceae	12	0	0	12
		Hyparrhenia cymbaria (L.) STAPF.	Poaceae	7	0	0	7
		Pteridium centralis	Pteridaceae	17	0	0	17
		Sous total :		36	0	0	36
Total global		-	-	491	35	51	577

L'analyse de l'information collectée montre que plus de 75% des plantes colonisées par les tiques appartiennent à la classe de monocotylédones et fougères. Cela s'explique par le fait que ce sont les herbes et surtout des graminées qui colonisent des prairies.

L'existence des différences d'altitude, de microclimats et le micro- habitats sont des facteurs qui influent sur la végétation et les mouvements des bovins et peuvent avoir un impact potentiel entre les récoltes de ces deux groupements. Les bovins pour atteindre leur lieu de pâture traversent des haies et broussailles qui constituent des biotopes favorables aux tiques. Les mouvements des bovins d'un coin à un autre est un facteur favorisant les infestations des animaux (Okuthe et Buyu ,2006). La disparité dans le nombre des tiques quoique ayant fait les mêmes nombre de bovin à Bugorhe et à Irhambi katana s'explique par l'élevage de bovins plus en altitude à Irhambi qu'à Bugorhe : cela qui confirme la théorie selon laquelle l'abondance et la fréquence des tiques décroit avec la montée en altitude (Bisusa et al. 2014).

3.2 ANALYSE DE LA SIMILARITE D'HABITATS

Cette similarité est résumée dans le dendrogramme voir figure 1.

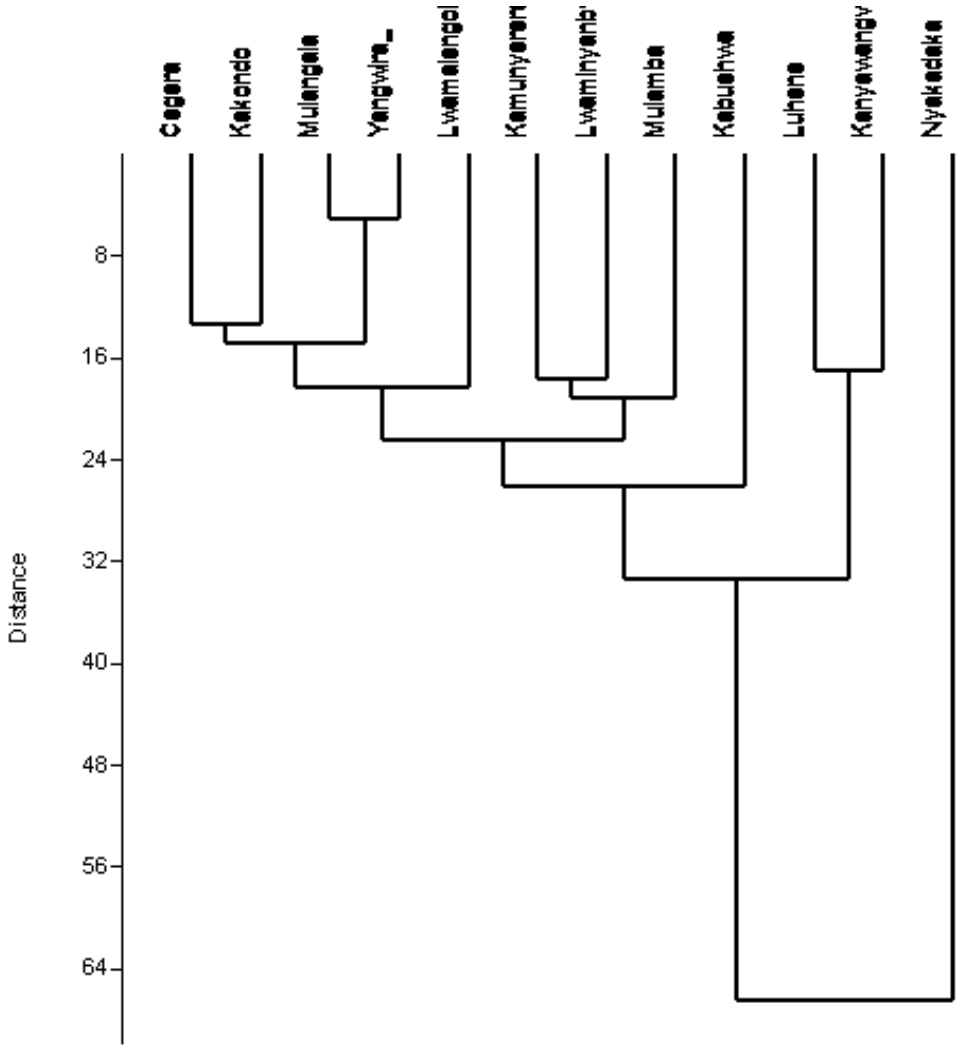

Fig. 1. Dendrogramme de similarité entre les prairies prospectées sur base des présences des tiques (méthode de Simpson).

La prise en compte de la similarité entre les 12 prairies en tenant compte des tiques présentes (incidence spécifique) nous donne deux groupes principaux. Le premier groupe est constitué des sites Nyakadaka, Luhene, et Kanyawangwa, tandis que le deuxième groupe comprend les sites Kabushwa, Mulamba, Lwaminyanbwe, Kamunyerere, Lwamalengoko, Yangwira, Mulangala, Cegera et Kakondo. Cette subdivision des sites dans ce dendrogramme reflète une colonisation différente en tiques dans les sites prospectés. Ceci peut également résulter de l'absence de l'une ou l'autre espèce dans ces entités suite à la variation des facteurs écologiques.

3.3 DIVERSITÉ DES TIQUES

La diversité de tiques montre que c'est au niveau du site Nyakadaka que les tiques sont plus diversifiées (en termes de richesse et abondance spécifiques) Le plus faible indice de diversité locale est observé également à Kakondo.

Tous ce détails sont résumes dans la fig. 2.

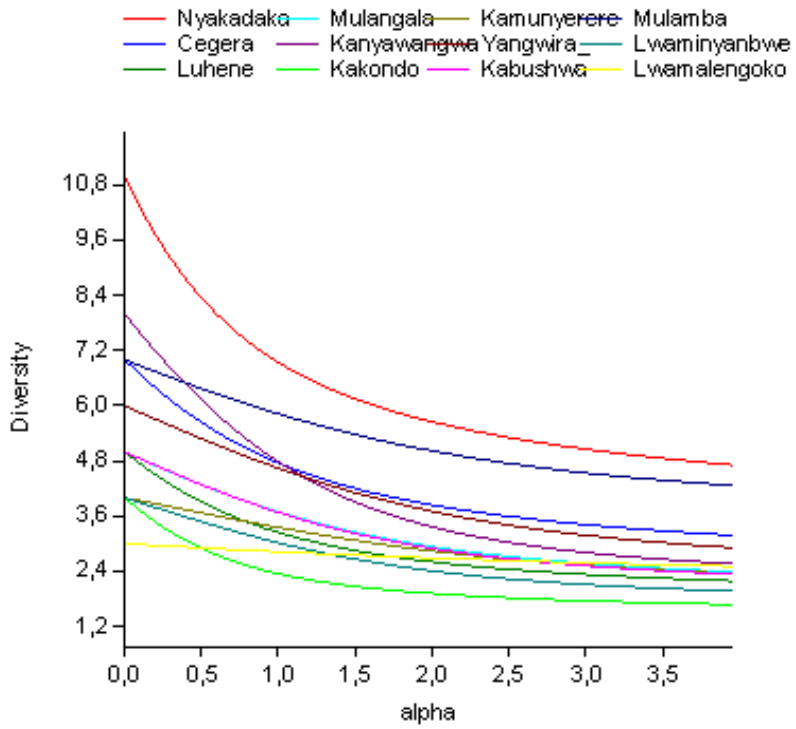

Fig. 2. Diversité des tiques

3.4 TOUTES LES FAMILLES DES ESPECES RENCONTREES DURANT NOTRE ETUDE

A l'issu de cette étude qui a duré douze mois, nous avons récolté des tiques sur des plantes dans des prairies réparties dans la région de Lwiro dont les familles sont regroupées dans le tableau 2.

3.5 FAMILLES PREPONDERANTES EN TERMES RICHESSE SPECIFIQUE ET LEUR DIVERSITE GENERIQUE

Les résultats se trouvent contenus dans le tableau 2.

Tableau 2 : Tableau contenant les fréquences genres et taux plantes sur lesquelles les tiques ont été récoltées.

Familles	Fréquences	Taux	Genres	Taux
Poaceae	47	69,1	9	52,9
Pteridaceae	12	17,6	1	5,8
Cyperaceae	4	5,8	3	17,6
Astéraceae	2	2,9	2	11,7
Malvaceae	2	2,9	1	5,8
Lamiaceae	1	1,4	1	5,8

De toutes les familles des plantes sur lesquelles ont été trouvées les tiques, les mieux représentée sont : Les Poaceae avec 47 fréquences suivies des Pteridaceae avec 12 fréquences, Cyperaceae avec 4 fréquences suivies de Astéraceae et de Malvaceae avec chacune 2 fréquences et enfin la Lamiaceae avec 1 fréquence. La famille de Poaceae est la mieux représentée car son importance économique réside dans le rôle essentiel qu'elle joue dans l'alimentation : environ 70% des terres arables du globe sont emblavées en Poaceae cultivées, et 50% de calories consommées par l'homme proviennent des Poaceae. Les Poaceae sont également employées dans l'alimentation du bétail, et la plus part des mauvaises herbes, des adventices et des rudérales sont composées des Poaceae.

INTERPRÉTATION DES RÉSULTATS

Concernant les la présence des tiques sur les plantes, toutes ces plantes sur lesquelles nous avions récoltées les tiques restent aussi celles fourragères. Elles ont été trouvées à 52,9% sur la seule famille de *Poaceae* et celle d'*Astéraceae* qui donnent dans un pâturage le fourrage avec un pourcentage variant entre 70 et 80%. Ainsi nous avons identifié pour la seule famille de Poaceae 9 genres qui sont : *Hyparrhenia variabilis* STAPF ; *Dactyloctenium aegyptium* (L.) BEAUV, *Eragrostis tenuifolia* (A.RICH.)HOCHST. Ex STEUD, *Cynodon dactylon* (L.) PERS, *Digitaria velutina* (FORSK.) P.BEAUV, *Sporobolus pyramidalis* P.BEAUV., *Hyparrhenia cymbaria* (L.) STAPF *Milinis minutiflora*, *Cyperus distans* L.

Pour la famille de Cyperaceae, nous avons identifié trios genres soit 17,6% à savoir *: Kyllinga brevifolia ROTTB. Subsp. Intricata, Hoslundia opposita VAHL, Abidgaardia abortive (STEUD.) LYE* .les plantes trois genres ont été récoltées dans deux pâturages LUHENE et NYAKADAKA, ces pâturages qui disposent un sol à certains endroits d'un sol hydromorphe et des marais.

Pour la famille d'Astéraceae, nous avons identifié les plantes appartenant aux genres suivants *Ageratum conyzoides* et *Sida acuta BURM*. F.

A ces trois familles prépondérantes ce sont ajoutées celle de Lamiaceae avec un genre *Conyza sumatrensis (RETZ) E.H. WALKER* ; celle de *Malvaceae* avec un genre : *Eragrostis tenuifolia (A.RICH.)HOCHST. Ex STEUD,* et celle de Pteridaceae avec aussi un genre *:* Sporobolus pyramidalis P.BEAUV. Toutefois ces espèces de fourrages ne sont pas complètes pour fournir une alimentation équilibrée aux bovins et pour cela il leur faut des suppléments alimentaires fourragers.

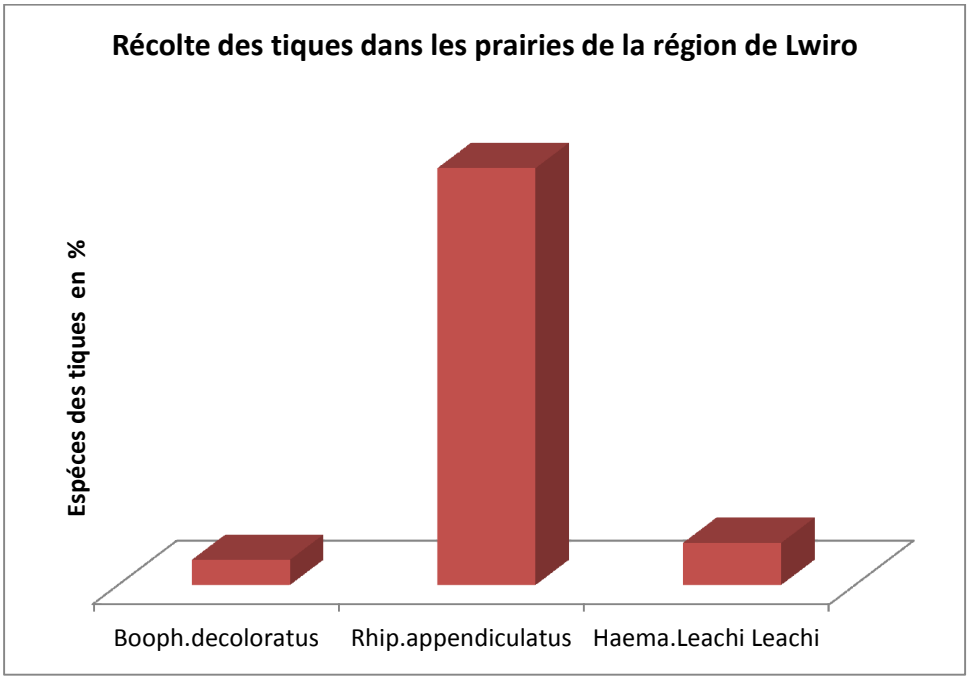

Fig. 3. Récolte des tiques dans les prairies

Légende: -Boophilus decoloratus

-Rhipicephalus appendiculatus

-Haemaphysalis Leach Leachi

Pour les espèces des tiques nous avons identifié deux genres dont *Rhipicephalus et Haemaphysalis réparties en* trois espèces qui sont *: Rhipicephalus appendiculatus* 491 tiques soit 85 ,09%, *Boophilus decoloratus* 35 tiques soit 6,06 % et *Haemaphysalis Leachi Leachi* 51 tiques soit 8,8 %.Ces résultats nous ont prouvé que toutes les espèces de tiques ne se fixent pas sur les plantes à l'attente de leur hôte.

Selon une étude réalisée dans ma même région d'étude (Bisusa et al.,2014) distribution altitudinale actuelle des tiques (*Acarina-ixodidae*) chez les bovins élevés dans les groupements de Bugorhe et Irhambi-katana en territoire de Kabare, province du Sud-Kivu, république démocratique du Congo

Dans la région d'étude, trois espèces de tiques ont été récoltées et identifiées. Il s'agit de *Rhipicephalus appendiculatus*, *Boophilus decoloratus* et enfin *Amblyomma variegatum*. Leur pourcentage de récoltes est présenté dans le tableau 3.

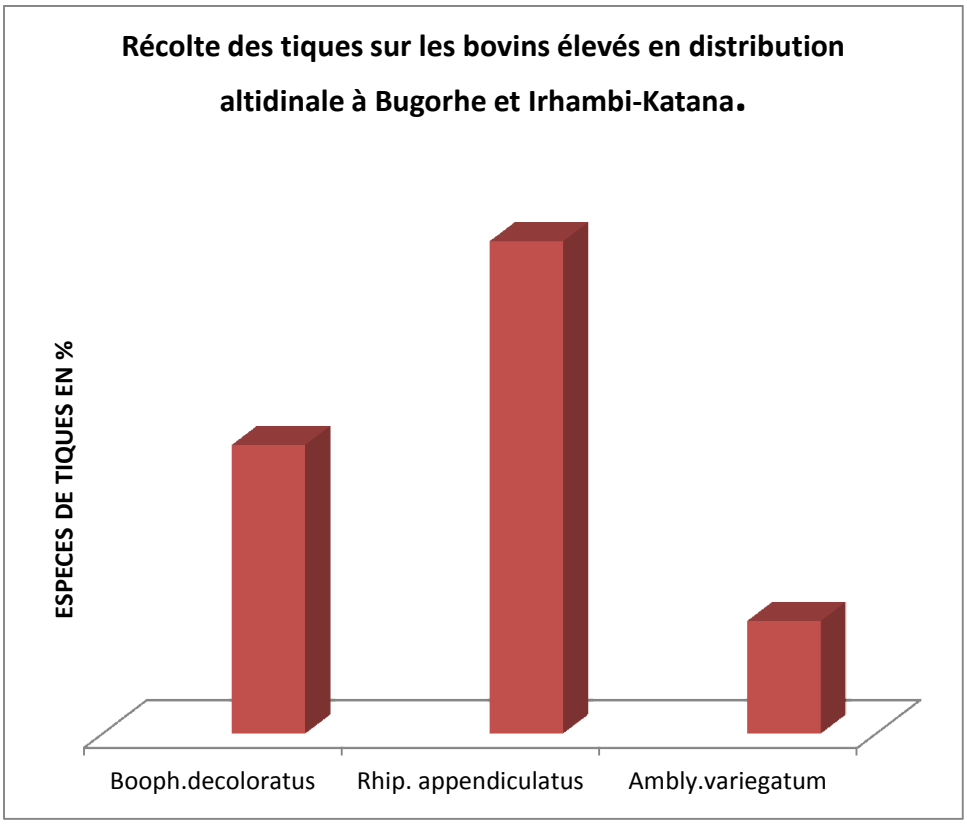

Fig. 4. Les espèces de tiques récoltées sur les bovins élevés à Bugorhe et Irhambi-katana en fonction de l'altitude.

Légende: -Boophilus decoloratus

-Rhipicephalus appendiculatus

-Amblyomma variegatum

Le mode d'élevage en système extensif est l'un des modes les plus repandus dans la plupart des pays sous-développés et qui se pratiquent par les paysans éleveurs. Leur caractéristique principale est que les moyens utilisés dans la pratique de ces élevages sont trop rudimentaires, sans aucune amélioration des conditions de travail des éleveurs et des bêtes. Les races bovines exploitées sont des races indigènes qui ont un faible rendement en viande du fait de leur difficulté d'engraissement et ne sont pas profitables.

Pour les espèces de tiques récoltées sur les plantes et le comparant à celles récoltées sur les bovins dans le même site, une différence s'est dégagée. Pour les tiques récoltées dans les prairies nous avons trouvé le *Rhipicephalus appendiculatus*, *le Boophilus decoloratus* et le *Haemaphysalis Leachi Leach*. Mais curieusement ces espèces de tiques ne sont celles qui ont été trouvé récolté sur les bovins, pendant qu'il est censé dire que les bovins sont infestés par les tiques lors de leur pâture dans les prairies.

Dans l'autre étude, réalisée dans le même site mais qui concernait de faire la récolte sur les bovins, les résultats ont été de espèces suivantes : *Rhipicephalus appendiculatus*, *le Boophilus decoloratus et l'Amblyomma variegatum.* Il convient de souligner que l' *l'Amblyomma variegatum* n'a pas été récoltée durant toute la période de notre étude. Et pourtant selon une étude récente portant sur la distribution altidinale des tiques dans les groupements de Bugorhe et d'Irhambi-katana (Bisusa et al.2014),

L'infestation prairies bovins est alors Ping poing c'est-à-dire prairie – bovins et bovins- prairies.les tiques sont entretenues sur les prairies par la présence des rats, serpents…Aussi, les chiens accompagnant les éleveurs dans les prairies amènent aussi les prairies à être infestées par les tiques plus hôte de chien qui est *Haemaphysalis Leachi Leachi* (Bisusa et al.,2014).*Cette étude prouve que la tique d'espèce Amblyomma variegatum dispose d'un autre mode et* stratégie de piéger son hôte aussi bien que de survie dans la prairie de cette tique jusqu'à l'atteinte par cette tique de son hôte et il reste à faire l'objet d'une autre recherche approfondie. Tandis que pour la tique *Haemaphysalis Leachi Leachi, elle* a été récoltée dans le groupement de Bugorhe et à Irhambi katana dans les pâturages ou les vachers se font accompagner de leur chiens. Ces derniers laissent tomber les tiques gorgées qui pondent et dont les larves se développement et cherchent leur l'hôte sur lesquels ils vont s'accrocher.

