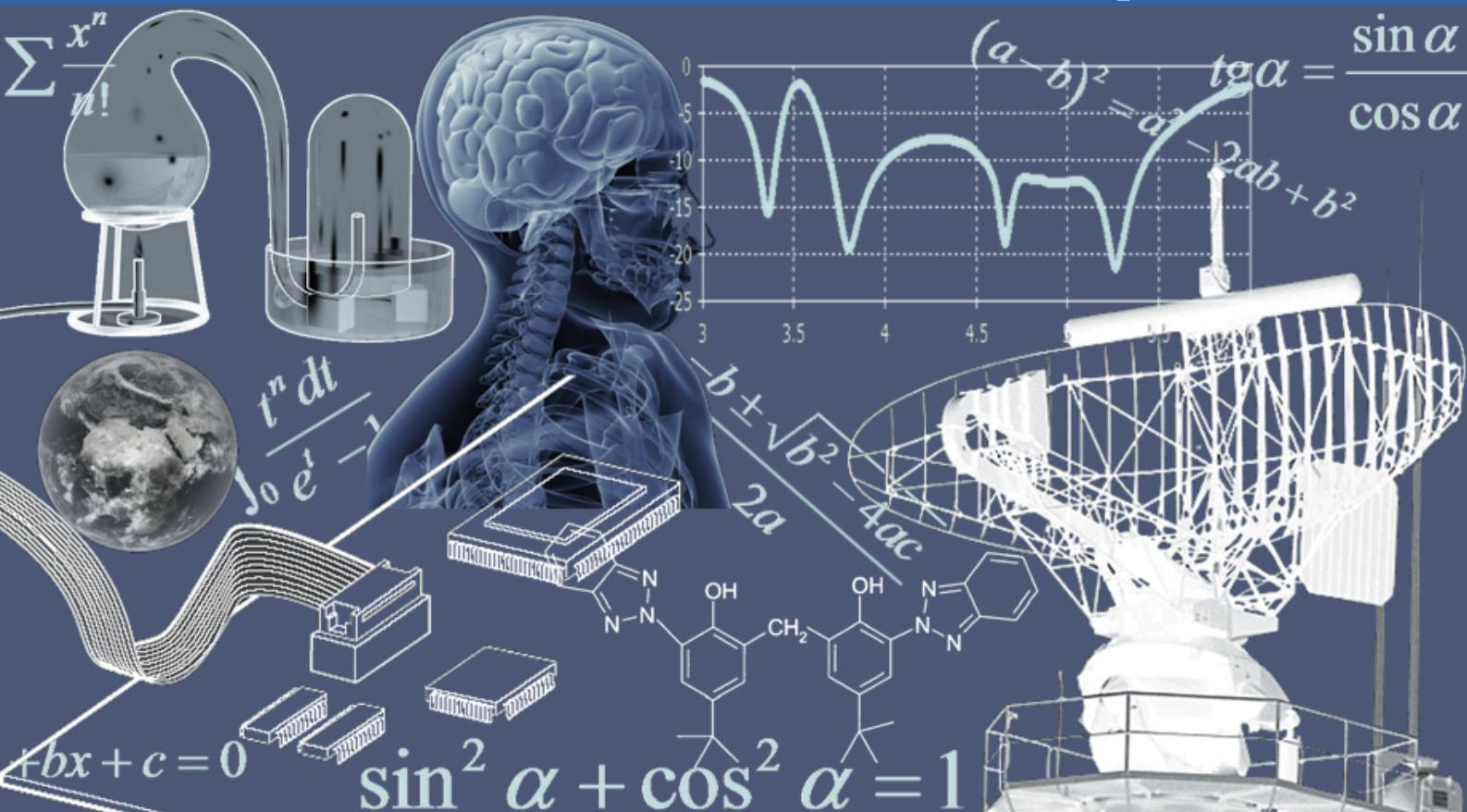


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Performance assessment, monitoring and evaluation of a portable sprinkler irrigation system at CSIR-Crops Research Institute

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ABSTRACT: Increased pressures on the finite water resources of the world are requiring the irrigation sector to become more accountable for its water use. There are a multitude of factors which can affect the uniformity of an irrigation system. An evaluation or performance assessment of irrigation systems can point out flaws or otherwise of an irrigation system for improvement. An evaluation of a recently installed sprinkler irrigation system was done to gather the necessary data needed to determine the systems performance and also to determine whether excessive application loses were occurring in the system. The assessment took into account the operating pressures, lateral and sprinkler discharges, sprinkler distribution patterns and uniformity coefficient. Operating pressures and discharge deviated marginally from manufacturers specifications. A uniformity coefficient of 84.13% suggested a good system with very minimal water loses.