4 CONCLUSION ET RECOMMANDATIONS

Une amélioration de la santé du bétail doit impérativement passer par la désinfection des prairies, par le traitement des bovins et la lutte contre les tiques dans les deux groupements aussi bien que partout ailleurs. Il s'avère que le meilleurs moyen de lutte serait de faire une dératisation la plus totale dans les prairies et en saison sèche mettre le feu dans la prairie pour réduire la fréquence des tiques. Aussi un système d'élevage en stabulation strict serait un atout pour diminuer l'infestation par les tiques.

La gestion intacte des prairies ferait recours au contrôle des populations de tiques par la mise en œuvre de six recommandations à savoir :

- Restaurer la création des couloirs et de dupping-tank
- le facteur le plus criant est celui de mouvement non contrôlés des bovins sous couvert des rotations de pâturages mais qui répond aux échanges sociaux ou aux caprices de prestige
- le contrôle par voie écologique semble pouvoir s'appliquer de manière plus systématique. Il fait appel à des modifications modérées des milieux de développement des tiques et a l'utilisation de la galerie forestière fourré, bosquet dans nos lieux de pâturent des bovins).
- faire une lutte biologique contre les tiques. Certaines espèces des plantes ont été identifiées comme étant celles préférées par les tiques à l'attente de l'hôte tant par les larves que par les adultes.
- Eviter de se faire accompagner de chiens dans les prairies quand ils ne sont pas désinfectés par les produits acaricides.

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REFERENCES

[1]. Amzati G.S. Modélisation par enquête rétrospective de l'épidémiologie de la Thélèriose bovins au Sud-Kivu, dans l'Est de la république Démocratique du Congo. IMTA. Thèses de master en Santé Animale Tropicale 2011 141:1-57

[2]. Ashford R.W., Calisher C.H., Eldridge B.F., Jones T.W., Wyatt G. Encyclopedia of arthropod -transmitted infections of man and domesticated animals, Service M.W. (Ed), Liverpool school of Tropical Medicine, Pembroke Place, 2001. 574 pp.

[3]. Balagizi K .I, Ngendakumana S., Adhama M.T., Bisusa M.A., Baluku B., Isumbisho M. Perspectives de gouvernance environnementale durable dans la région de Lwiro, Sud-Kivu, République Démocratique du Congo, in Vertigo, 2013. pp 24

[4]. BISUSA M., AMZATI S., BAGALWA M.. Distribution altitudinale des tiques (Acarina-*Ixodidae*) chez les bovins de groupements de Bugorhe et Irhambi-katana en province du Sud-Kivu, République démocratique du Congo. , 2014, Annales de l'UEA, numéro spécial ,69-80 pp

[5]. Bisusa M., Bagalwa M., Mushayuma N. La prévalence de la Fasciolose animale dans les groupements d'Irhambi-katana et Bugorhe, Sud-Kivu, République Démocratique du Congo, 2014, Annales de l'UEA, numéro spécial ,58- 68 pp

[6]. BISUSA M., OMBENI B., CHISHIBANJI B. Connaissance sur les tiques des chiens vivants dans les groupements de Bugorhe et Irhambi-katana, Sud-Kivu, République Démocratique du Congo. CERUKI-ISP, 2014, n°44, 65-79pp.

[7]. Muhimuzi Alphonse Bisusa, B.E. Ombeni, B.W. Chishibanji, and M.B. Masunga Identification des Tiques (*Acarina-Ixodidae*) Parasites des Bovins au Sud-Kivu, République Démocratique Du Congo, International Journal of Innovation and Applied Studies ISSN 2028-9324 Vol. 8 No. 4 Oct. 2014, pp. 1496-1503

[8]. Beatra P. 2012, Inventaire de la biodiversité dans la région de Lwiro, Rapport de terrain CRSN-CRH-ICCN .85 p.

[9]. De Failly D. 2000. L'économie du Sud-Kivu 1990-2000: mutations profondes cachées par une panne. L'*Afrique des Grands Lacs* Annuaire 1999-2000 **:** 163-192.

[10]. Euzeby J., Bourdoiseau G., Chauve C.M. - Dictionnaire de parasitologie médicale et vétérinaire, 492 pages, Ed. TEC et DOC, Paris, Ed. Médic. Internationale, Cachan et Lavoisier, 2005.

[11]. Gitau G.K, Perry B.D., McDermont J.J. The incidence, morbidity and mortality due to *Theileria parva* infections in smallholder dairy farms in Murang'a District, Kenya. *Prev. Vet. Med*., 1999, 39, 65-79.

[12]. Kalume M.K. Abondance saisonnière des tiques (Acari : *Ixodidae*) en fonction de système d'élevage des bovins dans la ville de Butembo, Province du Nord-Kivu, République Démocratique du Congo, Ed. Parcours et initiatives, 2012, 9, 56-66.

[13]. Kalume M.K., Saegerman C., Mbahikyavolo D.K., Mukunyaviri A.M., Marcotty T., Madder M., Caron Y., Lempereur L., Losson B. Identification of hard tick (Acari: *Ixodidae*) and seroprevalence to *Theileria parva* in cattle raised in North-Kivu Province, Democratic Republic of Congo. Parasitol*. Res.* 2013, 112, 789-797.

[14]. Maloo S. H., Thorpe W., Kioo G., Ngumi P., Rowlands G. J. & Perry B. D. Seroprevalences of vector-transmitted infections of small-holder dairy cattle in coastal Kenya 48. *Prev Vet Med 2001,* 52: 1, 1-16.

[15]. Morel P.C. - Maladies à tiques du bétail en Afrique. *In* : Précis de parasitologie vétérinaire tropicale. Chartier C., Itard J., Morel P.C., Troncy P.M. (Eds.), Editions Médicales internationales, Cachan, Editions TEC et DOC III, 2000, 452-761

[16]. Okuthe O.S., Buyu G.E. Prevalence and incidence of tick-borne diseases in smollholder systems in the westen-kenya highland. *Vêt. Parasitol*. 2006, 141, 307-312.

[17]. Rahm, U. et F. Dieterlen, 1966, Les muridés de la région de Lwiro. Bruxelles, Musée Royal de Tervuren, 41 p

[19]. Rapport sur la climatologie par le Centre de Recherche en Sciences Naturelles de Lwiro Département de Géophysique., 2012.

[20]. Dieterlen F. ,1966 Périodicité de la reproduction des rongeurs de la région de Lwiro, chronique de l'IRSAC, Tome I,n°2, pp 24-30.

[21]. Sonenshine D.E. Biology of ticks. Oxford University press: Oxford, 1991, 482p.

[22]. Vassallo M., Paul REL., Perez-Eid.temporal distribution of the annual nymphal stock of ixodes thombus. Ticks exp.Appl. Acarol, 2000, 24**;** 941- 949

[23]. Walker A.R., Bouattour A., Camicas J.L., Estrada-Panda A., Horak I.G., Latif A.A., Pergam R.G., Preston P.M. Ticks of domestic animals in Africa: a guid to identification of species. International consortium on Ticks and Ticks Borne Diseases: Edinburg, 2003, 221p.

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Species Richness and Abundance of Bivalvia and Gastropoda (Molluscs) in Mangrove Forest of Dumai City, Riau Province

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ABSTRACT: The mangrove forest of Dumai city house many mollusc species within its narrow habitat. This study focused on the bivalves and Gastropods (molluscs) inhabit the mangrove forest along the coastline. Fourteen species of molluscs were recorded in this survey, eleven of which were gastropoda and three species were bivalves. Species richness and abundance were surveyed at three sites and each site was sampled at ten spots made of 30 spots along the coast. Althogh low in number, *Polymesoda expansa* and *Pharella acutidens* were widely distributed across the surveyed sites, while *Isognomon ephippium* was rare. It was evident from this survey that conservation measures, such as collection quotas need to be established to protect the stocks of those, especially the edible molluscs species in this area. The study also identified two gastropods, *Thais lacera* and *Telescopium telescopium* that is known useful pollution bioindicators.

KEYWORDS: Molluscs, Richness, Abundance, Mangrove, Dumai.

1 INTRODUCTION

Dumai is a city located on the east coast of Sumatra that deal directly with the Strait of Malacca as an international shipping lane, where the beach is still much overgrown by mangrove forest which is quite good. As an industrial and port city, Dumai at least have had 5 large Industrial Estate and 9 units of major ports of international quality, which can accommodate tankers, complete with supporting facilities. Such conditions, led to Dumai waters are very susceptible to ecological problems both now and in the future such as pollution from industrial waste, organic waste, mangrove deforestation, and settlements.

Mangrove forests have many functions in the marine ecosystem in the form of ecological functions and economic functions. In terms of ecological functions, mangroves are habitat for many species of aquatic organisms or terrestrial organisms. In addition to functioning as a place of refuge, mangroves also provide organic groceries, as spawning areas and care for marine organisms. One of the groups of organisms that inhabit the mangrove forest is the animal mollusks. The organism most commonly found on the forest floor of the forest, plant roots, the leaves, stems, and twigs. The dominant group of molluscs found in mangrove forests are of the class Gastropoda and Bivalvia. This is due to the ability of this group to adapt in the face of extreme environmental changes such as droughts mangrove, fluctuations in temperature and high salinity.

Molluscan shells have been popular since ancient times and are still used widely amongst cultures all over the world as tools, containers, musical devices, currency and decoration. Malay community in Riau still consume molluscs for a substantial portion of their diet. Yulianda (2009) stated that the mollusc exports in 2007 reached trillion rupiah, and the figure is higher than the previous year that only 21 trillion rupiah. With such a market, there is a great potential for over-harvesting and exploitation giving rise to conservation issues.

The mud clam *Polymesoda expansa* from the family Corbiculidae and *Pharella acutidens* from the family of Pharidae, are typical mangrove bivalve which lives semi-infaunally on the soft sediment that accumulates around the roots of the mangrove trees (Ingole *et al*., 2002). The mangrove clam *P. expansa* is a deep burrowing bivalve found mostly in the tidal flat

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of Southeast Asia (Morton, 1976). Three species of *Polymesoda* sp. has been reported from the Indo-Pacific region; *P. erosa*, *P. expansa* and *P. bengalensis* (Ingole *et al*., 1994). Due to their high protein content and delicacy, mud clam is an important commodity in artisanal fishery which is the main activity in many islands of tropical and sub-tropical regions (Meehan, 1982). This study aims to determine the species richness and abundance of molluscs, particularly bivalves and gastropods that live in the town of Dumai coastal mangrove forests. This information is very useful as a baseline of biological resources, particularly mollusks that inhabit the mangrove forests in the region.

2 MATERIALS AND METHODS

Study area was located at mangrove forest of Dumai coastal waters. There were three chosen sites along the coast based on chracteristic of the sites. Site #1 was near by Pertamina Harbour for oil shipping close to Duami river, very little mangrove threes. Site #2 was near the village of Purnama about for miles from site #1. This site covered by mangrove, and basically used by local people as common need for woods, while site #3 was about another five miles from site #2. This mangrove forest has been preserved since 1996 by University of Riau, where its second campus located (Appendix 1).

Mollusc collection is done by drawing a line transect in each site from the high tide limit to the boundaries of a low ebb, across the intertidal zone. To obtain information about the type and density of mollusks in the study area, then along transects placed 10 plots measuring 1x1 M, whereas for infauna molluscs were collected by hand digging the substratum (Alfred *et al*., 1997), using a shovel to a depth of 15 cm. Sediment is filtered with a filter that has a size of 0.5 cm mess. The foulers like mussels and oysters were collected by scrapping those using knife either using a quadrate. The arboreal forms were collected from the stems, roots and other parts of the mangrove trees vertically by hand picking (Sasekumar, 1974). Organisms were stored in a plastic bag and preserved with 10% neutral formalin solution. Those samples transported to Laboratory and finally preserved in 90% alcohol.

The shell characters such as shape, spire length and shape, mouth opening, opercular shape, umbilicus shape and size, colour and ornamentation of the shell are used mainly for the identification of gastropods apart from the internal characters of which the important one is radula. The bivalves are identified mainly based on the shell morphology. The shell comprises of two valves. The outer surface is usually covered with a periostracum. The outer surface may be striated or ribbed. The two valves are held together by an elastic ligament, which leaves a scar on the hinge. The hinge may in addition have interlocking ridges called the dentition. The two valves are attracted to the soft body by adductor muscles that produce scar on the interior surface.

3 RESULTS

3.1 SPECIES RICHNESS

Fourteen species of molluscs were recorded during this survey. Three species have been identified as bivalvia molluscs composed of *Polymesoda expansa* from the family of Corbiculidae, *Pharella acutidens* from the family of Pharidae, and *Isognomon ephippium* from the family of Pteriidae. In addition to these bivalves, there were eleven species of gastropoda (*T. lacera, L. angulifera, C. quadrata, C. Cingulata, C. Capucinus, T. Sulcata, T. Telescopium, N.lineata, T. Palustis, L. Melanostoma, C. Aurisfelis, P. plicata* and *C. Obtusata* were documented during surveys. The highest species richness was identified at site number 2 and 3 (Table 1).

Table 1. Distribution of molluscs species across surveyed sites.

Family	Genus	Species	Site 1	Site 2	Site 3
Ellobiidae	*Cassidula*	*Cassidula aurisfelis*	○	▪	▪
		Pythia plicata	○	▪	□
Muricidae	Chicoreus	*Chicoreus capucinus*	●	●	□
	Thais	*Thais lacera*	●	□	▪
Neritidae	Nerita	*Nerita lineata*	●	□	○
Littorinidae	Littorina	*Littorina angulifera*	○	□	●
	Littorina	*Littorina melanostoma*	▪	●	●
Corbiculidae	Polymesoda	*Polymesoda expansa*	▪	□	□
Pteriidae	Isognomon	*Isognomon ephippium*	○	●	▪
Phariidae	Pharella	*Pharella acutidens*	▪	▪	▪
Chrysomelidae	Cassida	*Cassida obtusata*	○	▪	▪
Potamidae	Telescopium	*Telescopium telescopium*	□	○	●
	Terebralia	*Terebralia sulcata*	●	□	○
	Cerithium	*Cerithidea quadrata*	●	●	●

***Tabel 1**. Distribution of molluscs species across surveyed sites. An open circle (○) indicate that the species was none (nothing found), a black circle (●) indicate that the species was abundant (more than 20 individuals), an open square (□) indicate the species was found occasionally (10-20 individuals), an black square (▪) indicate the that the species was rare (0-10 individuals).*

3.2 SPECIES ABUNDANCE

Within the group of gastropoda, the species with the highest average abundance was *L. melanostoma*, followed by the species of *C. Cingulata* and *T. Sulcata.* While among those group of bivalvia, the highest abundance was *P. Expansa*, followed by *I. Ephippium* and *P. Acutidens* (Figure 1).

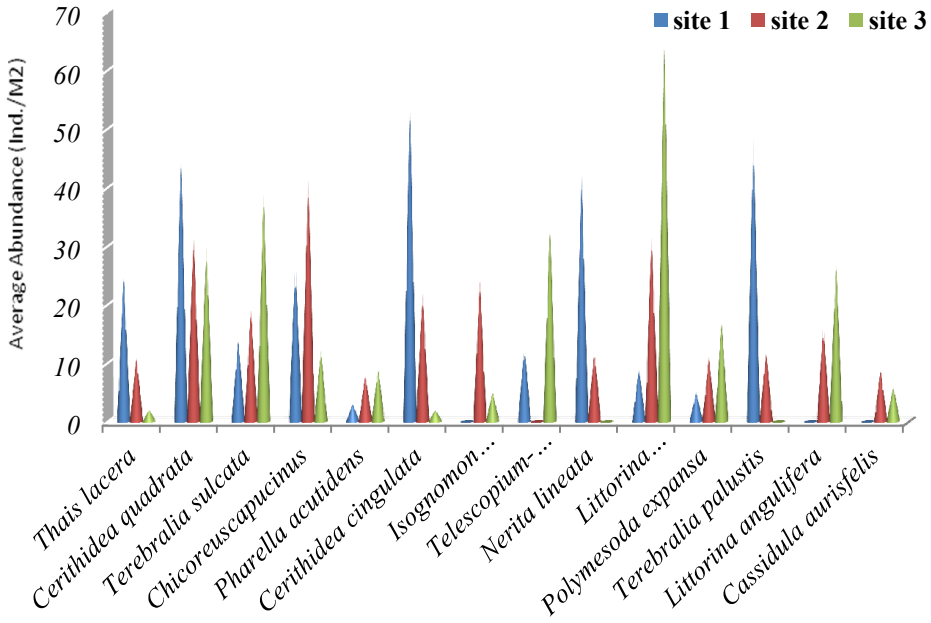

Figure 1. Average abundance of molluscs across the surveyed sites

3.3 HABITAT AND ABUNDANCE

The species *P. expansa was* more abundance in soft watery sediment just a few centimeters under the sediment surface. Unlike *P. expansa*, the species of *P. acutidens* commonly found much deeper down into bottom sediment, often hard to catch during low tide in the intertidal zone, most of the times this species rise up during the inundation in the early evening.

Some species of gastropoda recorded found crowling on the surface of mudy sediment, such as T. lacera, C. quadrata,C. capucinus, T. telescopium, N. lineata, T. palustis, and C. Aurisfelis. While a few species such as L. melanostoma, L. anbulifera, P. plicata, C. obtusata, often observed on the leave of mangrove tree or other object around the mangrove forest.

4 DISCUSSION

4.1 SPECIES INVENTORY

With many species inventory, it is apparent that there is much to learn about molluscs in Dumai mangrove forest. This study conducted during a very short of time only one day per site visited. One could be missed many species that actually inhabitant to the places. This could be due to the fact that they usually only forage at night, and hide underforest cannopy during the day, making them difficult to record during the daytime (Humann and Deloach 2002). Common snails such as *Pythia plicata* and *Cassida obtusata* was not previously identified either; however, their shells have been collected before during a students field trip to the sites, hence if more time were allocated for mollusc surveys and identification, more species could be recorded.

One concern of biological scientists are several species of snails Muricidae are very important in the study of the environment, because it can act as a biological indicator for marine pollution, especially pollution caused by Tributyltin which many mix in the paint as antifouling on ship hulls (Barcellos da Costa *et al*., 2008). Tributyltin (TBT) is jargon for organotin compounds that contain the $(C_4H_9)_3Sn$ group, such as tributyltin hydride or tributyltin oxide (Antizar-Ladislao, Blanca, 2008). Tributyltin acts as an endocrine disruptor in these gastropods and causes imposex. Imposex is the occurrence of induced male sex characteristics on normal female gastropods with the development of male sex organs (*i.e*. the penis and/or vas deferens) (Brady *et al*., 2008). This is due to the fact that these molluscs "posses only a limited metabolic capacity to eliminate such composites and thus present a great potential for organotin bioaccumulation" (Barcellos da Costa *et al*. 2008).

Tributilyn is toxic to aquatic organisms include fish, birds and mammals and "demonstrated to have hormone disruption properties in these animals" (OSPAR 1999). A case study from the Baltic Sea showed a widespread contamination in nine fish species. Studies suggest that organotins may threaten humans who consume large quantities of fish in their normal diet. The human immune system is affected by TBT because the chemical disrupts the immune cells, particularly those that fight infection (OSPAR 1999).

4.2 ABUNDANCE AND DISTRIBUTION

The abundance and distribution varied among species identified within the survey. Two species of bivalves namely *P. expansa* and *Pharella acutidens* have been known as common edible bivalves in the area surveyed, local people called lokan or kerang bakau. In fact their population were badly low, but very important protein source for coastal people. Although both species found distribute across the survyed sites, but very low in number.

According to Nasution (2008), these species live under the mudy sediment (infauna) with a high organic content. The population of the bivalva ware relatively low and distribute unequally through the mangrove forest. Their high population found to concentrate in the tide pool during the ebb tide. Many possible reason can be mention, such as irrational and over exploitation, human activity stress in the natural habitat (mangrove vegetation, expansion of agricultural diversity in the area, habitat destruction due to reclamation activities, factories, mining operations, etc.

Polymesoda and *Pharella* are harvested for its meat for local consumption and fish bait. These molluscs are limited to the accessible shallow and mudflat zone, making them easy to collect. The meat yield is relatively low per shell and therefore requires the collection of many individuals. Their low mobility rate leaves them vulnerable to predators and it limits their distribution. Their short larval phase limits their dispersal and increases local settlement which also aids in easy of collection by fishermen (Toller and Gordon, 2005).

This study showed that mollusc species can inhabit a variety of substrates and structures, but are primarily influenced by their food source. *Isognomon* is a suspension feeder and therefore requires being attaches with byssal threads to a solid substrate such as mangrove roots or other hard ocject. However, in the survey conducted it appeared to attach directly to mangrove roots. The surrounding structure then provided support and the shell, often covered in fouling organisms.

Gastropoda molluscs such as *C. quadrata, T. telescopium,* and *N. lineata were* found crowling on the intertidal mudflat, feeding on filamentous algae that grow on the substrate. This is an optimal location to feed because it is protected by the surf from grazing fish and echinoderms that would compete for this algae as well as from marine animals that would prey on them. However, it does make the organism more vulnerable to terrestrial predators, such as birds and humans.

4.3 HABITAT AND ABUNDANCE

Habitat is also affected by food preference. The intertidal zone provide *C. quadrata, T. telescopium, N. lineata* and others gastropoda a planty algae as food source. The morphology of gastropoda supports the organism to reside in such a habitat. Most of molluscs found at all sites and this suggests that they are very adaptable. *Thais* species feed upon other molluscs by boring into their shell to obtain the underlying flesh (Brusca and Brusca 1990). These results would suggest that *Thais lacera* is able to consume molluscs that inhabit a variety of habitats throughout the intertidal.

There is much to learn from the study of Mollusca. They are very useful not only as bioindicators of pollution, but also for medical purposes. Recently, the toxin from *Conus magus* has been used in the development of the strong pain medication. Many scientists believe other *Conus* species may yield more medicines in treating disease such as Alzheimer's, Parkinson's and epilepsy (BBC News, 1996). According to Humann and Deloach (2002) species such as *Conus floridanus, Conus cedonulli* and *Conus regius*, all of which secrete a neurotoxic venom.

5 CONCLUSION

The present study revealed the importance informations due the axistency of native molluscs inhabit mangrove forest in Dumai coast. There were nine Family, thirteen genus and fourteen species of molluscs identified. Among these molluscs, there are three importance bivalves, the edible *Polymesosa expansa*, *Pharella acutidens*, and *Isognomon ephippium*, but very low in number. Most of the species recorded distribute equally across the surveyed sites, but interm of number, Littorinidae and Potamidae were the predominant family in the area.

Altough among those eleven species of gastropoda have less importance economucally, but from the ecological point of view, they are significantly importance in food web within the mangrove ecosystem, as well as in pollution studies. Deterioration of mangrove ecosystem will have a direct effect on the molluscs communities.

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REFERENCES

[1] Antizar-Ladislao, Blanca (Feb 2008). "Environmental levels, toxicity and human exposure to tributyltin (TBT)-contaminated marine environment. A review". *Environmental International* 34 (2): 292–308.

[2] Alfred, J.B., R.K. Varshney and A.K. Ghosh (Eds.) (1997). An assessment manual for faunal biodiversity in South Asia. SACEP/NORAD publication series on Biodiversity in South Asia No. 1: 181pp.

[3] Barcellos da Costa M, Fernandex MA, Barbiero DC, Vaz de Melo FT, Otegui MPB, Ferreira BS (2008) First record of imposex in *Thais deltoidea* in Vitoria, ES, Brazil. Brazilian *Journal of Oceanography* 56(2): 145-148. BBC News (2006) Snail venom painkiller launched. (http://news.bbc.co.uk).

[4] Brady B, Rees CM, Fabris, GH (2008) Coastal Indicators: Imposex frequency. Australian Online Coastal Information. Canberra, Austrailia. (http://www.ozcoasts.org.au/indicators/imposex_frequency.jsp).

[5] Brusca RC, Brusca, GJ (1990) Invertebrates. Sinauer Associates, Inc. Sunderland, Massachusetts.

[6] Humann P, Deloach N (2002) Reef Creature Identification: Florida Caribbean Bahamas. New World Publications, Inc. Jacksonville, Florida.

[7] Ingole, B.S., L. Krishna Kumara, Z.A. Ansari and A.H. Parulekar, 1994. New record of mangrove clam *Geloina erosa* (Solander 1789) from the West Coast of India. J. Bombay Natl, History Soc., 91: 338-339.

[8] Meehan, B., 1982. Shell Bed to Shell Midden. Australian Institute of Aboriginal Studies, Canberra, ISBN-13: 9780855751319, Pages: 189.

[9] Morton, B. 1976. The diurnal rhythm and the process of feeding and digestion in *Tridacna crocea* (Bivalvia: Tridacnidae). Journal of Zoology, London. 185:371–387.

[10] Nasution,s. 2008. Ekologi kerang Bakau, *Gelonia expansa* dari Perairan Pantai Kota Dumai, Riau. *Jurnal Dinamika Pertanian. Vol.* XXIII (1): 58-64.

[11] OSPAR (1999) Update on Organotin Compounds: The Accumulation and Impact of Organotins on Marine Mammals, Seabirds and Fish for Human Consumption. London, England. (www.ngo.grida.no/wwfneap/Publication).

[12] Sasekumar, A. (1974). Distribution of the macro fauna on a Malayan mangrove shore. *J. Anim. Ecol.,* 43 : 51-69.

[13] Toller W, Gordon S (2005) A population survey of the West Indian topshell or whelk (*Cittarium pica*) in the U.S. Virgin Islands. Department of Planning and Natural Resources Division.

[14] Yulianda F. (2009). Mollusks: Business Opportunities and Conservation at IICC Bogor, KOMPAS.com on Wednesday, 11 February, 2009.

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Performance Evaluation of Honeybee (*Apis mellifera scutellata*) in Guji Zone

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ABSTRACT: Performance of a given particular area of honeybees can be tested based on their temperament, hygienic, inclination to swarm, resource hording and absconding behavior. Local honeybee race *Apis mellifera scutellata* was evaluated for its performance in Anna Sorra District of Guji Zone using 28 colonies were evaluated for temperament, hygienic behavior, brood area, pollen and nectar stores, absconding and honey yield. The result indicated that these colonies were not generally aggressive and only 7.14 % of them tried to defend their nest at 0.29m away from the entrance while 92.86% were reacted after hitting the lid twice. They removed from 86±3.16 to 99.62±0.26 % of pin killed pupae in 24 hrs, though there was significant ($P<0.05$) variation in different seasons. The unit area measurement of brood showed that as high as 216.42 unite areas of 5x5 cm^2.Similarly, the area allocated for stored nectar and pollen grains could reach up to 65.57 and 29.28 unit areas of 5x5 cm^2, respectively. The swarming tendency of the *A. m. scutellata* colonies was very low as only in average two queen cells were found during breeding season. However, the absconding behavior of the colonies was higher reaching up to 27 % between August and November, with significant ($p<0.05$) variation in different seasons. The honey yield from the colonies in box hive was 10 kg per colony per harvest. The comparison between two years indicated that there was no difference in yield between the two study years. In general, the study showed that *A. m. scutellata* honeybees are good in hygienic and temperament behavior and also perform well for honey yield under optimum management practices.

KEYWORDS: *Apis mellifera scutellata*, temperament, hygienic, swarming, absconding.

1 INTRODUCTION

Ethiopia is a land of contrast having wide range of topography, climate and vegetation, which favors considerable number of honeybee colonies and diversity of honeybee races. Despite the country's potential to apicultural resource, the production and productivity of the sector is still low. This could be attributed to many factors such as, poor management style, environmental factors and undesirable behaviors of local honeybees. In view of the fact that, no honeybee colony is exactly like other in their performance even in a given particular area especially in brood rearing, inclination to swarm, foraging vigor, stinginess, and susceptibility to diseases (Ruttner,1988).

It is known that the physical environment such as altitude, climate and vegetations greatly affect the behavioral and the productivity of colonies. Honeybees at highland area of Ethiopia were reported as they are less productive, larger in size, docile in behavior compared to relatively more productive small lowland honeybees that are very aggressive (Gebreyesus Mammo 1976). *A.m. scutellata* is the second darkest and largest honeybee race next to *A.m. bandasii.* It is distributed in the western, southern and southwestern humid mid-land parts of the country (Amssalu Bezabeh, 2002).Though the colour, size and distribution of this race is documented, its performance was not well studied so far. Therefore, performance evaluation of this honeybee race in its natural agro ecological distribution zone is very crucial to assess the potentiality of the race and to lay foundation for future selection and improvement of the local race.

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2 MATERIAL AND METHODS

2.1 STUDY SITE

The study was conducted from January 2010 to June 2012 at Peasant Association called Bube Korsa in Anna Sorra District of Guji Zone, Southern Oromia, Ethiopia. The area has about 13% of its land covered by natural forest in which honey plants like *Scheffleria abyssininca, Croton macrostachys* and *Syzygium guineese* are of high importance. The rainfall of the Anna Sorra District ranges between 750 and 1250mm while the annual temperature of minimum 17°C and maximum 21°C. The exact location of the apiary site was situated at 38° 44' 25" E and 6° 7' 90" N, altitude of 2351 m above sea level.

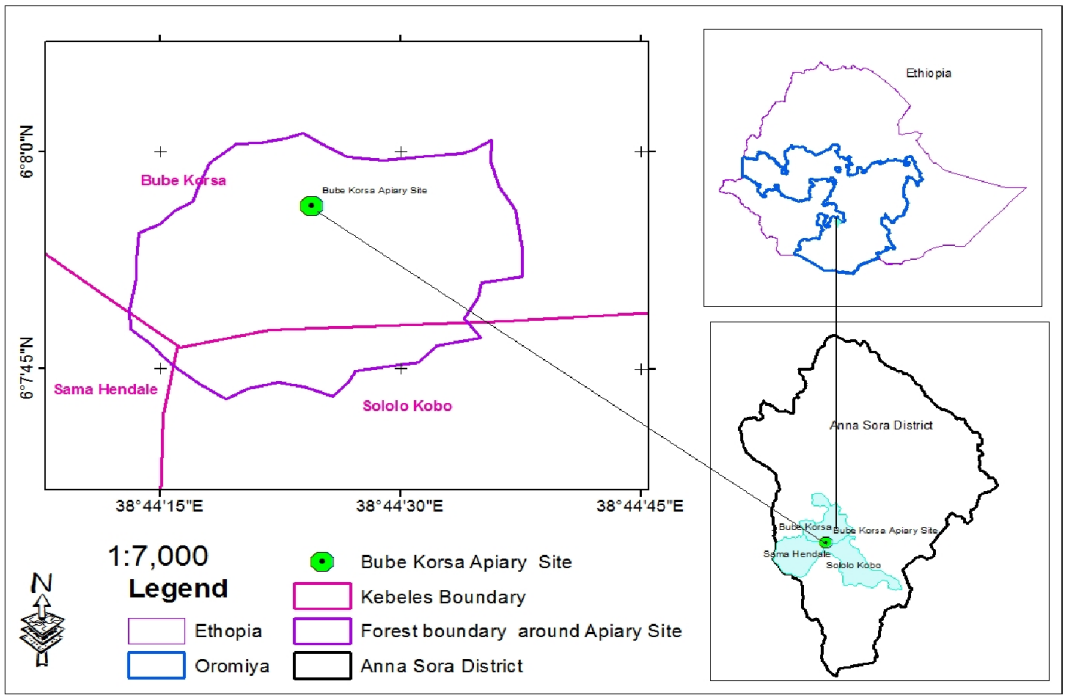

Fig. 1. Map of Apiary site

2.2 EXPERIMENTAL COLONIES

Twenty eight colonies of honeybees were used for this experiment to evaluate for temperament, hygienic, inclination to swarm, resource hording and absconding behavior. The necessary seasonal colony management activities were undertaken throughout the study period. Performance evaluation of the colonies was studied through the following different parameters.

2.3 EVALUATION OF TEMPERAMENT

The temperament of the colonies was assessed by recording time of reaction after hitting the lid twice. The distance the bees try to defend while approaching the hive entrance without any provoking action was also measured. Other subjective observation like calmness during the inspection (tendency to stay on the frames) was evaluated.

2.4 EVALUATION OF HYGIENIC BEHAVIOR

Hygienic behavior was determined by a pin-killed brood assay in which the time was recorded for colonies to detect and remove dead brood from a comb section containing 100 cells (containing approximately 100 capped pupae) on one side of the comb. This section of the comb was marked by removing one entire row of cells surrounding the 100 cells. The number of empty cells within the section was counted and recorded (when available). Then every capped pupae within the section was pin-killed and placed back in to the hive of the test colony. After 24 hrs the frame with the section was taken out and the

numbers of remaining dead brood and removed were recorded. This test was repeated five times for all the colonies to be tested for the hygienic behavior. Finally, the percent of removal of dead brood was calculated as follows the formula used by Kebede, 2006.

$$R = \frac{K - E - C}{T - E} \times 100$$

Where: R = Percent removal of dead brood within 24 hrs
K = Number of dead brood removed within 24 hrs
E = Number of empty cell within the section insert before test
C = Number of brood cell remained capped after 24 hrs
T = Total number of brood within the section of an insert

2.5 EVALUATION OF BROOD AREA, POLLEN AND NECTAR STORAGE AND SWARMING BEHAVIOR

The total brood area was measured during the study periods to determine the brood population using 5cm x 5cm gridded wooden frame and placed over each side of the brood combs. The total brood unit areas were calculated from the area occupied by the brood. In addition to this, the comb areas occupied by pollen and nectar stores were also measured in the same wa y. Swarming tendency of the colonies was evaluated by counting the number of queen cells constructed from all colonies under the study. These counted cells were removed immediately to avoid double counting.

2.6 EVALUATION OF ABSCONDING TENDENCY

Absconding tendency was assessed by the ratio of colonies evacuating to the total number of colonies used for the experiment provided that all the colonies are kept under uniform environmental condition.

2.7 EVALUATION OF HONEY YIELD

To obtain honey yield data during the study period first, frames with sealed honey combs were taken out of the hive and each frame with sealed honey was weighed. Then, frames with honey were extracted with centrifugal honey extractor. Empty frames after extracting the honey were weighed. Finally, net honey yield data was obtained by deducting weight after extraction from the weight before the extraction.

2.8 DATA MANAGEMENT AND STATISTICAL ANALYSIS

Data collected were entered into Microsoft excel 2007 and analyzed using SPSS version 20. Normality of the data were checked and they were transformed on Arcsine transformation when necessary. One-way analysis of variance (ANOVA) was run and Tukey's studentized test (HSD) at 5% level of significance was used to make mean separation, whenever significant results were encountered.

3 RESULTS AND DISCUSSION

3.1 EVALUATION OF TEMPERAMENT

The result of observation on unprovoked reaction was revealed that less proportion of the observations showed a reaction. Out of 42 observations made throughout the study period only 7.14% were reacted at a distance 0.29m away the hive entrance while 92.86 % did after hitting the lids twice. The study also showed that there was a significant difference among months ($F = 3.36$; d. f = 5, 36; $P < 0.01$) in the time of reaction after twice hitting of the hives lids. All colonies reacted slowly (19.29 seconds) in June than November, February and April but not in the rest of the months.

Calmness of the colonies during data collections was also observed. The observations indicated that the bees stayed on frames during inspection (Fig. 2), which is not common in bee colonies of other localities. It was observed that someone can easily walk among the colonies during the day time after the colonies were inspected or data collections in the previous nights with no or very few stings. This result contradicts the previous reports that *A. m. scutellata* honeybees had high defensive behavior by different authors Southwick, 1990,Winston, 1992, Schneider and McNally, 1992,Guzman-Novoa and Page, 1993, Collins et al., 1994. The latest report on the aggressive behavior of *A .m. scutellata* indicated that they are more

aggressive in September through November Amssalu,2002.However, results of current study during these months showed that these bees reacted only after provoking them by hitting the lids.

a) b)

Fig. 2. Field photo taken during inspection illustrating the calmness of these bees a) at 10: 30 Am and b) 7:00 Pm

Generally, the aggressive behavior of honeybees is associated with environmental factors, genetics, strength of colonies, large stores and amount of alarm produced (Chandler, 1976). The recent report (Amssalu, 2002) indicates that aggressive behavior of African honeybees is related with environmental conditions and the provocative factors in the region. It is an already established fact that high temperature and pest and/or predator attacks are the major causes of aggressiveness in African honeybees (Fletcher, 1978). In this regard, the very cool temperature of the study area, as it is in high altitude, might have caused the *A. m. scutellata* honeybees of Guji highlands to be very docile and calm.

3.2 EVALUATION OF HYGIENIC BEHAVIOR

The hygienic behavior of honeybees (*Apis species*) is a natural defense against diseases and parasites (Kavinseksan *et.al*, 2004).The result of the hygienic behavior of seven colonies *A. m*. *scutellata* colonies in terms of removing successive pin-killed capped brood in 24 hrs in different seasons is shown in (Table 1). In this test, the mean percent removal per colony varied from 86.57 (June) to 99.62 (December). The test colonies removed significantly less pin-killed capped brood in the month June than in November and December ($F = 6.21$, d.f. = 4, 30; $P < 0.001$). This indicated that there was a significant effect of test time (month) on performance of *A*. *m*. *scutellata* honeybee colonies in hygienic behavior. The variation in removing pin-killed capped brood between June and, November and December could be related to the performance of the colonies during different seasons. Starting from end of November the colonies became relatively stronger compared to June and stronger colonies might be more efficient than the weaker colonies.

Table 1. Mean± SE percent removal of pin-killed capped brood within 24 hrs

Months	Removal of pin-killed brood
June	86.57±3.16B
August	94.50±2.81AB
November	98.25±1.14A
December	99.62±0.27 A
February	94.87±1.20AB

Values followed by different letters within a column are significantly different at $\alpha=0.05$ using Tukey Student Test (HSD).

3.3 EVALUATION OF BROOD AREA, POLLEN AND NECTAR STORAGE AND SWARMING BEHAVIOR

The analysis of data recorded in different months between April 2011 and February 2012 is depicted in table 2. The results indicated that the highest brood rearing activity was observed from December to February that covered up to 216 unit areas of 5cm x5cm per colony while the least was observed during November 2011. The smallest brood area coverage for these colonies coincided with seasons of rainfall. The brood rearing pattern of *A. m. scutellata* honeybee colonies showed fast build up of population between December and February. However, the fast colony build up was not accompanied by

swarm initiation as the case in other honeybee populations in the country and the tropics as a whole. In fact, these populations produced almost no swarm in the study period.