KEYWORDS: Discharge, operating pressures, uniformity coefficient, irrigation, sprinkler

1 INTRODUCTION

A portable sprinkler irrigation system was installed to cover a 20 ha operational area of the research fields of the CSIR-Crops Research Institute with financial assistance from the West African Agricultural Productivity Programme (WAAPP). In portable set sprinkler irrigation systems, the sprinklers and associated pipelines are temporarily set up and operated for each irrigated zone. They are then moved to a new zone for irrigation. These systems are used to irrigate several zones; thus, they are designed so that all zones can be irrigated before the first zone needs to be re-irrigated.

The individual sprinkler spacing and discharge rates determine the average irrigation application rate. Many additional factors, including operating pressure, changes in elevation, friction pressure losses, wind, and individual sprinkler characteristics affect the uniformity of water application within an irrigated zone. The performance of a sprinkler irrigation system is described by uniformity and application efficiency. Water application efficiency is an irrigation concept that is very important in both system design and irrigation management due to its relationship with the energy and the labour requirements for implementing a sustainable irrigation scheme. One of the standard practices to characterize water use in an irrigated area is to conduct evaluations.

Several factors regarding soil, plant and atmosphere interact to determine the productivity of agricultural crops. If the water necessary for plant growth is not applied uniformly, growth and yields will be affected. Non-uniform application also leads to surface redistribution and eventual leaching of nutrients on over-irrigated areas whilst under-irrigated portions end up as dead spots, unable to support plant growth and also create non-uniform crop stands. Irrigation uniformity is linked to crop yield through the effects of under or over irrigation. Inadequate water results in high soil moisture tension, plant stress and reduced crop yields, whilst excess water may also reduce crop yield through mechanisms such as leaching of plant nutrients, increased disease incidence or hindered growth of commercially valuable parts of crops [1]. The uniformity and performance of an irrigation system are inherently associated with the manner in which agricultural resources are utilised. So that non-uniformity and under performance result in excess pumping costs and fertiliser loss either through fertigation or

leaching by the excess water. Capital losses are also incurred due to the extra capacity put into the irrigation and drainage systems to convey the excess water from the field [1].

Reference [2] reported several studies that show a linear relationship between yield reduction in crops and seasonal evapotranspiration deficit. Generally, the production functions regarding water permit an analysis of the total dry matter production or commercial matter production of the crops for transpiration, evapotranspiration or quantity of water applied by irrigation. Knowing these relationships is necessary to assess irrigation strategies [3]. Thus, the uniformity of a sprinkler irrigation system is significant to realising the basic aim of efficient application of water to eliminate wastage and the overall improvement in potential irrigation systems efficiency. Reference [4] identified some benefit of conducting performance evaluation of a sprinkler irrigation system. Some of these are: improved soil moisture uniformity; lower water and energy requirement; easier irrigation system scheduling and management; reduced runoff and deep percolation and healthier plant growth for optimum yield.

The main objective of this paper was to examine the performance of a recently installed sprinkler irrigation system at the CSIR-Crops Research Institute. This research has the potential benefit of improving irrigation efficiency and reducing stress on water resources and losses of water and nutrients to groundwater and surface water resources. Furthermore, findings from the study would serve as a guide in irrigation scheduling and the implementation of future sprinkler systems for irrigating larger areas with a given volume of water. This study would also contribute to knowledge in the field of irrigation practice in Ghana at large.

2 MATERIALS AND METHODS

2.1 DESCRIPTION OF STUDY AREA AND IRRIGATION SYSTEM

The Crop Research Institute (CRI) is one of the 13 institutes of the Council for Scientific and Industrial Research of Ghana. It is mandated to develop and disseminate environmentally sound technologies, comprising improved high yielding, good quality, pest and disease resistance varieties and improved crop management and post harvest practices. It is located at Fumesua, 30km away from Kumasi, in the Ejisu-Juabeng District of the Ashanti Region of Ghana. It is on longitude 1° 32' W and latitude 6° 43' N. The location of the project area is as shown on the Google image in Figure1 below. The topography at the site and its surrounding areas is undulating with gentle slopes. The slope is flows between 3 – 8 percent. The average elevation is 295m taken from GPS readings and corroborated from 1:25,000 topographic map of Ghana.

Supplementary irrigation is currently being applied to sections of the fields covering an area of 23 ha. The overall objective of the irrigation project was to enhance crop improvement and technology development capacity of the CSIR-Crops Research Institute to improve food security and livelihoods of smallholder and commercial farmers in Ghana.

A portable sprinkler irrigation system was installed to cover a 20 ha operational area with the remaining 3 ha fitted with a drip irrigation system. In portable set sprinkler irrigation systems, the sprinklers and associated pipelines are temporarily set up and operated for each irrigated zone. The main components of the sprinkler irrigation system are as follows:

2.1.1 THE CONTROL STATION

This consists of a supply line (rigid galvanized steel suction pipes and manifolds), two 45 HP electric pumps, control panels, pressure sustain valve, water flow meters, and a filter. It is also equipped with an air release valve and a check valve

2.1.2 THE MAINS AND SUB MAINS (PIPELINES)

The main and sub main pipelines are made up of 160mm, 110mm, and 75mm PE pipes. The main pipelines have the largest diameter (160mm and 110mm) of the network and it conveys water from the pumping station through the system. The pipes are black high density polyethylene (HDPE), buried permanently at a depth of 1m. The sub mains are smaller diameter pipelines (75 mm HDPE) which extend from the main lines and from which the system flow is diverted for distribution to the various plots.

2.1.3 THE HYDRANTS

There are 5 major hydrants fitted on the main (160mm) pipeline. These are equipped with a 50-75mm (2-3") shut-off valve. They deliver part of the flow to the sub mains and serve as controls for switching between sets. The sub main pipelines

(75mm PE pipes) are also installed with a total of 94 valves connected to elbows for delivering water to the laterals. The valves are spaced 12 m apart on the sub mains.

2.1.4 THE LATERALS (IRRIGATING PIPELINES) AND SPRINKLERS

These are the smallest diameter pipelines of the system. They are made of 40 mm low density polyethylene (LDPE) pipes. They are fitted perpendicular to the sub mains at fixed positions (12 m intervals), laid along the plant rows and equipped with water emitters spaced 12 m apart.

2.2 FIELD EVALUATION

Field evaluations were conducted by adopting the methodology of [5] and [6], following ASAE standard S330.1 [7] and ASAE standard S398.1 [8].

2.2.1 MEASURING OPERATING PRESSURE

Pressures within zones were measured at the sprinkler nozzles using Pitot tube pressure gauges. The pitot tubes were positioned in the discharge stream about 3mm from the nozzle. It was adjusted by moving it slowly within the stream until the highest constant pressure reading was obtained. Pressures were recorded at critical points within the system, including at the pump discharge, at the entrance to zones, at the distant end of laterals, and at extreme high and low elevations. This was done to correct any extreme deviations from the pressures specified by the system designer.

2.2.2 MEASURING LATERAL AND SPRINKLER DISCHARGES AND SPRINKLER APPLICATION RATES

Lateral discharge: A 40mm pipe was connected to the lateral and directed into a bucket of known volume. The valve was switched on and the water collected into the bucket. The time taken to fill the bucket was noted. This was repeated three times. The volumes were divided by their respective times (as shown in equation 1) and the average was taken as the lateral discharges.

$$q_l = \frac{V_l}{t} \quad (\text{Equation 1})$$

Where:

q_l = lateral discharge, mm/h

V_l = volume of water collected, ml

t = catch can fill time, s

Lateral Number	Volume (V), L	Time (T), s	Discharge(Q), L/s
1	10.8	1.32	8.18
2	11.2	1.48	7.56
3	12.7	1.51	8.41
Mean	11.57	1.44	8.05