The storage of nectar and pollen grains by *A*. *m*. *scutellata* honeybees showed no significant variation in different seasons (Table 2). The highest nectar and pollen grain storage was recorded in February while the least nectar was stored between November and December and the least for pollen grains was in November. In general, it was observed that the general trend of nectar and pollen grains storing coincided with the brood rearing pattern for these colonies.

The *A*. *m*. *scutellata* honeybees in Guji highlands showed very small reproductive swarming tendency (Table 2). The maximum number of queen cells encountered throughout the study period was only two per colony. These results are totally not consistent with the previous reports of (Seeley, 1978, Winston, 1980, Winston et.al., 1983, Schneider and Blyther, 1988, Winston, 1992, and Schneider and McNally, 1994) that declared tropical honeybees generally have a strong reproductive swarming impulse and tendency to increase population very quickly leading to rapid multiplication of colonies. The recent report (Amssalu Bezabeh 2002) revealed that *A m*. *scutellata* had higher tendency to reproductive swarming than *A*. *m*. *jemenitica* and *A*. *m*. *woyi-gambella* as 36.6% of the populations of the former race swarm every year and issuing multiple swarms commonly 3 to 6 per colony per annum.

Table 2. Mean± SE (number of 5x5 cm^2 unit area) of brood, nectar, pollen and number of queen cells observed per colony

Time	Brood area	Nectar area	Pollen area	Number of queen cells per colony
April 2011	13.17±6.49B	4.29±0.42A	0±0A	0±0A
June 2011	11.33±2.28B	26.33±9.53A	1.00±0.82A	0±0A
August 2011	66.67±28.85B	29.50±11.66A	4.33±1.02A	0.5±0.5A
November 2011	6.60±4.69B	0±0A	0±0A	0±0A
December 2011	111.71±33.37AB	0±0A	20.57±19.91A	0±0A
February 2012	216.43±48.32 A	65.57±37.39A	29.29±14.98A	2.00±2.00A

Values followed by different letters within a row are significantly different at α=0.05 using Tukey Student Test (HSD).

3.4 EVALUATION OF ABSCONDING BEHAVIOR

Absconding is abandoning of a nest by a colony which forms a swarm and presumably reestablishes itself elsewhere (Winston 1987). Shortage of resources and other factors could cause the absconding behavior of African honeybees (Schneider, 1990). Accordingly, absconding behavior of *A*. *m*. *scutellata* honeybee's colonies in Guji highland was pronounced (Fig. 3). The highest absconding rate (27%) was recorded between August and November while the least was observed between April and June. Our observation also indicates that there is a resource shortage and unfavorable weather condition (high rainfall and very chilly) temperature from July to November in Guji highland (Table 2).

Despite this, there is a plenty of bee forages and suitable weather condition for bee colonies at the nearby midland of the same area of Guji zone. This could be the major causes for the high percentage of absconding (bee migration) from the highland to midland of Guji zone. Earlier study conducted on *A*. *m*. *scutellata* in Botswana (Schneider, 1992) also supports the idea that colony movement is related with seasonally shifting resource pattern. Moreover, informal personal communications with local beekeepers around the study area also supported our observation. A study conducted on the behavioral aspects of *Apis m. bandasii* at central highland of Ethiopia (Zewdu, 2012) also coincide with the result of our study at Guji highlands. It was also observed that common hive operation (both during active and dearth periods) and disturbance due to predator and pests might not be a cause for colony absconding in the study area.

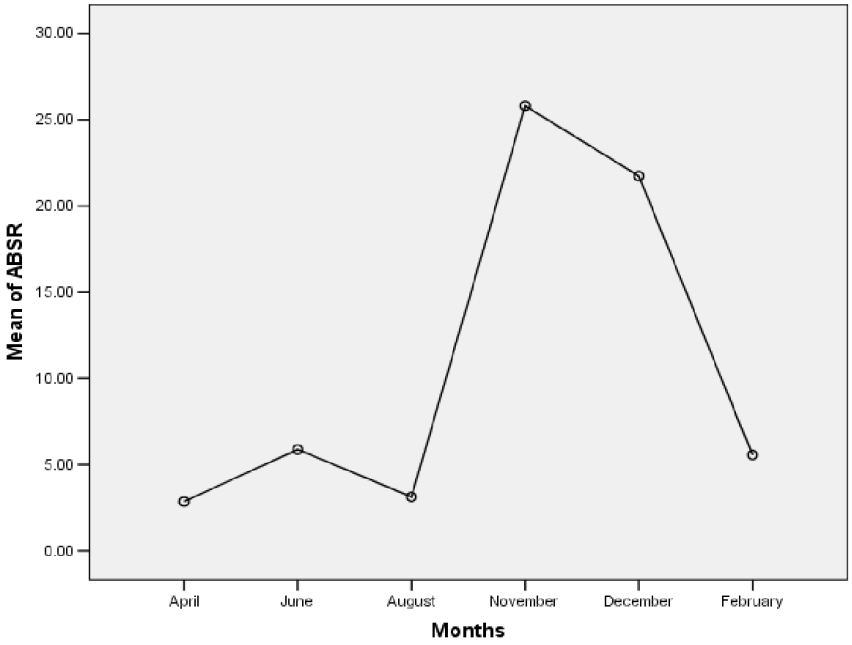

Fig. 3. Colony absconding trend in different periods

3.5 EVALUATION OF HONEY YIELD

The honey yield results per harvest per hive of the *A*. *m*. *scutellata* honeybees colonies in Anna Sorra District indicated that there was no significant (p=0.59) yield difference during the study period. The mean honey yield (kg) per harvest per hive was 9.64±3.02, 11.54±1.87 for the year 2011 and 2012, respectively. These colonies produced significantly less honey compared to the average national yield of colonies in frame hives. The major honey harvesting season for the study area was from mid April to mid May and followed by minor harvesting season in August. In the former harvesting season honey comes mainly from *Scheffleria abyssininca* and *Croton macrostachys* for the latter.

4 CONCLUSION AND RECOMMENDATIONS

This study revealed that *A*. *m*. *scutellata* honeybee colonies in Anna Sorra District (or may be the whole Guji highlands) had generally different behavioral and productive performances. These honeybees displayed very calm defensive behavior and they seem to be unique in their defense behavior as compared to *A.m. bandasii* that is located in the central highland of Ethiopia.

Moreover, the colonies had remarkable hygienic performance in removing pin-killed capped brood that reached up to 100% cleaning of dead broods within 24 hrs in some colonies. This high level of hygienic performance could be important in disease and parasite resistance like varroa as the population of the parasites could be easily kept under threshold by the colonies. As the study was conducted in the highland of Guji, which could not cover the other agro ecology of *A*. *m*. *scutellata* further studies that could address the whole agro-ecology of *A*. *m. scutellata* is recommended to investigate its detail behavioral aspects whether it is due to environmental or genetical factor for future selection and improvement.

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REFERENCES

[1] Amssalu B. (2002). *Multivariate Morphometric Analysis and Behaviour of honeybees (Apis mellifera L.) in the Southern Regions of Ethiopia.* PhD Thesis, Rhodes University, South Africa. Pp.109-214

[2] Chandler, M. T. (1976). The African honeybees - *Apis mellifera adansonii*: The biological basis of its management. *Proceeding of First International Conference on Apiculture in tropical climate,* London, UK, 61-68.

[3] Collins, Anita M., T. E Rinderer, and K. W. Tucker. 1988. Colony defence of two honeybee types and their hybrid (F1). Naturally Mated Queens. *Journal of Apicultural Research.* 27:137-140

[4] Collins, Anita M., H.V. Daly, T .E. Rinderer, J.R. Harbo and K. Holmer. (1994). Correlations between Morphology and colony defense in Apis mellifera. *Journal of Apicultural Research*33**:** 3-10

[5] Fletcher, D.J.C. (1978). The African Bee, *Apis mellifera adansonii*, in Africa. *Annual Review of Entomology* 23**:** 151-171.

[6] Gebreyesus M. (1976). Practical aspects of bee management in Ethiopia, in Proceedings of the First International Conference on Apiculture in Tropical Climates, pp. 69-78.

[7] Guzman-Novoa, E. and R. E. Page Jr. (1993). Backcrossing Africanized Honey Bee Queens to European Drones reduces Colony Defensive Behavior. *Annals of the Entomological Society of America.* 86**:** 352-355

[8] Kavinseksan, B., Wongsiri, S., Rinderer, T. E. and De Guzman, L. I. (2004). Comparison of the Hygienic Behavior of ARS Russian and Commercial honey bees in Thailand. *American Bee Journal***:** vol. 144, pp.870 -872.

[9] Kebede D.(2006). Testing colonies of India honey bees *Apis cerana* for hygienic behavior, (MSc Thesis). Bangalore: Department of Apiculture of Agricultural Science, PP.26-28.

[10] Ruttner, F. (1988). Breeding techniques and selection for breeding of the honeybee. The British Isles bee breeders Association by arrangement with Ehrenwirth Verlag Munich.pp.45-78.

[11] Schneider, S.S and Blyther, R. (1988).The habitat and nesting biology of the African honeybee *Apis mellifera scutellata* in the in the Okavango River Delta, Botswana, Africa. Insectes Society 35: 167-181.

[12] Schneider, S.S (1990). Nest characteristics and recruitment behavior of absconding colonies of the African honeybee, *Apis mellifera scutellata*, in Africa." *Journal ofInsect Behavior,* vol.3, pp.225-240

[13] Schneider, S.S and McNally, L.C. (1992). Seasonal cycles of growth, development and movement of the African honeybee, Apis mellifera scutellata, in Africa. *Insectes Sociaux*, vol. 39, pp.167-179.

[14] Schneider, S.S and McNally, L.C. (1994). Developmental patterns associated with founding and swarming in colonies of the African honeybee race, *Apis mellifera scutellata* Lepeletier. *Apidologie*, vol. 25, pp.530-539.

[15] Seeley, T. D. (1978). Life history strategy of the honeybee *Apis mellifera*. Oecologia 32: 109-118.

[16] Southwick, E. E. (1990). The Spread of Neotropical Honey Bees in the Americas by African Swarms. *American Bee Journal*. 130: 413-415.

[17] Winston, M. L. (1980). Swarming, after swarming, and reproductive rate of unmanaged honeybee colonies (*Apis mellifera*). *Insectes Sociaux* 27: 391-398.

[18] Winston, M. L., O. R. Taylor and G. W. Otis (1987). Some differences between temperate European and Tropical African and South American honeybees. Bee World 64: 12-21.

[19] Winston, M. L. (1987). *The biology of honey bee*. London: Harvard University press, PP. 217-220

[20] Winston, M. L. (1992). Killer bees. *The Africanized honeybee in the Americans*. Massachuters: Harvard University Press, pp. 176.

[21] Winston, M. L. (1992). The biology and management of Africanized honeybees. Annual Review of Entomology, 37: 173-193.

[22] Zewdu A. (2012). Study on productivity and behavioral aspects of local honeybee (*Apis Mellifera bandasii*), In: Apicultural Research achievement in Ethiopia, (Gemechis L., Kibebew, W., Amssalu B., Desalegn B., and Admassu A. Eds.), Addis Ababa: Holeta Bee Research Center, pp. 32.

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Relative Growth and Morphometric Measurements as an index for Estimating Meat Yield of two edible crabs *Portunus pelagicus* and *P. sanguinolentus* from the coastal waters of Pakistan

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ABSTRACT: This paper deals with relative growth of long carapace width (LCW) and carapace length (CL) with reference to short carapace width (SCW) in two species of edible crabs, namely *Portunus pelagicus* and *P. sanguinolentus*. The relationship between SCW and CL was found negatively co-related in both the species. Size-weight relationship showed that males are heavier than similar sized females in both species. Meat yield was found higher in *P. pelagicus* than *P. sanguinolentus*. Male P. pelagicus had 40.1 to 51.3% (average 44.5% ± 2.41 SD) meat of the total body weight, whereas female P. pelagicus had 35.6 to 48.6% (average 41.9% ± 2.17 SD) meat. In case of male *P. sanguinolentus* the meat yield varied from 39.0 to 47.7% of the body weight while in female it varied from 32.1 to 43.8% (average 37.7% ± 2.31 SD). More than half of the total meat was found in the thorax. Female thorax yielded more meat (56 and 55% in *P. pelagicus* and *P. sanguinolentus*, respectively) than the male thorax (53 and 51% respectively). Male chalae yielded more meat (30 and 32% in *P. pelagicus* and *P. sanguinolentus*) than that of female (27 and 30%, respectively). Periopods yielded 15 to 17% meat only in both species.

KEYWORDS: Pakistan, Relative growth, Meat yield, *Portunus,* Carapace.

1 INTRODUCTION

The growth in crustacea is a discontinuous process involving a succession of moults separated by intermoults. During intermoults, the exoskeleton is rigid and facilitates accurate measurement. Allometric analysis is useful for taxonomists and ecologists interested in intra- and interspecific morphological variations. Several researchers have used allometric analysis to compare inter-specific variation among population of brachyuran crabs from different location [1], [2], [3], [4], [5].

In fisheries work it is sometimes desirable or even necessary to convert one dimension into other or body size into body weight. The size-weight relationship has a number of uses including the estimation of weight from size for individual crab and also estimation of standing crop biomass when the size-frequency distribution is known [6], [7].

Early studies of relative growth of brachyuran crabs were concentrated on benthic and burrowing species while recent studies have included swimming crabs belonging to the family Portunidae. Width-weight and length-weight relationships of portunid crabs have been studied by Olmi III and Bishop [8], Potter et al. [9], Du Preez and McLachalan [10], George et al. [11], Davidson and Marsden [12], Sumpton et al. [13], Sumpton [14], Sukumaran and Neelakantan [15], Atar and Secer [16], Ali et al. [17], Akin-Oriola et al. [18] and Al-Rumaidh et al. [19].

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Study of relative growth and size-weight relationship of crustaceans in general and portunid crabs in particular have received very little attention here in Pakistan. Tirmizi and Aziz [20] studied relative growth of planktonic shrimp Sergestes semissis while presented length-weight relationship of two species of brachyuran crabs [21], namely Matuta planipes and M. lunaris belonging to family Clappidae. No work on relative growth and size-weight relationship of *Portunus* crabs from Pakistan has been published so far.

No analyses on the meat yield have so far been attempted on any brachyuran crabs of Pakistan except Akbar et al. [22] who studied condition index of *P. pelagicus* from the Karachi coast. This being the case, the Morphometric relationship between short carapace width (SCW) and long carapace width (LCW); SCW and carapace length (CL) and SCW and body weight (BW) of the two species of *Portunus* were studied. Also studied were amount of meat present in the crabs and the percentage composition of meat in various parts of the body.

2 MATERIALS AND METHODS

The sampling was done twice in a month from January 2004 to December 2005. In the laboratory, crabs were sexed, measured and weighted. Only intermoults crabs with intact appendages were used. Berried females, crabs in ecdysis or recently moulted and those with broken appendages or damaged carapace or broken long spine (9th anterolateral tooth) were not included in the analysis.

Measurements of different body parts were taken with the help of divider and millimeter scale. Long carapace width was taken from the tips of ninth anterolateral teeth whereas SCW was taken from the bases of ninth anterolateral teeth. Carapace length (CL) was measured from anterior to posterior edge of carapace. Length of chelar propodus (CPL) was taken from the tip of propodus (fixed finger) to the base where it articulates with carpus. A total of 962 crabs (540 belonging to *Portunus pelagicus* and 422 to *P. sanguinolentus*) were studied for relative growth.

For the study of meat content, 502 crabs (282 *P. pelagicus* and 220 *P. sanguinolentus*) were sacrificed for determining the weight of meat present in the different parts of the body. After taking the wet weight of the intact crab, it was dissected and meat from the thorax, walking legs and cheliped was carefully removed manually and weighted separately on a top loading electronic balance to nearest 0.1 gram. The statistical analysis of the data, was done as described by Rasheed and Mustaquim [23].

3 RESULTS

RELATIVE GROWTH

3.1 PORTUNUS PELAGICUS

A total of 540 *P. pelagicus* (280 males and 260 females) were used for study of relative growth. The size (SCW) of male and female crabs, ranged from 23 -135 mm (mean 73.87 mm ± 21.87 S.D.) and from 26-148 mm (mean 72.97 mm ± 24.01 S.D.) respectively. The weight of crabs varied from 2 - 380g (mean 70.53 g ± 64.27 S.D.) for males and from 2- 397g (mean 66.55 g ± 65.54 S.D.) for females.

3.1.1 SHORT CARAPACE WIDTH AND LONG CARAPACE WIDTH

Figures 1A-C illustrates the linear relationships between SCW and LCW. The regression equations are given in table 1. It is evident from the regression equations that allometric growth in male was negative and value b obtained for male was found significantly less than 1 ($t = 2.233$; $\alpha = 0.05$) but the growth was isometric in female and value b obtained for female was not significantly different from 1 ($t = 1.233$; $\alpha = 0.05$). Similarly the difference between male and female 'b' values was found statistically insignificant ($t = 0.724$; $\alpha = 0.05$). When the male and female data were combined, the value of b obtained was 0.9824, which is not significantly different from 1 ($t = 1.665$; $\alpha = 0.05$). The two variables were found strongly co-related ($R^2 = 0.99$).

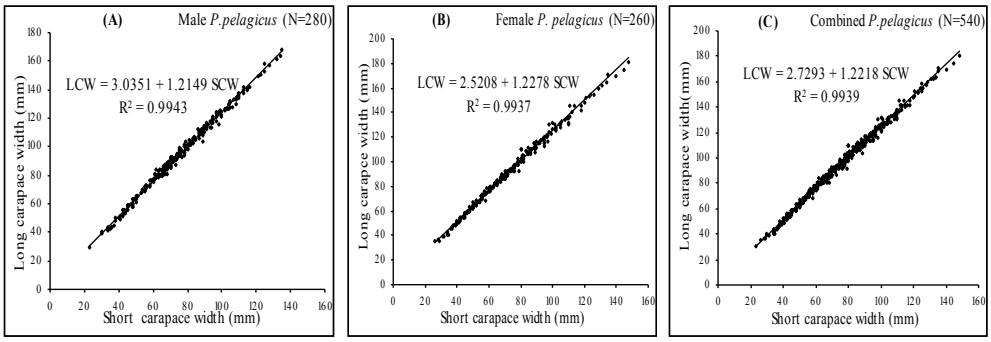

Fig. 1. Portunus pelagicus: linear relationship between short carapace width (SCW) and long carapace width (LCW) in (A) male, (B) female and (C) combined.

3.1.2 SHORT CARAPACE WIDTH AND CARAPACE LENGTH

The relationships between SCW and CL are illustrated in figures 2 A-C for male and female *P. pelagicus*, while regression equations are given in table 1.

Table 1. Portunus pelagicus: summary of linear regression and log-transformed regression analysis. Short carapace width (SCW) and long carapace width (LCW) and carapace length (CL) of male, female and combined. b: regression coefficient (slope of the line), R^2: coefficient of determination, S.E. (b): standard error of b, t (b=1): student's t-test when b =1, t (b=b): student's t-test for comparison of two slopes b.