Thus, the mean lateral discharge was determined to be 8.05 L/s

Sprinkler discharge: The length of a garden hose was connected to the nozzle of a sprinkler and whilst the sprinkler was operating, the water was directed in a bucket of known volume. The time taken to fill the bucket was noted. The discharge was determined by dividing the volume collected over time taken to collect the known volume. This was later converted to mm^3/h

$$q_s = \frac{V_s}{t} \quad (\text{Equation 2})$$

Where ;

q_s = the sprinkler discharge, ml/s

V_s = volume of water collected, ml

t = catch can fill time, s

Sprinkler application rate: Sprinkler application rates must be known so that irrigation durations needed to apply specific depths of water can accurately be determined. This was done: (1) to verify irrigation system designs and (2) to determine whether runoff can occur during the period of irrigation. The application volume was measured directly with catch cans. The volume of water collected was converted to depth by dividing the volume to the base area of the catch can. The average application rate was then calculated as the average depth of water measured divided by the time (measured using a stopwatch) during which the data was collected. The average flow rate and area covered by each sprinkler was measured. Since the sprinklers are regularly spaced, the application rate was calculated from:

$$\text{Rate} = \frac{\text{sprinkler discharge}(\frac{\text{mm}}{\text{h}})}{\text{lateral spacing(m)} * \text{sprinkler spacing(m)}} \quad (\text{Equation 3})$$

2.2.3 DETERMINING SWATH RADIUS, ROTATIONAL SPEED, AND SPRINKLER DISTRIBUTION PATTERN AND PATTERN EFFICIENCY

The farthest distance covered by water droplets (throw) from the sprinkler was measured for the swath radius. This was done during the dry season whilst the irrigation system was operated at full pressure. .

The speed of rotation of a sprinkler varies with nozzle size, stator size, operating pressure and condition of the impact drive mechanism. Several sprinklers were selected and allowed to make one revolution. The time taken to make the revolution was taken.

Uniformity was determined by placing 24 catch cans spaced 3 m, across the travel lane of four selected sprinklers. Because application rates may vary throughout a large irrigated field, measurements were made at several locations. Test locations were selected over the entire range of pressures that were encountered in the irrigation system. That is, locations were selected closer and farther from the irrigation pump at both high and low elevations.

The Christiansen's coefficient was used to test the distribution uniformity using the formula below;

$$CU = 100\%(1 - \sum \frac{x}{mn}) \quad (\text{Equation 4})$$

Where:

$\sum x$ is the sum of the absolute deviations from the mean (mm or ml) of all the observations

m is the mean application depth measured (mm or ml)

n is the number of observations (catch cans)

Distribution uniformity is usually defined as a ratio of the smallest accumulated depths in the distribution to the average depths of the whole distribution [9]. This uniformity measure is also called low-quarter distribution uniformity and it is often used to quantify irrigation uniformity of surface systems [10]. The DU coefficient takes into account the variation of can readings from the mean but concentrates on the lowest 25% of readings. A commonly used fraction is the lower quarter, which has been used by the USDA since the 1940s [9].

3 RESULTS AND DISCUSSIONS

The results and discussions are as follows.

3.1 PUMP OPERATING PRESSURE

The operating pressure of the pump was measured as **330 KPa**.

3.2 SPRINKLER OPERATING PRESSURE, SWATH RADIUS, ROTATIONAL SPEED, SPRINKLER DISTRIBUTION PATTERN AND PATTERN EFFICIENCY

The sprinkler operating pressure used in the study was satisfactory inferring from the manufacturer specification of 30Kpa. The sprinkler operating pressures ranged from 12 – 30Kpa. The average sprinkler precipitation profiles obtained were also consistent with established profiles of a single nozzle sprinkler operating at a satisfactory pressure.

To achieve good water distribution, rotation speed is to be consistent between sprinklers. Reference [11] stated that impact sprinklers should complete one revolution in 2 minutes (± 15 seconds) and that under no circumstance should a sprinkler complete a revolution in less than 105 seconds. However, [12] asserts that the ideal rotation speed of a 19mm

impact sprinkler is 1 rpm and that tighter spring tension increases the number of beats per minute and speed of rotation. The mean rotational speed determined was 1.96 rpm.

The Swath radius of the sprinklers were found to range from 8.10m to 8.81m with an average of 8.47m, and their corresponding wetted area ranging from 206.12m² to 243.84m². A mean discharge of 479L/h was recorded which deviated marginally from the standard values 495L/h quoted by the manufacturer.

Table 1. A table showing data collected from seven sprinklers on a lateral

Sprinkler	Distance from valve, m	Speed rev/min	Pressure (KPa)	Swath radius, m	Throw area, m ²	Discharge, l ³ /h
1	12	2.259036	305	8.81	243.84	498
2	24	2.162942	295	8.72	238.88	490
3	36	2.009377	285	8.65	235.06	485
4	48	1.892148	273	8.41	222.20	481
5	60	1.838799	270	8.38	220.62	472
6	72	1.805054	265	8.24	213.30	467
7	84	1.726122	261	8.10	206.12	462
Mean		1.96	279.14	8.47	225.71	479

3.3 UNIFORMITY OF APPLICATION

CU values of 80-90% is attainable for set-move systems which are properly designed and maintained, operating under moderate wind speeds less than 16km/h [13]. It has been found that CU values as low as 60% can occur with systems on undulating topography, with worn or plugged nozzles, and/or under windy conditions [10]. Sprinkler uniformity is generally affected by the combination of wind speed/direction, operating pressure and sprinkler spacing, in the case of set-move sprinkler system. Reference [13] indicated that the uniformity of application is acceptable for CU values greater than 0.84 or 84%. Reference [15] also wrote that in general CU of at least 85% is recommended for delicate and shallow-rooted crops such as potatoes and most other vegetables, whilst values between 75% and 83% is acceptable for deep-rooted crops like alfalfa, corn, cotton and sugar beets. In cases where chemicals are applied through the irrigation water, the CU should be at least 80%.

Table 2. A table of values used to calculate the lowest quartile

Catch can number	Volume, ml	Absolute deviation
1	37.1	12.7
2	39.1	10.7
3	40.2	9.6
4	40.4	9.4
5	41.0	8.8
6	44.0	5.8
7	45.0	4.8
8	45.8	4.0
9	47.0	2.8
10	48.4	1.4
11	49.1	0.7
12	49.4	0.4
13	50.2	0.4
14	51.0	1.2
15	52.3	2.5
16	54.7	4.9
17	56.4	6.6
18	57.6	7.8
19	60.4	10.6
20	62.6	12.8
21	65.1	15.3
22	69.5	19.7
23	71.8	22.0
24	73.5	23.7
Total	1251.6	198.6
Mean	52.15	
Median (50 th Percentile)	49.8	
Mean absolute deviation	2.35	
Sum of absolute deviation		198.65

From table 2, equation 4 becomes

$$CU = 100 \left(1 - \frac{198.65}{52.15 \times 24} \right) = 84.13\%$$

The system gave a CU of 84.13% which according to [13] is acceptable for such systems.

4 CONCLUSIONS

The average sprinkler distribution patterns obtained were consistent with established profiles of a single nozzle sprinkler operating at a satisfactory pressure. The operating pressure and application rates were satisfactory inferring that the sprinklers could be used without runoff or major losses. However, detailed irrigation scheduling is needed to attain the maximum benefit from the system.

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Cash Holdings and Corporate Profitability: Some Evidences from Jordan

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ABSTRACT: The purpose of this paper is to examine the effect of cash holdings level on firms' profitability. Three simple regression models were used to examine the relationships between cash holdings and firms' profitability using a panel data of 65 non-financial firms listed in Amman Stock Exchange (ASE) during the period from 2000 to 2011. The results showed a positive significant relationship between cash holdings and profitability. This means that a good financial performance of the firm is an outcome of vast corporate cash holdings. This positive relationship reflected the beliefs of Jordanian firms' managers that the absence of effective liquidity management will cause cash shortages and will result in difficulties in paying obligations, which negatively affected the firm's profitability. This study contributes to the practical world. It helps firms in the markets of emerging countries in general and in ASE in particular, manage their liquidity and cash. Furthermore, the study helps firms hold the percentage of cash, which lead to efficient financial performance. This study encourages the future researches to find out the suitable strategies related to cash holdings.

KEYWORDS: Cash Holdings, Profitability, Return on Assets (ROA), Return on Equity (ROE), Earnings per share (EPS), Amman Stock Exchange (ASE).

1 INTRODUCTION

The financial crisis (2007-2009) has returned the attention back to cash holdings and liquidity management, directing the efforts to the policies to improve the company's cash management. The first function of cash management is to secure the short term normal business activities, manage resources and enhance liquidity (Allman-Ward & Sagner, 2003). The essential objective of this practice is to reduce the percentage of liquid assets held by companies in order to fulfill their ongoing activities on one hand, and on the other hand, to achieve a sufficient level of cash holdings to empower the company to obtain trade discounts to achieve acceptable credit rating and to meet unexpected cash requirements (Brigham, Gapenski, & Daves, 2003).