Y-Variable	Sex	Regression equations	R^2	b	S.E. (b)	t (b=1)	t (b=b)
Long carapace width (LCW)	Male	LCW = 3.0351 + 1.2149 SCW	0.994	0.9774	0.0101	2.233*	0.724
		Log LCW = log 0.141 + 0.9774 log SCW	0.994				
	Female	LCW = 2.5208 + 1.2278 SCW	0.993	0.9866	0.0108	1.233	
		Log LCW = log 0.126 + 0.986 log SCW	0.994				
	Combine	LCW= 2.7293 + 1.2218 SCW	0.993	0.9824	0.0105	1.665	……
		Log LCW = log 0.1333+ 0.982 log SCW	0.994				
Carapace length (CL)	Male	CL = 1.3641 + 0.5598 SCW	0.993	0.9551	0.0104	4.280*	0.032
		Log CL= log - 0.1534 + 0.955 log SCW	0.993				
	Female	CL = 1.3837 + 0.5586 SCW	0.995	0.9555	0.009	4.579*	
		Log CL = log - 0.1548 + 0.955 log SCW	0.995				
	Combine	CL = 1.3604 + 0.5591SCW	0.994	0.9554	0.0106	4.203*	…..
		Log CL = log -0.1546 + 0.9554 log SCW	0.994				

* significant (α = 0.05)

The values of b obtained from log-transformed data are 0.9551 for male and 0.9555 for female which are significantly less than one (t= 4.280 for male and 4.579 for female; α = 0.05) which indicates negative allometric growth for both male and female. The difference between male and female b was found insignificant (t= 0.032, α = 0.05). Hence the two data were pooled together (figure 2C). The regression equations for combined data are given in table 1 and the value of b (0.9554) was found significantly less than 1(t = 4.203; α = 0.05). The two variables were found strongly co-related (R^2= 0.99).

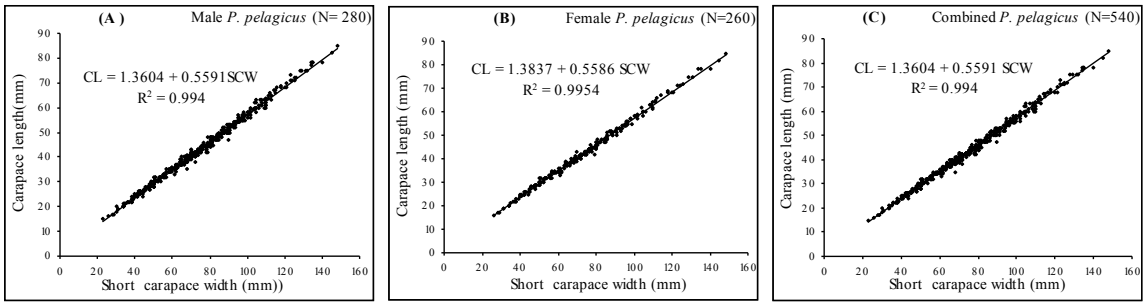

Fig. 2. Portunus pelagicus: linear relationship between short carapace width (SCW) and carapace length (CL) in (A) male, (B) female and (C) combined

3.1.3 SHORT CARAPACE WIDTH AND BODY WEIGHT

The relationships between SCW and BW for male and female *P. pelagicus* are shown in figures 3 A-C. The estimated value of b was 3.0278 for male and 2.9864 for female. Although the males appear to be slightly heavier than the females of equal size, but the values of b were not found significantly different from 3 (t = 0.591 for male and 0.346 for female; α = 0.05). This shows that there is cubic relationship between size and weight, hence the growth is isometric. Student's *t*-test was also performed to compare the two values of b and it was found that the difference was also insignificant statistically (t = 1.019; α = 0.05). The regression equations are given in table 2.

Table 2. Portunus pelagicus: summary of cubic regression and log-transformed regression analysis between short carapace width (SCW) in mm and body weight (BW) in g.

Y-Variable	Sex	Regression equation	R^2	b	S.E. (b)	t (b=3)	t (b=b)
Body weight (BW)	Male	$BW = 0.0001\ SCW^{3.0278}$	0.9873	3.0278	0.046	0.591	1.019
		Log BW = - 3.91 + 3.0278 log SCW	0.9873				
	Female	$BW = 0.0001\ SCW^{2.9864}$	0.9922	2.9864	0.0393	0.346	
		Log BW= - 3.864+ 2.9864 log SCW	0.9922				
	Combined	$BW = 0.0001 SCW^{3.0086}$	0.9892	3.0086	0.0447	0.192	….
		Log BW = -3.894+ 3.0086 log SCW	0.9892				

The coefficient of determination (R^2) was found to be 0.99 indicating strong relationship between the two variables.

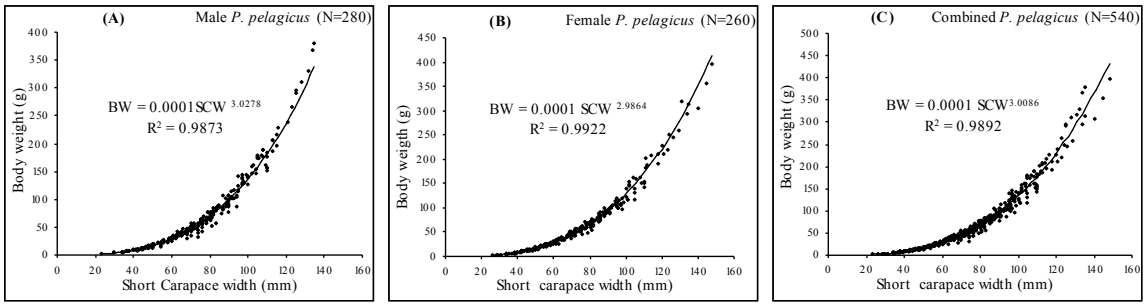

Fig. 3. Portunus pelagicus: cubic relationship between short carapace width (SCW) and body weight (BW) of (A) male, (B) female and (C) combined.

3.2 PORTUNUS SANGUINOLENTUS

Out of 422 *P. sanguinolentus* used for relative growth study, 214 were males and 208 were females. The short carapace width of the crabs ranged from 24 to 130 mm (mean 84.58 mm ± 17.34 S.D). The mean short carapace width of males was 88.08 mm ± 17.85 S.D. (range: 24 to 125 mm) and that of females 81.04 mm ± 16.09 S.D. (range: 28 to 130 mm).

3.2.1 SHORT CARAPACE WIDTH AND LONG CARAPACE WIDTH

Figures 4 A-B shows the linear and log-transformed relationships between SCW and LCW in male and female *P. sanguinolentus*. The regression equations are given in table 3.

Table 3. Portunus sanguinolentus: summary of linear regression and log-transformed regression analysis: (short carapace width (SCW) with long carapace width (LCW) and carapace length (CL) of male, female and combined. b: regression coefficient (slope of the line), R^2: coefficient of determination, S.E. (b): standard error of b, t (b=1): student's t-test when b=1, t (b=b): student's t-test for comparison of two slopes b.

Y-Variable	Sex	*Regression equations*	R^2	b	S.E. (b)	t (b = 1)	t (b = b)
Long carapace width (LCW)	Male	LCW = 2.565 + 1.2386 SCW	0.991	0.979	0.008	2.505*	2.468*
		Log LCW = log 0.144 + 0.9787 log SCW	0.9932				
	Female	LCW = 4. 0429 + 1.2272 SCW	0.9869	0.956	0.009	4.494*	
		Log LCW = log 0.191 + 0.9555 log SCW	0.9879				
Carapace length (CL)	Male	CL = 1.7825 + 0.517 SCW	0.9912	0.949	0.008	6.121*	1.245
		Log CL = log - 0.172 + 0.9498 log SCW	0.9933				
	Female	CL = 1.8386 + 0.5218 SCW	0.9903	0.956	0.008	6.151*	
		Log CL = log - 0.179 + 0. 9559 log SCW	0.9917				
	Combined	CL = 2.1084 + 0.5155 SCW	0.9895	0.952	0.009	5.314*	…..
		Log CL = log -0.1736 + 0.9516 log SCW	0.991				

*significant (α=0.05)

The value of regression coefficient b was found to be 0.9787 for male and 0.9555 for female. These values were found significantly less than 1 (t = 2.505 for male and 4.494 for female, α = 0.05), which shows that the growth was negative. The difference between male and female b values were also found significantly different (t = 2.468, α = 0.05) therefore the data of male and female crabs were not combined. The two variables in male and female were found strongly co- related (R^2= 0.99).

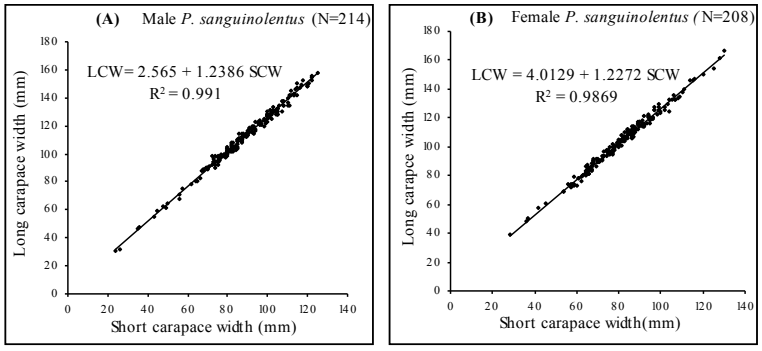

Fig. 4. Portunus sanguinolentus: linear relationship between short carapace width (SCW) and long carapace width (LCW) in (A) male and (B) female

3.2.2 SHORT CARAPACE WIDTH AND LONG CARAPACE LENGTH

The relationships between SCW and CL for male and female *P. sanguinolentus* are shown in figures 5 A-C. The regression equations, which are given in table 3, shows that the CL does not increase isometrically with respect to SCW. The value of regression coefficient b for male was found to be 0.9498 and that of female 0.9559, which are significantly less than 1 (t = 6.121 for male and 6.151 for female, α = 0.05) indicating negative allometry. Student's *t*-test revealed that the difference between male and female b values was insignificant (t = 1.248; α = 0.05) and therefore the two data were combined. The two variables were more strongly co related in male (R^2= 0.990) than those of female (R^2= 0.987). Figure 5C shows the linear relationship between carapace width and carapace length of the combined data and 5F shows log- transformed relationship of same variables.

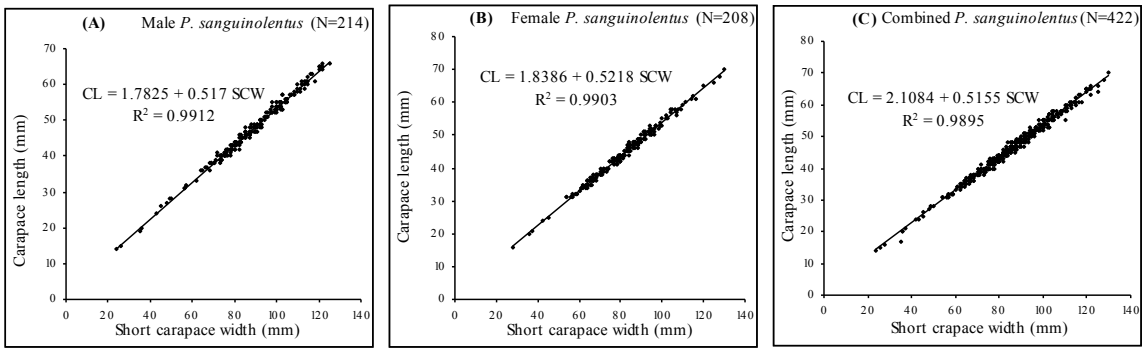

Fig. 5. Portunus sanguinolentus: linear relationship between short carapace width (SCW)and carapace length (CL) in (A) male, (B) female and (C) combined.

3.2.3 SHORT CARAPACE WIDTH AND BODY WEIGHT

The cubic relationships between short carapace width and body weight are shown in figures 6 A-B. The regression equations are given in table 4. The value of b for male was found to be 3.0223 and that of female 2.806, which shows that males are slightly heavier than females of the same size. The value of b obtained for male was not significantly different from 3 (t = 0.724, α = 0.05) whereas that of female was found significantly less than 3 (t = 6.592, α = 0.05) and this shows that the relationship between size and weight in female is negative. Student's *t*-test revealed that the difference between male and female b values was significant (t = 11.716; α = 0.05) and therefore data of male and female were not combined. The two variables were more strongly co related in male (R^2 = 0.990) than those of female (R^2= 0.987).

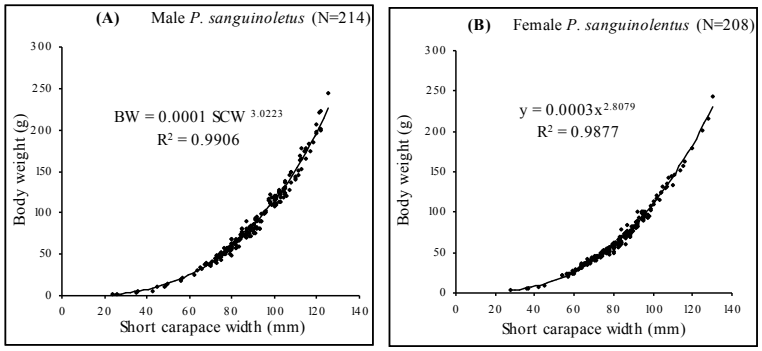

Fig. 6. Portunus sanguinolentus: cubic relationship between short carapace width (SCW) and body weight (BW) of (A) male and (B) female.

Table 4. Portunus sanguinolentus: summary of cubic regression and log-transformed regression analysis between short carapace width (SCW) in mm and body weight (BW) in g.

Y-variable	Sex	Regression equations	R^2	b	S.E. (b)	t (b = 3)	T (b = b)
Body weight (BW)	Male	BW = 0.0001 SCW $^{3.0223}$	0.9906	3.022	0.031	0.724	11.71*
		Log BW = log - 3.984 + 3.0223 log SCW	0.9906				
	Female	BW = 0.0003 SCW $^{2.8079}$	0.9877	2.808	0.029	6.592*	
		Log BW = log - 3.574 + 2. 808 log SCW	0.9877				

*significant (α=0.05)

MEAT YIELD

Meat from thorax, chela and periopods (legs) was extracted manually from a total of 602 crabs. Of these, 382 were *P. pelagicus* and 220 were *P. sanguinolentus*. The results are presented below.

3.2.4 PORTUNUS PELAGICUS

One hundred fifty seven male crabs weighing from 17 to 368 g (average 91.41g ± 65.67 S.D.) were dissected and the weight of meat was recorded separately for thorax, chelae and periopods of each crab. Table 5 gives the range, average and standard deviation of some morphological parameters as well as weight of meat present in different parts of the body of male and female *P. pelagicus*. The weight of the meat varied from 7.5 to 186.1 g (average 41.4 g ± 31.1 SD). The linear relationship between body weight and meat weight for male *P. pelagicus* is shown in figure 7A-B.

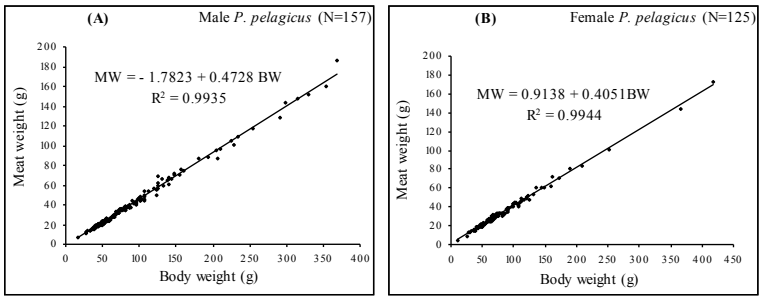

Fig. 7. Portunus pelagicus: linear relationship between body weight (BW) and meat weight (MW) in (A) male and (B) female crabs.

Table 5. Portunus pelagicus: range, mean and standard deviation (S.D.) of some parameters

Parameters	Male (N =157) Range (mean ± S.D.)	Female (N = 125) Range (mean ± S. D.)
Short carapace width (SCW) (mm)	52 - 134 (83.66 ± 16.34)	44 - 145 (82.25 ± 15.18)
Chelar propodus length (CPL) (mm)	35 - 142 (69.8 ± 20.8)	29 - 112 (58.84 ± 12.08)
Body Weight (BW) (g)	17 - 368 (91.41 ± 65.67)	11- 417 (80.9 ± 54.88)
Meat weight (MW) (g)	7.5 -186.1 (41.43 ± 31.1)	4.9 -173 (33.68 ± 22.29)
Thorax Meat (TM) (g)	4.8 - 87.2 (21.89 ± 14.9)	3 - 80.6 (18.87 ± 11.39)
Chelar meat (CM) (g)	0.9 - 33.2 (6.3 ± 5.28)	0.5 - 30.6 (4.82 ± 3.77)
Legs meat (LM) (g)	0.8 - 34.6 (7.08 ± 5.88)	0.8 - 32.6 (5.67 ± 4.05)

The regression equations are given in table 6. It is evident from the regression equation that value b obtained for male is significantly greater than 1 (t = 2.047; α = 0.05). In term of percentage, male crabs had 40.1 to 51.3% meat of the total body weight. The average of the percent meat was found to be 44.5 % ± 2.41 SD.

Table 6. Portunus pelagicus: summary of linear regressions and log-transformed regression analysis between meat yield (MW) and body weight (BW) of male and female crabs. b: regression coefficient (slope of the line), R^2: coefficient of determination, S.E. (b): standard error of b, t (b=1): student's t-test when b=1, t (b=b): student's t-test for comparison of two slopes b .

Variable	Sex	*Regression equations*	R^2	b	S.E. (b)	t (b=1)	t (b=b)
BW x MW	Male	MW = -1.7823 + 0. 4728 BW	0.993	1.043	0.021	2.04*	2.369*
		Log MW = log -0.4324 + 1.0432 log BW	0.993				
	Female	MW = 0.9138 + 0.4051BW	0.994	0.983	0.021	0.74	
		Log MW = log -0.3486 + 0.9838 log BW	0.99				

* significant (α=0.05)

In case of female *P. pelagicus*, a total of 125 crabs were dissected. Their body weight varied from 11 to 417 g (average 80.9g ± 54.88 SD.) and the weight of the meat varied from 4.9 to 173 g (average 33.7 g ± 22.29 SD.). Figures 7B shows the linear relationship between body weight and meat weight of female *P. pelagicus*. The regression equations, which are given in table 6 show that value b obtained for female is not different significantly from 1 (t = 0.736; α = 0.05). The difference between male and female b values was found statistically significant (t = 2.368; α = 0.05). The female crabs, on average, yielded 41.93 % ± 2.17 SD. meat of the total body weight (range: 35.6 % to 48.63%).

Most of the meat was found in the thorax (56 % in female and 53 % in male) followed by chelae (30% in male and 27 % in female) and Periopods (17 % each in male and female). The percentage composition of meat yield in male and female *P. pelagicus* is shown in figure 8.

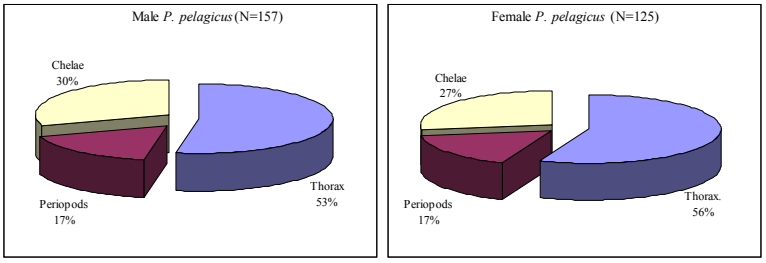

Fig. 8. Portunus pelagicus: percentage composition of meat in different parts of the body in male and female crabs.

The thorax of female yielded more meat than that of male whereas male chelae had more meat than that of female. In periopods, the amount of meat in term of percentage was almost same in both the sexes. The cubic relationship between SCW and thorax meat weight for male and female *P. pelagicus* is shown in Figure 9.

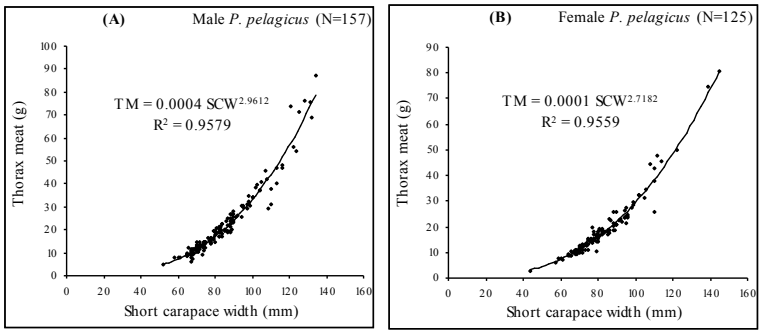

Fig. 9. Portunus pelagicus: cubic relationship between short carapace width(SCW) and thorax meat (TM) in (A) male and (B) female crabs.