Cash holdings have many advantages related directly to investment activities, especially in flexibility and capitalizing on opportunities. Firms with high cash holdings can take advantage of more investment opportunities without being too restricted by capital, ensure adequate capital for planned or unplanned opportunities (business expansion, market opportunities during the financial crisis, when unexpected news brings a stock price down, real estate deal, business opportunities, and so on) (Ogundipe, Ogundipe, & Ajao, 2012). Availability of cash holdings allows firms to take advantage of the moment. Firms can make profitable investment deals that have a huge impact on their continuity whether for restructuring purposes or for taking advantage of new opportunities. On the other hand, the cash holdings decision must be sound, thorough and logical in order to avoid the negative impact of holding too much cash (Elkinawy & Stater, 2007).

While the researches on cash holdings discussed the profitability as a determinant of cash holdings, this paper aims to investigate the outcome of holding vast cash by examining the effects of holding vast cash on firms' profitability. The paper aims to present empirical evidences that cash holdings decision affects on corporate financial performance by using panel data of 65 non-financial firms listed in Amman Stock Exchange (ASE) during the period from 2000 to 2011.

2 RELATED LITERATURE

The trade-off theory refers to as the negative effect of return on assets on cash holdings arguing that profitable firms have enough cash flows to avoid under-investment problems (Almeida & Campello, 2005). In contrast, **the pecking order theory** predicts the positive effect of return on assets on cash holdings (Ogundipe, Salawu, & Ogundipe, 2012).

There are few studies that addressed the effect of cash holdings decisions on the firm's profits and financial performances (Lehtinen, 2011). The relationship between liquidity and profitability was fairly discussed in the financial management. The wide perception in the classical view is that there is a negative effect of firms' liquidity on profits, and that firms holding more liquidity will not be able to exploit the profitable investment opportunities, and possibly ending up paying higher taxes on this asset (Wenya, 2010). This negative relationship has faced a number of objections. For example, Shin and Soenen (1998) argued that an efficient company in managing its liquidity is the less the need for external funding, and higher chances of achieving profitability.

Frésard (2010) found evidence that firms holding higher cash than their competition achieve better performance and profitability when measured by return on assets. The study presented evidence that firm's market-share increased than that of their competitors as a result of increasing levels of corporate cash holdings. The firm employs effective capital management to benefit from operational competitive advantages whatever the economic climate is (Vuorikari, 2012).

The study also helps set a fundamental strategy of success in improving firm's financial performance through good managing to cash holdings within the different market conditions. Opler, Pinkowitz, Stulz, and Williamson (1999) argued that when the investment opportunities are large enough to hold larger cash, they will have a positive effect on corporate financial performance.

Related literature focused on the investors' negative views towards cash holdings and the negative effect of liquidity and cash holdings on the firms' financial performance as well. With the global financial crisis of 2007-2009, the financial markets around the world were hit by the most awful crisis since the great depression.

This crisis caused difficulties for the most firms around the world which faced severe funding problems especially the non-financial firms, which were directly forced to strengthen their financing strategies against financial constraints and transfer from indirect finance to direct finance to face this new situation (Mizen, 2008).

Investors have currently realized the advantages of cash holdings and liquid investments for the firm operations and its performance. For example, a recent article published in the Economist (2008) stated "how time changes; not long ago, companies with cash piles were assailed by corporate activists to return money to shareholders, but currently it is only a slight exaggeration to say that the more cash that investors see in a firm's coffers, the happier they are". This leads to believe that increasing of cash will lead the firm to a better competitive position especially when market trend is bearish.

Corporate cash holdings and its implications have been widely investigated in the major developed countries. On the contrary, this issue received little attention in the developing countries even though they observe the same phenomenon (Chen, 2012).

Many studies have addressed the effect cash holdings on the profitability and give varied results. For example, using a data set of US public companies, Palazzo (2011) found evidence of the cash holding effects on firms financial performance that precautionary savings motive involves a positive relation between expected return on equity and cash holdings. This positive relationship is going stronger for firms with less valued growth opportunities. Furthermore, Sur, Biswas, and Ganguly (2001) investigated the positive association between liquidity and financial performance. Shin and Soenen (1998) pointed out that efficient firm is the least necessity for external funds, the better financial performance and the well managing its working capital.

L. Pinkowitz, Stulz, and Williamson (2006) examined the determinants of the market value of cash holdings U.S. public firms over the period 1950 to 1999. Their results showed that both past and future changes of cash holding levels only contribute just a little to the market value of a firm. They also argued that the value of cash holdings increases for the firms with growth opportunities. Moreover, they demonstrated that cash holdings of corporates with constant investment opportunities and corporates forcing the risk of insolvency were less valued.

Raheman and Nasr (2007) using a sample of 94 Pakistani listed firms, found a significant negative relationship between liquid assets and profitability during the period from 1999 to 2004. On the other hand, Lyroudi and Lazaridis (2000) studied the listed companies on the London Stock Exchange for a period of four years. They found that cash conversion cycle, current ratio and the quick ratio effect on firms' profitability negatively.

Wang (2002) examined the relationship between liquidity and firm profitability as well as value for Japanese and Taiwanese listed firms in the period from 1985 to 1996. The results of the paper acknowledged the existence of a negative and significant relationship between liquidity and profitability.

The study of Allahawiah and Al Amro (2012) also concluded that liquidity holdings do not depend on debt, mostly made stronger financial position to the firms and attract many investors to invest in these firms, which was reflected positively on their stock market price.

The decision of cash holdings is one of the most significant decisions required for management (Islam, 2012). In spite of the abundant previous studies and many discussions of corporate cash holdings, the implications of firms' cash policy are not yet full-understood (Frésard, 2009). In the emerging markets, the strategic decision of cash holdings is necessary, but it has been under-researched or incompletely explored in the previous studies (Al-Najjar, 2012).

Cash holdings play a significant role in the economic growth in the emerging countries. Chen (2012) suggested that corporate cash holdings in emerging markets promote economic growth. The study attributed this relationship to firms' desire in developing countries taking advantage of investment opportunities.

Better managing of the firm liquidity is one of the main goals for any business. However, collecting cash from customers in time helps firms paying short term debts and protect the firm of technical insolvency. In contrary, the absence of right liquidity management will cause cash shortages and will result in difficulty in paying obligations which effect negatively on the firm's profitability (Vijayakumar, 2011).

A high deal in liquid assets means low corporate's profits margins and low investment earnings. That, more investment in liquid assets will not yield enough earnings, and vice versa. On the other hand, a low investment in liquid assets a high rate of return as no unused investment is tied up in current assets. However, as a result of disruption in production and sales and its bad effects on inventory, the low current ratio causes a technical insolvency represented on incapability to repay the creditors in time due to the restrictive strategy (Vishnani & Shah, 2007).

Afza and Adnan (2007) suggested that the future researches should explore the impact of corporate cash holdings on firms' profitability and performance, which is mainly related to the hedging logic of the precautionary motive, numerous literatures explored the influence of the competitive situation on corporate cash holdings policy.

The recent findings of the positive relationship between cash holdings and firm value have proved after the financial crisis by Martínez-Sola, García-Teruel, and Martínez-Solano (2013), Morellec and Schürhoff (2011), and Bates, Kahle, and Stulz (2009) among others. These literatures argued that cash holdings increase the ability on competition in financial markets.

The most common measures of profitability are return on assets, return on equity and earnings per share (Benos & Papanastasopoulos, 2007).

The weakness of corporate governance in the emerging markets decreases the shareholders' and creditors' ability to monitor cash holdings. So cash holdings expected deviate from the optimal level. In reality, poor governance corporations may waste cash holdings easily and accordingly decreases corporate profitability (Dittmar & Mahrt-Smith, 2007).

Although previous literature has recognized a significant influence of the corporate market position on the decision of capital structure, but the influence of cash holdings is far less understood (i.e., Campello, 2006; Kovenock & Phillips, 1997; MacKay & Phillips, 2005). Kalcheva and Lins (2007) indicated that firm values are always lower when controlling managers hold more cash in countries where external level of shareholder protection is weak, and are higher when controlling managers pay payouts.

Based on similar arguments, and in harmony with results of Bates et al. (2009) study, Morellec, Nikolov, and Schürhoff (2008) concluded that US corporations hold cash more than they need. This can be explained due to the rise of last decade industrial competitiveness. In that sense, Gaspar and Massa (2006) investigated the relationship between the competitive situation and corporate financial profitability and performance of the financial market. They attributed the rise of stocks idiosyncratic volatility to the growth of industrial competitiveness.