The regression equations, which are given in table 7 show the rate of increase in SCW and weight of the meat in the thorax is same in male and value b obtained is insignificantly different from 1 (t = 0.784; α = 0.05) but in female the rate of growth is negative and value b obtained for female is statistically significantly different from 3 (t = 6.308; α = 0.05). The difference between male and female b values was found statistically significant (t = 9.843; α = 0.05).

Table 7. Portunus pelagicus: summary of cubic regression and log transformed regression analysis between short carapace width (SCW) with thorax meat (TM) and chelar propodus length (CPL) and chelar meat (CM) in male and female crabs. b: regression coefficient (slope of the line), R^2: coefficient of determination, S.E. (b): standard error of b, t (b=1): student's t-test when b=1, t (b=b): student's t-test for comparison of two slopes b .

Variable	Sex	Regression equations	R^2	b	S.E. (b)	t (b=3)	t (b=b)
SCW x TM	Male	$TM = 0.0004\ SCW^{2.9612}$	0.958	2.961	0.049	0.784	9.843*
		Log TM = log -4.4035 + 2.9612 log SCW	0.958				
	Female	$TM = 0.0001\ SCW^{2.7182}$	0.956	2.718	0.044	6.308*	
		Log TM = log -3.9667 + 2.7182 log SCW	0.956				
CPL x CM	Male	$CM = 0.0002\ CPL^{2.3976}$	0.947	2.397	0.067	8.939*	9.769*
		Log CM = log -3.6888 + 2.397 log CPL	0.947				
	Female	$CM = 0.00005\ CPL^{2.7788}$	0.951	2.778	0.053	4.195*	
		Log CM = log -4.2846 + 2.7788 log CPL	0.951				

*significant (α=0.05)

Figure 10 shows the cubic relationship between chelar propodus length and chelar meat weight for male and female *P. pelagicus.* The regression equations are given in table 8. The estimated value of b was 2.397 for male and 2.778 for female. The values of b were found significantly less than 3 (t = 8.939 for male and 4.195 for female; α = 0.05). Student's *t*-test was also performed to compare the two values of b and it was found that the difference was also significant statistically (t = 9.769; α = 0.05).

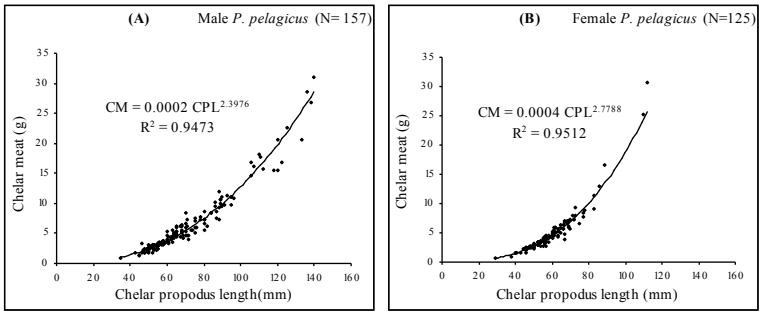

Fig. 10. Portunus pelagicus: cubic relationship between chelar propodus length (CPL) and chelar meat (CM) in (A) male and (B) female crab.

3.2.5 PORTUNUS SANGUINOLENTUS

The male crabs used for meat yield analysis numbered 112. Table 8 presents the range, mean and standard deviation of some morphological parameters as well as meat weight in male and female *P. sanguinolentus*. The smallest male crab was 20g in weight and yielded 7.8 g meat whereas the largest crab weighing 247g yielded 109.4g of meat. The average weight of the male crabs was found to be 90.36 g ± 46.88 S.D. and average weight of the meat was estimated to be 39.38 g ± 21.28 S.D. In term of percentage, the male *P. sanguinolentus* yielded 43.2 % ± 1.96 S.D. meat of the total body weight (range 39 % to 47.73 %). The linear relationship between body weight and meat weight of male *P. sanguinolentus* is shown in figure 11A.

Table 8. Portunus sanguinolentus: range, average and standard deviation of different parameters

Parameters	Male (N =157) Range (mean ± S.D.)	Female (N = 125) Range (mean ± S. D.)
Short carapace width (SCW) (mm)	56 - 122 (89.29 ± 13.87)	54 - 130 (82.25 ± 15.18)
Chelar propodus length (CPL) (mm)	38 - 105 (67.88 ± 14.01)	30 - 85 (57.06 ± 10.22)
Body Weight (BW) (g)	20 - 247 (90.36 ± 46.88)	19 - 222 (79.21 ± 39.99)
Meat weight (MW) (g)	7.8 - 109.4 (39.68 ± 21.28)	6.5 - 86.3 (29.97 ± 15.36)
Thorax Meat (TM) (g)	4.4 - 51 (19.97 ± 9.94)	4.2 - 49.2 (16.4 ± 8.19)
Chelar meat (CM) (g)	0.9 - 21.9 (6.39 ± 3.89)	0.8 - 12.3 (4.42 ± 2.54)
Legs meat (LM) (g)	1.4 - 21 (6.66 ± 4.02)	0.6 - 14 (4.55 ± 2.43)

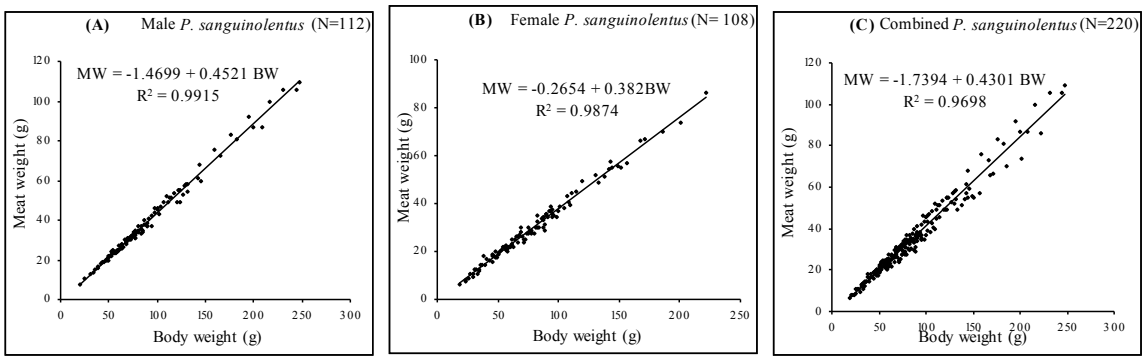

Fig. 11. Portunus sanguinolentus: linear relationship between body weight (BW) and meat weight (MW) in (A) male, (B) female and (C) combined.

The regression equations are given in Table 9.

Table 9. Portunus sanguinolentus: summary of linear regression and log-transformed regression analysis of body weight (BW) and meat weight (MW) of male and female crabs, b: regression coefficient (slope of the line), R^2 = coefficient of determination, S.E. (b): standard error of b, t (b=1) = student's t-test when b=1), t (b = b): student's t-test for comparison of two slopes b.

Variable	Sex	Regression equations	R^2	b	S.E. (b)	t (b=1)	t (b=b)
BW x MW	Male	MW = -1.4699 + 0.4521BW	0.991	1.038	0.018	2.107*	0.782
		Log MW = log -0.4377 + 1.038 log BW	0.993				
	Female	MW = -0.2654 + 0.382 BW	0.987	1.020	0.029	0.695	
		Log MW = log -0.4615 + 1.020 log BW	0.983				
	Combined	MW = -1.7394 + 0.4301BW	0.969	1.047	0.037	1.261	…
		Log MW = log -0.482 + 1.047 log BW	0.973				

* significant (α= 0.05)

The female crabs used for meat yield analysis were 108 in number weighing from 19 to 222 g. The weight of meat extracted varied from 6.5 to 86.3 g. The average weight of the female crabs was found to be 79.89 g ± 39.94 S.D and the average meat weight was 29.98 g ± 15.31 S.D. On the whole the female *P. sanguinolentus* yielded 37.7 % ± 2.31 S.D. meat of the total body weight (range: 32.1 % to 43.8%). The linear relationship between body weight and meat weight for female *P. sanguinolentus* are shown in figures 11B. The difference between male and female 'b' values was found insignificant (t = 0.782, α = 0.05), hence the two data were pooled together and figure 11C is the scattered diagram of combined data. The regression equation for combined data is given in table 9.

In *P. sanguinolentus,* more than half of the total meat was found in thorax (55% in female and 51 % in male) followed by chelae (32 % in male and 30 % in female) and periopods (17 % in male and 15% in female). Figure 12 shows the percentage distribution of meat in male and female *P. sanguinolentus.* Female *P. sanguinolentus* had more meat in thorax than that of male while chela and periopods of male yielded more meat than those of female.

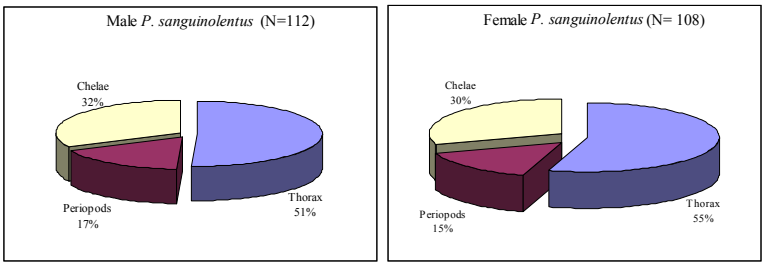

Fig. 12. Portunus sanguinolentus: percentage composition of meat in different parts of the body in male and female.

The cubic relationship between SCW and thorax meat of male and female *P. sanguinolentus* are shown in figures 13 A-B. The regression equations, which are given in table 10, show that the thorax meat does not increase isometrically with respect to SCW. The value of regression coefficient b for male was found to be 2.9042 and that of female 2.6542, which are significantly less than 3 (t = 1.902 for male and 6.529 for female, α = 0.05). Student's *t*-test revealed that the difference between male and female b values was also significant (t = 9.259; α = 0.05).

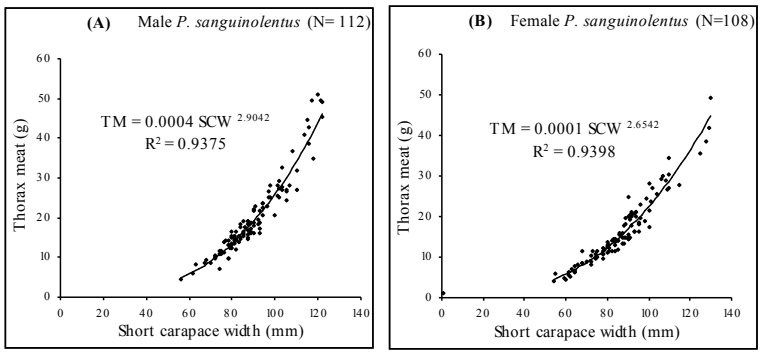

Fig. 13. Portunus sanguinolentus: cubic relationship between carapace width (CW) and thorax meat (TM) of (A) male and (B) female crabs.

Table 10. Portunus sanguinolentus: summary of cubic regression and log-transformed regression analysis of meat yield and morphometric relationship between short carapace width (SCW) and thorax meat (TM) and chelar propodus length (CPL) and chelar meat (CM) in male and female crabs. b: regression coefficient (slope of the line), R^2 = coefficient of determination, S.E. (b): standard error of b, t (b=1) = student's t-test when b=1), t (b= b): student's t-test for comparison of two slopes b.

Variable	Sex	Regression equations	R^2	b	S.E. (b)	t (b=3)	t (b=b)
CW x TM	Male	$TM = 0.0004\ CW^{2.9042}$	0.937	2.904	0.050	1.902*	9.259*
		Log TM = log -4.3969 + 2.904 log CW	0.937				
	Female	$TM = 0.0001\ CW^{2.6542}$	0.939	2.654	0.052	6.528*	
		Log TM = log -3.9578 + 2.6542 log CW	0.939				
CPL x CM	Male	$CM = 0.0005\ CPL^{2.7468}$	0.951	2.746	0.055	4.568*	6.956*
		Log CM = log -4.2692 + 2.7468 log CPL	0.951				
	Female	$CM = 0.0002\ CPL^{2.9833}$	0.939	2.983	0.059	$0.278^{i.s}$	
		Log CM = log - 4.6187 + 2.9833 log CPL	0.939				

* significant (α= 0.05)

Figures 14 A-B show the cubic relationship and between chelar propodus length and chelar meat of male and female *P. sanguinolentus.* It is evident from the regression equations, which are given table 10, that the value b obtained for male is significantly less than 3 (t = 4.568; α = 0.05) but in female the value b obtained is not significantly different from 3 (t = 0.278; α = 0.05). The difference between male and female b values was found statistically significant (t = 6.956; α = 0.05).

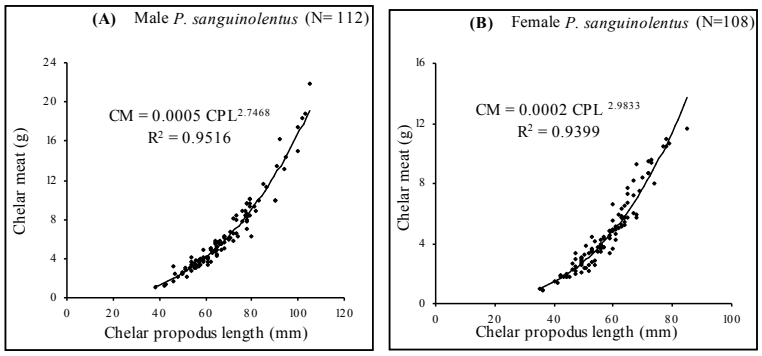

Fig. 14. Portunus sanguinolentus: cubic relationship between chelar propodus length (CPL) and chelar meat (CM) in (A) male and (B) female crabs.

4 DISCUSSION

During present investigation, relative growth of LCW with reference to SCW was found isometric only in female *P. pelagicus* while in male it was slightly negative, However the difference between males' and females' regression coefficient was found insignificant ($\alpha = 0.05$). This result differs from that of Potter *et al*. who studied biology of *Portunus pelagicus* in an Australian estuary. They found significant differences ($P < 0.001$) between the slope of the regression equation relating carapace width from the base of the large lateral spine (= SCW of the present study) and from the tip of these spines (=LCW of the present study) in males and females. According to them the regression equation for males is $CW_1 = -5.2513 + 0.8840$ CW ($n = 326$, $r = 0.99$) and for females is $CW_1 = -2.6865 + 0.8480$ CW ($n = 542$, $r = 0.99$); where CW_1 is the short carapace width and CW is the long carapace width. Unfortunately Potter *et al*. presented the data without logarithmic transformation and therefore the allometric status of the carapace growth is not obvious. However from the regression equations it is evident that the length of the long spines (*i.e.* ninth anterolateral teeth of carapace) is much shorter in Australian specimens than those of Pakistani specimens. For instance, a male *P. pelagicus* of 100 mm short carapace width is expected to have 119 mm long carapace width in Australia whereas a male *P. pelagicus* of the same short carapace width is expected to have 124.5 mm long carapace width (according to regression equation given in the result of the present study). Hence the combined length of the two long spines in Australian specimen is estimated to be 19 mm as against 24.5 mm of Pakistani specimens.

Such variation of carapace in portunid crabs caused [24] to differentiate taxonomically a long-spined sub species from that with typical spine in the blue crab, *Callinectes sapidus* from United States. Chace and Hobbs [25], from West Indies, stated that the extreme variants of long-spine and typical spines of *C. sapidus* might be designated as distinct species. However, Williams [26], who re-examined the status of *C. sapidus,* concluded that it is a single species, which has diverged into poorly defined population in certain areas of its range. The morphological variation was found in adult female *C. sapidus* from year to year within Delaware Bay and also from one area to another by Porter [27] who suggested salinity, temperature, and food abundance as possible causative factors.

The relationship between SCW and CL was found negatively co-related in both the species during present investigation which means that the carapace increases more rapidly in width than in length. This result of the present study partially agrees with that of Al-Rumaidh *et al*. who studied *P. pelagicus* from Bahraini waters. They examined *P. pelagicus* from three areas designated as A, B and C. The crabs from areas A and B exhibited isometric growth of carapace length with respect to carapace width, while those from area C had negative allometric growth and the value of b was significantly less than 1.

Results of the present study regarding size-weight relationship replicate the result of earlier studies that males are heavier than similar sized females in *P. pelagicus and P. sanguinolentus*. Sukumaran and Neelakantan, studied relationship between carapace width and body weight and carapace length and body weight in *P. pelagicus* and *P. sanguinolentus* from the Karnataka coast, India. The values of regression coefficient (b) were found very close to 3 in both the species. Analysis of covariance revealed that there was no significant difference ($P<0.05$) between regression equation in males and females of *P. sanguinolentus* whereas significant difference ($P<0.05$) was observed between males and females in *P. pelagicus* (which is other way round in present study). They, however, concluded that males are heavier than females at any given length in these two species of *Portunus* crab. Potter *et al.*, in their study of *P. pelagicus* from an Australian estuary observed significant difference in the slopes in regression equation relating body weight (w) and carapace width measured between the tip of the lateral spines (= LCW) between males and females. The log transformed regression equations given by potter *et al* are: log W

= log 2.56 X 10^{-5} + 3.260 log CW (n = 694; r = 0.99) for males and log W = log 5.97 X 10^{-5} + 3.056 log CW (n = 1076; r = 0.99) for females. Theses equations show that the males have a greater b values (3.260) than that of females (3.056). The relationship between carapace width and body weight of the blue swimming crabs *P. pelagicus* in Bahraini waters was studied by Al-Rumaidh *et al.*. They collected 2070 males and 3005 females *P. pelagicus* over a period of 14 months (March 1999 to April 2000) and observed that males were slightly heavier than females at 20 mm carapace width, becoming heavier above 60 mm carapace width.

Results of the present investigation show much higher meat yield in *P. pelagicus* than those reported earlier. From southeast Queensland, Australia, [28] reported that the meat yield of *P. pelagicus* was 39% of the body weight, which is less than that of present study (*i.e.* 43.4%). Similarly Akbar *et al*. (1988), who studied condition index of *P. pelagicus* from the Karachi coast, stated that "on average about 23.81 percent (in the male) and 23.17 percent (in the female) edible meats can be extracted". Akbar *et al.* (1988) extracted meat only from the thorax and cheliped and not from the periopods (walking legs). They weighted the crabs and meat after drying them in an oven at 110˚ (unit not mentioned). The difference in the results may be attributed to different methodology used in the present investigation Akbar *et al.*.

A comparison of meat yield of different brachyuran crabs is presented in table 11, which shows that *P. pelagicus* yields 43.4 % meat of the total body weight followed by *P. sanguinolentus* (41.01%). The low meat yield in other species may be due to legs (periopods) meat which is not considered usually in the analyses [29]. For instance George *et al*. (1986), who estimated meat yield in *Scylla serrata* from India, stated that after removing the carapace, gills, intestine and eggs, the meat was picked up and weighted. There is no mention of chelae and legs and it is not clear whether the meat from these appendages was included in the total meat yield analyses. On the other hand Hattori *et al*. [30] clearly mention that the meat present in the carapace, chelae and legs of *Callinectes bocourti* (from Sao Paulo, Brazil) were taken into account. They found that *C. bocourti* contain 23.4% meat of the body weight as against 10% recorded for *C. sapidus* by Ward [31], from USA. Hattori *et al*. took the wet weight of the crab which was then cooked in water at 100 ˚C for 20 minutes. The meat was then removed from claws, legs and body and the weight was recorded.

Table 11. A comparison of average value of total meat yields in commercially exploited portunid and other crabs.

Family	Species	Meat Yield (%)			References
		Male	Female	Total	
Portunidae	*Portunus sanguinolentus* (Herbst, 1783)	43	37	41. 01	Present study
	Portunus pelagicus (Linnaeus, 1758)	44	42	43. 4	Present study
	Portunus pelagicus (Linnaeus, 1758)	23.8	23.2	…	Akbar *et al*. (1988a)*
	Portunus pelagicus (Linnaeus, 1758)	…	…	39	Brown, (1986)
	Scylla serrata (Forskal, 1755)	…	…	29	Brown, (1986)
	Scylla serrata (Forskal, 1755)	…	…	16.16	George *et al*. (1986)
	Scylla serrata (Forskal, 1755)	…	…	21. 9	George and Gopakumar (1987)
	Charybdis natator (Herbst, 1794)	…	…	35	Sumpton (1990b)
	Callinectes sapidus Rathbun, 1896	…	…	10	Ward (1990)
	C. bocourti A. Milne Edwards, 1879	28. 5	22. 1	23. 4	Hattori, *et al* (2006)
Gecarcinidae	*Cardisoma guanhumi* Latereille, 1825	18	21. 5	…	Hattori, *et al* (2006)
Ocypodidae	*Ucides cordatus* (Linnaeus, 1763)	25. 4	21. 1	23. 2	Hattori, *et al* (2006)

* Only claws and thorax meat, leg meat not included.

The different methodology used by different authors to calculate amount of meat present in the crab makes it difficult to compare their results. However, it appears that it is *P. pelagicus* which contains more meat (in terms of percentage of body weight) than other brachyuran species studied so far.

REFERENCES

[1] Porter, H. J. "Variation in morphometry of the adult female blue crab, *Callinectes sapidus* Rathbun". M.S. thesis, University of Delaware, Newark, 1-69, 1955.

[2] Huber, M. E. "Allometric growth of the carapace in *Trapezia* (Brachyura, Xanthidae)." Journal of Crustacean Biology, 5(1): 79-83, 1985.

[3] Olmi III, E. J. and Bishop, J. M. "Variations in total width-weight relationships of blue crabs, *Callinectes sapidus,* in relation to sex, maturity, molt stage and carapace form." Journal of Crustacean Biology, 3(4):575-581, 1983.

[4] Ibanez-Aguirre, A.L., Cabrol-Solis, E., Gallardo-Cabelo, M. and Espino-Barr, E. "Comparative morphometrics of two populations of *Mugil curema* (Pisces:Mugilidae) on the Atlantic and Mexican Pacific coasts." Scientia Marina, 70(1): 139-145, 2006.

[5] Atar, H. H. and Secer, S. "Width/ Length-Weight relationships of the blue crab (*Callinectes sapidus* Rathbun 1896) population living in Beymelek Lagoon Lake." *Turkish Journal of Veterinary and Animal Science*, 27: 443-447, 2003.

[6] Hattori, Y. G.; Sampaio-Sant'Anna, B. and Pinheiro, M. A. "Meat yield of Callinectes bocourti A. Milne Edwards, 1879 (Crustacea, Portunidae) in Iguape, Sao Paulo, Brazil." Investigaciones Marinas, Valparaiso, 34(2): 231-236, 2006.

[7] Ali, M.Y., Kamal, D. Hossain, S. M. M., Azam, M. A., Sabbir, W., Murshida, A., Ahmed, B. and Azam, K. "Biological studies of the Mud crab, *Scylla serrata* (Forskal) of the Sundarbans Mangrove Ecosystem in Khulna Region of Bangladesh." *Pakistan Journal of Biological Sciences*, 7(11): 1981-1987, 2004.

[8] Sumpton, W. D. "Morphometric growth and fisheries biology of the crab, *Charybdis natator* (Herbst) in Moreton Bay, Australia (Decapoda, Brachyura)." Crustaceana, 59: 113-120, 1990.

[9] Al-Rumaidh, M. J., Yule, A. B. and Walker, G. "Observation on the carapace length-width and carapace width-weight relationships of the blue swimming crab, *Portunus pelagicus* (Linnaeus, 1758) in Bahraini waters." *Arab Gulf Journal of Scientific Research.* 23(3):109-119, 2005.

[10] Rathbun, M.J. "The genus Callinectes." Proceedings of the United States National Museum, 18: 349-375, 1896.

[11] Du Preez, H. H. and McLachalan, A. "Biology of the three-spot swimming crab, *Ovalipes punctatus*, I. Morphometrics and relative growth (Decapoda: Portunidae)." Crustaceana, 47(1): 72-82, 1984.

[12] Chace, F.A. and Hobbs, H.H. "The freshwater and terrestrial decapods crustacean of West Indies with special reference to Dominica." United States National Museum Bulletin, 292: 1-258, 1969.

[13] Petrakis, G. and Stergion, K.I. "Weight-length relationships for 33 fish species in Greek waters." Fisheries Research, 21: 465-469. 1995.

[14] Akin-Oriola, G., Anetekhai, M. and Olowonirejuaro, K. "Morphometric and meristic studies in two crabs: *Cardiosoma armatum* and *Callinectes pallidus*." *Turkish Journal of fisheries and Aquatic Sciences*, 5:85-89, 2005.

[15] Davidson, R. J. and Marsden, I. D. "Size relationship and relative growth of the New Zealand swimming crab *Ovalipes catharus* (White, 1843)". Journal of Crustacean Biology, 7(2): 308-317. 1987.

[16] Ward, D. R. "Processing Crustaceans." The Seafood Industry. Martin R. E. and J. F. Flick (Eds.). Van Nostrand Reinhold, New York, 174-181, 1990.

[17] Akbar, Z., Qasim, R. and Siddiqui, P.J.A. "Condition index of the blue swim crab *Portunus pelagicus* L. From the Karachi Coast." *Pakistan Journal of Scientific and Industrial Research*, 31(9): 656- 660, 1988.

[18] Anderson, R. and Gutreuter, S. "Length-weight and associated structural indices." *Fisheries Techniques* (ed. L. Nielsen and D. Johnson) pp.283-300. American Fisheries Society, 1983.

[19] Brown, I.W.B., "Population biology of the spanner crab in south-east Queensland Queensland Department of Primary Industries": 1-106, 1986.

[20] Tirmizi, N. M. and Aziz, N. "The study of relative growth in the planktonic shrimp. *Sergestes semissis* Burkenroad 1940, collected from the Indian Ocean." In: Thompson, M. F. and Tirmizi, N. M. (eds.) Marine Science of the Arabian Sea. American Institute of Biological Society, Washington. D. C.: 193-205, 1988.

[21] Bennetti, A. S. and Negreiros-Fransozo, M. L. "Relative growth of *Uca burgersi* (Crustacea, Ocypodidae) from two mangroves in the southeast Brazilian coast." Iheringia, 9491): 67: 72, 2004.

[22] Sumpton, W.D., Potter, M.A. and Smith, G.S., "The commercial pot and trawlfisheries for sand crabs (*Portunus pelagicus L.)* in Moreton Bay, Queensland." Proceeding of the Royal Society of Queensland, 100: 89-100, 1989.

[23] Cardoso, F.C.R. and Negreiros-Fransozo, M. L., "A comparison of the allometric growth in *Uca leptodactyla* (Crustacea: Brachyura: Ocypodidae) from two subtropical estuaries." Journal of the Marine Biological Association of the United Kingdom, 84: 733-735, 2004.

[24] Potter, I. C., Crystal, P. J. and Loneragan, N. R., "The biology of the blue manna crab *Portunus pelagicus* in an Australian estuary." Marine Biology, 78: 75-85, 1983.

[25] Rasheed, S. and Mustaquim, J. "Size at sexual maturity, breeding Season and fecundity of three-spot swimming crab *Portunus sanguinolentus* (Herbst, 1783) (Decapoda, Brachyura, Portunidae) occurring in the coastal waters of Karachi, Pakistan." Fisheries Research, 103: 56-62, 2010.

[26] George, C.; Unnithan, R. and Gopkumar, K. "Morphometric measurements as an index for estimating yield of Meat in Shell Fishes 1. Crab (*Scylla serrata*) Forskal." Fishery Technology, 23: 196-198, 1986.

[27] Fatima, M. "Length-weight study of two species of crabs *Matuta planipes* and *Matuta lunaris* from Karachi, Pakistan." Pakistan Journal of Biological Science, 6(4): 397-398, 2003.

[28] Garcia-Davila, C.R.C.; Magalhas, C. and Guerrero, J. C. H. "Morphometric variability in populations of *Palaemonetes spp*. (Crustacea: Decapoda: Palaemonidae) from the Peruvian and Brazilian Amazon Basin." Iheringia, 95(3): 327-334, 2005.

[29] Oshiro, L.M.Y. Silva, R. and Silveria, C.M., "Meat Yield of *Menippe nodifrons* Stimpson, 1859 and *Cardisoma guanhuimi* Latreille, 1825 (Crustacea, Decapoda, Branchyura) of Baia de Sepetiba/R J." Acta Biol. Leopoldensia, 21 (1): 83-88, 1999.

[30] Williams, A.B., "The swimming crabs of the genus *Callinectes* (Decapoda: Portunidae). Fishery Bulletin" 72(3): 685-769, 1974

[31] Sukumaran K.K. and Neelakantan, B., "Length–weight relationship in two marineportunid crabs, *Portunus (Portunus) sanguinolentus* (Herbst) and *Portunus (Portunus) pelagicus* (Linnaeus) from the Karnataka coast." Indian Journal of Marine Science, 26: 39-42, 1997.

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La méthode de reconnaissance pour les immigrés

[The recognition method for immigrants]

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ABSTRACT: If the reports of international private law between Muslim legal systems and the Occident system have revealed due to the underlying conflict of norms the limited reception of Muslim personal status in Occident. We are convinced that neither the adoption of the domicile factor of international Occident private law nor the adoption of the factor of nationality in Muslim international private law can mitigate the problems of international private law raised by the Muslim's immigration in Occident. In other words, the traditional bilateral conflict rule is not able to reconcile the objectives of international private law of internal tendency and those of international tendency. It has also failed to adopt a pluralistic and private vision well adapted to new paradigms that dominate the world in the 21st century (pluralism multiculturalism, globalism and the computer revolution). In another hand, the advantages of the recognition method has resulted not only from its adapting to these new paradigms, but also the analysis in our research indicate that the application of this method on Muslims personal status in the Occident responds to real needs, namely the continuity of treatment of legal situations without breaking the cohesion and coherence of the internal system. The reason why we promote the recognition method.

KEYWORDS: Personal Status, conflict of laws, conflict of jurisdiction, Occident, law of domicile, law of nationality, immigration, Muslim legal systems.

RESUME: Si les rapports du droit international privé entre les systèmes juridiques musulmans et le système occidental ont révélé, à cause du conflit de normes sous-jacent, la réception limitée du statut personnel musulman en Occident, nous sommes persuadé que ni l'adoption du facteur du domicile en droit international privé occidental ni l'adoption du facteur de la nationalité en droit international privé des pays musulmans ne peuvent atténuer les problèmes du droit international privé suscités par l'immigration des musulmans en Occident. En d'autres termes, la règle de conflit bilatérale classique n'est pas capable de concilier les objectifs du droit international privé de tendance interne et ceux de tendance internationale. Elle n'a pas réussi non plus à adopter une vue pluraliste et privatiste appropriée aux nouveaux paradigmes qui dominent le monde du 21ème siècle (pluralisme multiculturalisme, globalisme et la révolution informatique). En contrepartie, le regain de faveur dont bénéficie la méthode de reconnaissance résulte non seulement de son adaptation à ces nouveaux paradigmes, mais aussi l'analyse de notre recherche révèle que l'application de cette méthode au statut personnel des musulmans établis en Occident répond à des besoins véritables, à savoir la continuité de traitement des situations juridiques sans briser la cohésion et la cohérence du système juridique interne. La raison pour laquelle nous favorisons cette méthode de reconnaissance.

MOTS-CLEFS: Statut personnel, conflit de lois, conflit de juridictions, Occident, loi du domicile, loi nationale, immigration, systèmes juridiques musulmans.

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1 INTRODUCTION

La méthode de reconnaissance ou ”the recognition method”s'inscrit totalement dans la méthodologie de conflit de lois. Or, cette méthode se distingue au moins de l'une des méthodes de résolution des conflits de lois: celle de la règle de conflit bilatérale (la méthode classique) [1] . L'essence de la méthode de reconnaissance est de donner effet aux rapports juridiques privés crées à l'étranger indépendamment de toute désignation par la règle de conflit de l'ordre juridique du for. (l'ordre juridique de reconnaissance) [1].

Si la méthode de reconnaissance est réputée s'appliquer aux seules décisions étrangères, on constate aujourd'hui qu'elle tend à sortir de ce lit, en particulier pour appréhender les actes publics de caractère non décisionnel [1], voire les rapports privés crées en dehors de toute intervention d'une autorité publique [2].

On s'interroge aujourd'hui sur la pérennité de l'analyse qui dit qu'en l'absence de toute décision, il conviendrait de recourir à la méthode classique des conflits de lois. En effet, il existe un fort mouvement en faveur de l'utilisation d'une méthode de reconnaissance. Une doctrine importante vient favoriser l'application de la méthode de reconnaissance à des règles et non seulement à des décisions; il s'agit là de P. Mayer [2], S. Bollée [1] et C. Pamboukis [3] et autres.

Comme le souligne monsieur S. Bollée, il est théoriquement concevable et pratiquement souhaitable d'élargir le champ de la méthode de reconnaissance pour introduire dans son orbite des rapports juridiques exprimés autrement que sous la forme des décisions [1].

La méthode de reconnaissance est présentée ici comme une concurrente de la règle de conflit bilatérale. Par conséquent, la victime de cette méthode est le facteur de rattachement adopté en matière de statut personnel (nationalité, domicile et la résidence habituelle…etc.) [2]**.**

Il faut souligner que la méthode de reconnaissance, telle qu'envisagée ici, repose sur une référence au point de vue de l'ordre juridique étranger qui est plus large que dans le cadre d'une règle de conflit bilatérale : on ne s'intéresse pas aux seules règles substantielles posées par cet ordre juridique, mais aussi à ses règles de droit international privé de manière à faire prévaloir son point de vue global. Cette approche est illustrée par la convention de la Haye du 14 mars 1978 sur la célébration et la reconnaissance de la validité des mariages dont l'article 9 al. 1 dispose que « le mariage qui à été valablement conclu selon le droit de l'État de célébration ou qui devient ultérieurement valable selon ce droit est considéré comme valable dans tout État contractant ». Par droit de l'État de célébration, on entend l'entier système juridique de cet État, règles de droit international privé incluses.

Selon la formule de monsieur P. Lagarde, « dans l'État B, le mariage célébré sera reconnu valable s'il est effectivement valable selon la loi désignée, non par le système de conflit de l'État B, mais par celui de l'État A, État de célébration » [1].

Ce raisonnement s'applique aux institutions du droit musulman qui viennent interpeller sans cesse les organes judiciaires de l'Occident: (polygamie, répudiation, Wilaya, Tanzil, Kafala, …etc.).

Le regain de faveur de la méthode de reconnaissance résulte de la combinaison de deux facteurs : d'abord un facteur *politique*, qui avec la globalisation impliquant une exigence de cohérence internationale des rapports privés, ensuite un facteur *technique* lié à l'inadéquation de la règle de conflit classique à reconnaître des rapports privés effectivement crées.

La méthode de reconnaissance renouvelle aussi la vieille querelle entre internationalisme et nationalise, pluralisme et positivisme, elle prend aujourd'hui la forme d'un clivage entre les pluralistes attachés, pour l'essentiel, au concept de l'autonomie et les nationalistes attachés, pour l'essentiel, au droit du for (droit interne) comme point de départ.

Dans le présent travail, nous allons analyser successivement les causes de la réapparition de la méthode de reconnaissance, l'assise de la méthode de reconnaissance, les spécificités de la méthode de reconnaissance et le domaine de la méthode de reconnaissance.

2 RÉSULTATS ET DISCUSSIONS

La règle de conflit est un procédé inadéquat pour la reconnaissance de rapports de droit effectivement crées dans les pays d'origine des immigrés ainsi que pour le maintien de la cohérence internationale du rapport juridique. Le principe du respect de la cohérence internationale d'un rapport privé préserve évidemment les prévisions des parties que l'intervention de la règle de conflit classique risque de mettre en cause. La méthode de reconnaissance a été proposée en vue de surpasser la conjoncture contemporaine.

2.1 LES CAUSES DE REAPPARITION DE LA METHODE DE RECONNAISSANCE

Il s'agit là de deux causes majeures : la cause politique et la cause technique.

2.1.1 LA CAUSE POLITIQUE OU LE CHANGEMENT DU PARADIGME

La réapparition de la méthode de reconnaissance est due non seulement à des raisons inhérentes à cette méthode, mais aussi au changement du paradigme et au changement du contexte social international : l'individu acquiert plus d'autonomie et plus de liberté. Ce dernier participe également à la création de la norme juridique. On assiste vraiment à une privatisation du droit international privé ayant comme caractéristique le recul de la règle de conflit devant les rapports privés crées et déjà existants [3]. En effet, l'individu, à travers la globalisation et le phénomène migratoire, s'est affranchi socialement, voire juridiquement de l'ordre juridique étatique, tantôt de l'ordre juridique du pays d'origine, tantôt de l'ordre juridique du pays d'accueil. Le changement de paradigme est donc la raison principale `` du déclin`` de la règle de conflit. Cet affranchissement de l'individu a pour conséquence d'une part le recul de la dominance de la règle de conflit, et d'autre part la reconnaissance des rapports juridiques déjà existants.

En outre la conséquence majeure est au niveau des objectifs du DIP. On devra respecter l'intégrité du rapport juridique au plan international: (la cohérence internationale du rapport juridique en cause), en d'autres termes, éviter au maximum la création des situations boiteuses, et cela au prix de l'effacement partiel de la règle de conflit [3].

2.1.2 LA CAUSE TECHNIQUE

Il s'agit ici d'une raison technique inhérente à la méthode classique de Savigny. Il est à signaler que la tentation de limiter le champ de la règle de conflit n'est pas neuve. À ce sujet, on peut citer la théorie classique des droits acquis.

Selon la doctrine des droits acquis ou de vested rights, chaque État est tenu de donner effet aux droits crées sur le territoire d'un autre État conformément à sa loi.

La théorie classique des droits acquis à été beaucoup critiqué par certains auteurs : Savigny, Bartin, Pillet [3]. Selon ces auteurs, pour reconnaître si des droits étaient bien acquis il faut faire appel à la règle de conflit en faisant de celle-ci l'outil incontournable et enlevant à la doctrine des droits acquis classique tout utilité. À titre d'exemple, en matière de mariage pour que les deux personnes qui ont célébré leur mariage à l'étranger conservent la qualité des époux dans le pays du for, il faut d'abord vérifier si le mariage est valable. Et cette vérification ne peut se faire que par le recours à la loi applicable aux conditions de validité du mariage, autrement dit le recours à la règle de conflit bilatérale.

Selon monsieur Pamboukis, la méthode de reconnaissance n'est qu'une autre forme de la théorie des droits acquis [3]. Dans le cadre de cette nouvelle théorie des droits acquis (méthode de reconnaissance), monsieur Pamboukis reproche aux auteurs l'erreur suivante : confondre *la création* du rapport juridique avec son *existence*. En suivant le raisonnement de monsieur Pamboukis, si un mariage a été célébré devant un Cadi (juge) marocain par exemple, le mariage, aux yeux de l'ordre juridique marocain, est existant et prima facie valable, même si un juge étranger, le juge canadien par exemple, décide ultérieurement que ce mariage n'est pas valable parce que les condition de validité ne sont pas remplies aux yeux d'un tiers droit applicable par le jeu de sa règle de conflit. Il n'empêche que le mariage sera toujours tenu pour existant. D'où la question principale suivante : pour la confirmation de l'existence du mariage, avons-nous besoin de la règle de conflit ? Avons-nous besoin de localiser le mariage? La réponse est non. Aux termes de monsieur C. Pamboukis, ''en dehors du domaine de la création, la mise en œuvre de la règle de conflit conduit à des complications qui éloignent le doit international privé de son rôle de son fondement, à savoir faciliter la réglementation de rapports privé internationaux et conduit à des résultats peu satisfaisants pour la cohérence de la vie privée internationale'' [3].

Toute localisation du rapport privé étranger déjà créé est inutile. Pour cela le test de localisation semble inapproprié. L'échec de la théorie classique des droits acquis s'explique par l'hypertrophie de la règle de conflit et l'expansion anormale en dehors du domaine de la création de rapports juridiques [3].

Le droit international privé contemporain devra alors trouver une solution au clivage entre la cohérence internationale du rapport juridique privé crée, effectif, existant et la conception du for de reconnaissance, en d'autres termes répondre au besoin de coexistence des objectifs du droit international privé de tendance international et les objectifs du droit international privé de tendance interne.

Il est vrai que selon la méthode de reconnaissance, la cohérence internationale du rapport juridique privé effectif et existant l'emporte sur la cohérence du système juridique de reconnaissance. Néanmoins, cette nouvelle approche n'empêche

pas la réalisation des objectifs véhiculés par des règles ou des mécanismes que le for de reconnaissance utilise d'abord pour freiner un laxisme outre mesure [3], ensuite pour préserver les principes fondamentaux du for. On peut citer l'exemple des règles d'application nécessaire, de l'ordre public et de la fraude à la loi du for. Partant, les objectifs du DIP de tendance interne peuvent être réalisés sans aucune utilité de passer par la règle de conflit classique.

2.2 L'ASSISE DE LA METHODE DE RECONNAISSANCE

L'assise de la méthode de reconnaissance ne serait autre que l'impératif de maintien de la cohérence internationale du rapport juridique. Le principe du respect de la cohérence internationale d'un rapport privé préserve évidemment les prévisions des parties que l'intervention de la règle de conflit classique risque de mettre en cause. De plus, l'effectivité est le vrai moteur de la reconnaissance qui fait basculer en quelque sorte la proximité [3].

Aux termes du professeur Mayer [2] '' inspirée par le souci du respect des prévisions des parties, la méthode de reconnaissance favorise la validité des actes ainsi que l'alignement de la réalité juridique sur la situation de fait''. Cette faveur se manifeste sous plusieurs formes:

- La faiblesse des exigences relatives à la validité de l'acte accompli par les parties, la situation de fait étant reconnue comme une situation de droit.
- La subordination de la reconnaissance à la validité de la situation créée selon la loi de l'autorité choisie par les parties. Ce qui permet de choisir indirectement la loi applicable.
- La subordination de la reconnaissance à la validité de la situation créée selon la loi désignée par le droit international privé du pays dont une autorité est intervenue.

Cet objectif d'effectivité se recoupe avec d'autres objectifs du DIP, à savoir le respect de la prévisibilité des individus et la continuité de traitement des situations juridiques [2]. Le prix à payer pour réaliser ces objectifs est la limitation matérielle du jeu de la règle de conflit. Surtout lorsque le conflit met en opposition des parties appartenant à des civilisations antagonistes. Dans ce contexte de conflit de civilisations, la méthode classique conduit vers le refus de reconnaître par exemple les décisions canadiennes par les tribunaux des pays musulmans à cause de l'intervention de l'ordre public.

Laisser à la règle de conflit régir un rapport juridique constitué sous l'autorité d'un droit étranger perd son poids en matière de statut personnel car ce dernier exige la permanence et la continuité de traitement des situations juridiques transnationales [4].

En fait, chaque fois que l'on n'est pas en présence d'une demande de création d'un rapport juridique nouveau, il faut céder le pas à la méthode de reconnaissance.

2.3 LES SPECIFICITES DE LA METHODE DE RECONNAISSANCE

Il s'agit des spécificités suivantes:

- La méthode de reconnaissance se distingue réellement de l'application de la règle de conflit du for.
- La reconnaissance a pour objet la consécration par l'ordre juridique du for d'un rapport juridique concret extérieur à lui-même.
- Ce rapport juridique concret objet de reconnaissance doit être cristallisé.

La reconnaissance n'est pas subordonnée à la constatation que la situation résulte de l'application des règles de l'ordre juridique désigné par la règle de conflit du for. Il n'est pas pourtant exclu que la reconnaissance soit subordonnée à une exigence relative à la loi applicable, pourvue que l'on n'aille pas jusqu'à faire dépendre strictement la reconnaissance de la conformité de la situation à la loi désignée par la règle de conflit ordinaire de l'État de reconnaissance [2]. Comme le souligne monsieur P. Mayer, la reconnaissance comporte un processus de deux étapes [2]: d'abord la détermination d'un point de vue concret non déduit du droit international privé du for, ensuite consacrer dans le for ce point de vue concret moyennant la vérification de conditions posées par le droit international privé du pays de reconnaissance.

Le point de vue concret susceptible de reconnaissance doit avoir déjà été cristallisé. C'est en raison de cette cristallisation que la question de reconnaissance se pose. Dans le cadre de la méthode de reconnaissance des décisions, la reconnaissance est recommandée par le double respect des prévisibilités des parties et de l'autorité de la décision, alors que dans la méthode de reconnaissance des situations (absence de décision), la situation cristallisée est reconnue seulement parce que, sur la base de cette cristallisation, les parties ont formés des prévisions légitimes. Par exemple, la célébration du mariage

persuade les époux qu'ils sont effectivement mariés. Le fait de vivre ensemble comme mari et femme les en persuade encore d'avantage.

Il y a aussi cristallisation lorsqu'il y a intervention d'une autorité publique même si cette autorité a un faible pouvoir. Dans ce cas, ce n'est pas l'acte public qui est reconnu, mais la situation qu'il a contribué à créer. Il en est ainsi de la célébration du mariage par un officier de l'état civil, enregistrement d'un partenariat. Néanmoins, la cristallisation n'est pas suffisante à elle seule. À cette condition s'ajoute un lien réel entre la situation créée et l'ordre juridique dont elle émane (la règle de relevance). La raison pour laquelle certains auteurs ont critiqué le laxisme de la règle posée par la convention de la Haye du 14 Mars sur la célébration et la reconnaissance de validité des mariages [2]car cette règle fait dépendre la validité du mariage au seul choix non limité des futurs époux du lieu de célébration, alors qu'il aurait fallu subordonner la reconnaissance à un lien réel entre la célébration du mariage et le lieu de célébration, à titre d'exemple la loi du domicile, de la résidence habituelle ou de la loi nationale de l'un des époux au moins.

Un exemple très frappant du processus de cristallisation est celui issu de la jurisprudence canadienne: l'arrêt Schwebel c. Ungar [5] : les époux Watkor, juifs hongrois, avaient quitté en 1945 la Hongrie pour se rendre en Israël, mais avaient dû séjourner dans plusieurs camps de réfugiés en Europe. C'est dans l'un des ces camps, en Italie, qu'ils avaient divorcé sous la forme du gueth (divorce religieux), irrégulière tant en droit hongrois qu'en droit italien. Après avoir séjourné sept ans en Israël, où son divorce était considéré comme valable, madame Watkor (née Schwebel) alla au Canada précisément à la province d'Ontario où elle se maria avec Ungar et s'installa. Selon le droit international privé de l'Ontario, la loi applicable au divorce est la hongroise. Ce qui veut dire que le divorce de madame Watkor n'était pas valide. Néanmoins, la cour d'appel de l'Ontario jugea que le séjour de madame en Israël avait restitué à cette dernière son état de célibataire. Le tribunal Ontarien a consacré dans le for canadien un point de vue concret extérieur à lui-même (divorce qui a eu lieu en Italie), un rapport juridique cristallisé (par le séjour de madame pour une période de sept ans en Israël), en excluant l'application la règle de conflit du droit international privé canadien qui prévoit l'application de la loi du domicile des époux (la loi hongroise), selon laquelle le divorce n'est pas valide. C'est exactement ce raisonnement que sous-tend la méthode de reconnaissance. Selon nous, en appliquant la question préalable, le tribunal canadien a appliqué indirectement la méthode de reconnaissance qu'il ignorait et a reconnu le divorce étranger.

2.4 LE DOMAINE DE LA METHODE DE RECONNAISSANCE

L'analyse susmentionnée démontre qu'on est devant deux situations différentes : la première est celle de rapports juridiques rendus tangible par un acte public (*rapports juridiques consacrés*), cristallisés par l'intervention d'une autorité publique. D'où la soumission au procédé de reconnaissance. La seconde est celle de *rapports juridiques créés,* constitués en dehors de toute intervention d'une autorité publique, qui sont soumis au procédé de relevance et dont la catégorisation comme variante de la règle de conflit ou de la méthode de reconnaissance reste disputée [3]. La méthode de relevance appartient à la règle de conflit, en constitue une variante comme le suggère monsieur Mayer ou elle appartient aux méthodes de reconnaissance comme le suggèrent S. Bollée et C. Pamboukis?

Nous sommes d'avis que la règle de relevance appartient aux méthodes de reconnaissance car celle-ci permet de déterminer si un lien suffisant existe entre la situation juridique créée à l'étranger et l'ordre juridique dans lequel cette situation est créée. Ce lien de proximité ne sera pas forcement un lien établi sur la base des critères contenus dans la règle de conflit de l'ordre juridique de reconnaissance.

Pour la première situation, celle des rapports consacrés, la soumission à la méthode de reconnaissance ne semble plus faire de difficultés majeures malgré la proposition de monsieur Callé excluant de la méthode de reconnaissance certains actes publics étrangers [6].

Quant à la deuxième, celle des rapports créés, c'est tant la soumission à la méthode de reconnaissance qui est douteuse que ses modalités d'application fondées essentiellement sur la vérification de la relevance d'après les conceptions de l'ordre juridique de reconnaissance.

2.4.1 LES RAPPORTS JURIDIQUES CONSACRES : UNE SOUMISSION INCONTESTEE

Comme le souligne monsieur C. Pamboukis, l'évolution progressive en faveur de l'extension de la méthode de reconnaissance pour embrasser les actes créés, cautionne la soumission des rapports juridiques consacrés (actes publics) à la méthode de reconnaissance, et ce en raison de la cristallisation manifestée par l'intervention dans le rapport privé d'une autorité publique étrangère. Toutefois, cette idée a été contestée par monsieur Callé [6] qui fait la distinction entre *effets décisionnels* et *effets de titre* de l'acte public. Selon lui, les premiers sont soumis à la méthode de reconnaissance car

l'autorité publique impose un état nouveau qu'elle crée. En revanche, les seconds sont soumis à la règle de conflit car ils n'ont aucune force normative car l'autorité publique se borne à accomplir une formalité. Il est à noter que cette contestation de monsieur Callé est beaucoup critiquable. Cette critique peut se résumer ainsi:

- L'analyse de monsieur Callé a pour effet de méconnaître l'existence de l'acte public dans son ensemble et son enracinement dans un ordre juridique donné; cette logique exclut l'applicabilité des méthodes de reconnaissance.
- La distinction entre effets: effet décisionnel et effet de titre n'est pas toujours aisée et parfois même non souhaitable faute d'utilité.
- Monsieur Callé a négligé la donnée, pourtant essentielle, que l'acte s'est déjà vu attribuer des effets substantiels par l'ordre juridique de sa création.
- L'objection majeure consiste dans l'impossibilité de dissociation du titre de son contenu. Que vaut le titre sans contenu ? Il est à noter le rapport juridique substantiel voyage avec le titre.

Donc, il ne faut pas soumettre les actes publics à la règle de conflit, mais à la méthode de reconnaissance, sans perdre de vue que le système juridique de reconnaissance (le for) peut exercer un contrôle de proximité. En d'autres termes, ce contrôle ne visera plus à l'établissement de la loi la plus proche selon la règle de conflit du for, mais à constater de façon concrète si la loi applicable avait un lien suffisant avec le rapport juridique. Ce lien ne sera pas forcément un lien établi sur la base des critères contenus dans la règle de conflit de l'ordre juridique de reconnaissance. Le souci de proximité n'est donc pas absent dans la méthode de reconnaissance. Dans ce contexte, la proximité intervient donc soit pour éviter le danger des fraudes, soit pour assurer indirectement l'harmonie internationale des solutions en respectant les ordres juridiques les plus proches. «La règle de relevance » aurait ainsi pour objet le contrôle de la qualité des liens du rapport avec l'ordre juridique d'origine (de création) afin de refuser la reconnaissance ou l'efficacité d'un rapport juridique constitué frauduleusement, surtout dans les matières où les parties n'ont pas la libre disposition, d'après le for de reconnaissance [3].

2.4.2 LES RAPPORTS JURIDIQUES EFFECTIVEMENT CREES: SOUMISSION CONTESTEE

Il s'agit là des rapports effectivement créés en dehors de toute intervention de l'autorité publique. Il est indéniable que les actes *consacrés* et des actes *effectivement crées* ont des caractéristiques communes, servent une même finalité, mais leur différence réside dans la nature de la cristallisation. Quand est-ce qu'un rapport est considéré comme effectif en dehors de toute cristallisation?

Un rapport crée à l'étranger en dehors de l'intervention de l'autorité publique est considéré effectif en raison de *l'apparence créée*. Cette apparence est due essentiellement à l'association de deux facteurs: le facteur spatial (production des effets juridiques dans un ordre juridique donné) et le facteur temporel (l'écoulement du temps). Ces deux facteurs créent une apparence, une croyance commune, difficile à nier, si forte que sa négation perturbe l'objectif et le rôle du droit international privé. Cette perturbation devient plus grave lorsqu'il s'agit de l'état des personnes (marié, divorcé, enfant légitime, etc.)

En d'autres mots, si l'état d'une personne a évolué dans le temps, concrètement dans un système juridique étranger, son existence selon cet ordre juridique est un fait et tenue pour acquise. Pour des fins de cohérence internationale, l'ordre juridique de reconnaissances ne peut que se plier devant cette réalité, exclure la règle de conflit et appliquer la méthode de reconnaissance [3]. Par conséquent, l'effacement de la règle de conflit est légitimé par l'effectivité du rapport, juridique en cause.

La cohérence et la cohésion du système juridique de reconnaissance peuvent être garanties soit par les lois d'application nécessaire, soit par le jeu de l'exception d'ordre public internationale, ou encore par le contrôle de relevance. Concernant cette dernière possibilité de contrôle, on doit à Paul Lagarde l'élaboration des diverses hypothèses de relevance:

- Une première hypothèse libérale est consacrée par la convention de la Haye du 14 mars 1978 sur la célébration et reconnaissance de la validité des mariages. Ce cas de figure est voisin de l'absence de tout contrôle de relevance. L'ordre juridique de reconnaissance se contente de contrôler l'impérativité. C'est la raison pour laquelle les termes de l'article 9 de cette convention ont été beaucoup critiqués par la doctrine relative à la méthode de reconnaissance.
- Une deuxième hypothèse est plus stricte que nous rejetons parce qu'elle tend à subordonner la reconnaissance au respect d'une loi déterminée par l'ordre juridique de la reconnaissance. Cette deuxième hypothèse se distingue clairement de la première que nous refusons aussi grâce à son caractère laxiste. Dans cette deuxième hypothèse, la règle de relevance se rapproche de la règle de conflit classique même si cette première a un aspect global (référence en bloc à un ordre juridique) et la deuxième assure une fonction de localisation au sens conflictuel.

Aux termes de Pamboukis, « La méthode de reconnaissance étant encore dans sa première jeunesse et ayant vécu des difficultés de naissance, elle n'a pas de règles de relevance qui rendront apparente cette différence entre la règle de conflit et la règle de relevance ». C'est-à-dire qu'il faut d'abord adopter la méthode de reconnaissance dans les différents systèmes juridiques pour éclairer les règles de relevance en vue de tracer les limites entre le facteur de rattachement et la règle de relevance.

- Une troisième hypothèse est ouverte, laquelle nous défendons : un contrôle de relevance souple ni libéral, ni strict, fondé sur un lien caractéristique (suffisant ou sérieux) avec l'ordre juridique d'origine, même si ce lien n'est pas déterminé par l'ordre juridique de reconnaissance.

3 CONCLUSION

Grâce à la révolution communicationnelle, l'individu acquiert plus de liberté et plus d'autonomie par rapport au système juridique étatique. Actuellement, l'individu est également un acteur du droit et il peut participer à la création de la norme juridique.

En droit postmoderne, l'intégration de l'étranger dans le pays d'accueil n'est plus l'uniformité répondant aux nécessités politiques et économiques de l'État du for, mais une intégration qui répond aux préoccupations identitaires et culturelles. Il ne s'agit plus de l'hétéronomie. L'individu acquiert une dimension autonome au plan international. Il résulte de cette consécration de l'autonomie que chaque situation juridique n'est pas forcément rattachée à un seul ordre juridique et peut être appréhendée par plusieurs ordres juridiques. Par conséquent, l'étranger immigré peut en même temps créer des rapports juridiques selon la loi du pays d'origine, vivre ses propres valeurs, conserver son identité et s'intégrer positivement dans le milieu social et juridique dans lequel il vit.

Il n'a été jamais prouvé que l'intégration des étrangers dans le pays d'accueil soit intimement liée à l'application de la lex fori. D'ailleurs, même le recours à la règle de conflit classique de Savigny ne peut garantir à 100% l'application de la loi du for.

À notre avis, la méthode de reconnaissance est une approche qui favorise l'individualisme au mépris du monisme étatique, mais n'empêche pas l'étranger de s'intégrer dans le for de reconnaissance. Peut être l'intégration souhaitée par les immigrés n'est pas celle qui permet aux organes du pays d'accueil à les forcer à se soumettre à un seul ordre juridique celui du for. Mais peut être celle basée sur un vrai pluralisme juridique. Aux termes de madame Andrée Lajoie, '' un vrai pluralisme juridique commence quand un groupe se voit attribué la possibilité de faire ses propres règles en raison de ses propres valeurs ou bien ce groupe s'attribue lui-même le pouvoir de faire ses propres règles en fonction de ses valeurs'' [7].

REFERENCES

[1] Sylvain BOLLÉE, "L'extension du domaine de la méthode de reconnaissance unilatérale", *Revue critique du DIP*. 96(2) Avril- Juin 2007.

[2] Pierre MAYER, *Les méthodes de reconnaissance en DIP*, dans le DIP esprit et méthodes, mélanges en l'honneur de Paul Lagarde, éd. Dalloz, 2005

[3] Charalambous PAMBOUKIS, la renaissance métamorphose de la méthode de reconnaissance, Revue critique de DIP, vol. 97, no. 3, pp. 513-560, 2008.

[4] Bertrand. ANCEL et Yves. LEQUETTE, les grands arrêts de la jurisprudence française de DIP, 5éme éd. Paris, Éd. Dalloz, 2006.

[5] Shwebel c. Ungar, (1965), S.C.R. 148

[6] Pierre CALLÉ, l'acte public en DIP, Paris, Economica, 2004.

[7] Andrée LAJOIE, J.M BRISSON, S. NORMAND, A. BISSONNETTE, *le statut juridique des peuples autochtones au Québec et le pluralisme juridique*, Coll., le droit aussi, Cowansville, Yvon Blais, 1997.