Haushalter, Klass, and Maxwell (2007) argued that selecting the optimum corporate cash holdings takes into consideration the competitive position compared to industry rivals (i.e., market share). This is in addition to the competitive strength of their industry or the similarity of their technology. Frésard (2010) pointed out that companies held vast cash are capable to rise their market share vis-à-vis their rivals. This anticipates the key role of market share itself corporate's optimal cash holdings policy.

The firms hold vast amount of cash during crises times gain competitive advantages. When the markets in trouble, firms trying seriously to decrease their prices to gain competitive pricing. In this vein, firms with vast cash holdings can last longer with weak margins and later on gain market shares from the non-survivors of the price war. Furthermore, these firms gain more advantages that are presented in the increased bargaining power with banks and creditors (Pettit, 2011).

The increase of product market competition originates the relationship between holding vast cash and income uncertainty. This encouraged Frésard (2010) to examine the role of firms cash policies to face up predator behavior of competitors. The results ratified the key role of cash buffer in protecting companies contrary to predator behavior of rivals, while giving them a room to survive exogenous against unexpected shocks in the product market. Moreover, Bolton and Scharfstein (1990) argued that the key to success in the product markets heavily depends on corporate ability to internally finance investments.

In addition to the performance and profitability aspect, the decision of cash holdings is associated to rivalry and rapacity in product markets. The flexible firms with incapability to respond to changes in product markets can force the risk of being excluded out of the market. For example, holding vast cash can empower a firm to respond rapidly to new investments opportunities by building entry barriers and let the firm monopolizes the market in a situation where an entrant is trying to create competition (Baskin, 1987). Cash rich corporations seek to enforce the competitors who are financially constrained out of the product market by mediating their cash flow. The model of Bolton and Scharfstein (1990) showed that the company's ability to finance their activities mitigates the financial distress through generating funds internally, decreasing the rapacity risk and stimulating growth in the product markets.

According to the risk return theory which states a positive relationship between risk and return, it is expected to observe that business with high cash holdings and liquidity ratios have low risk which implies a low return and vice versa.

As an emerging market, the recent global financial crisis is affected negatively on the activities and trend of Amman stock exchange. In spite of the dramatic increase of the listing activity of public firms during the period pre-global financial crisis, the decline of the trust in the investment activity combined with the bad performance of the firm play key roles in value losses in the of public firms at ASE after 2007 (Al-khatib & Al-Horani, 2012).

According to the statistics of the Edaa (2011), the number of companies that are trading below par value (one Jordanian dinar per share) on October, 2011 reached 117 companies out of 211 companies that were traded on the stock market. The problem is that about 55 percent of the companies were only listed in Amman Stock Exchange.

The number of insolvent Jordanian firms listed in Amman Exchange for the last three years are (60) companies, and the number of companies almost stalled, and which suffered losses for two consecutive years are (15) companies. The accumulated losses often lead to a decline in shareholder's value and thus a significant drop in market prices which may cause a high risk of creditors and banks.

The indicators of insolvent economic companies appear when the firms do not cover their expenditures by using their revenue. The firms are going up to the stage of technical insolvent. In such case, the firms will not be able to repay debts on time, because of the expansion in investment in assets of non-convertible to cash.

Despite the fact that its assets exceed the value of its debt, this requires rescheduling of debt and the sale part of its assets at unfair prices, but when it goes down the value of the assets of the company to less than the value of its debt, the result of this situation and called the financial distress which need to the real liquidation of these companies as soon as possible to reduce the losses of the creditors.

Unfortunately, cases of financial distress suffered by many companies in Amman Stock Exchange (ASE) reflect the lack of sufficient knowledge to the importance of liquidity, whether by the senior management of companies or boards of management and inefficiency of liquidity management in ASE although of the impact of liquidity on the profitability. This paper aims to find out the impact of cash holdings decision in corporate cash holdings using a panel data of 65 nonfinancial firms listed in ASE during the period from 2000 to 2011

3 DATA AND METHODOLOGY

The main source of data for this paper was the financial reports of the non-financial firms having their domicile in all 232 Jordan listed firms in ASE over 12 years from 2000 to 2011. All financial collected data are in Jordan Dinar. Consistent with previous literatures, this study excludes financial firms due to their regulated environment and the dissimilarity in their financial statement structure, which eventually reduced the sample to 125 firms. Next, this study dropped all firms with missing variables, and lastly only those firms with at least twelve continuous time series observations during the sample

period were selected as a sample. All these were done to ensure consistency in the data set although it may result in survivorship bias. The final number of firms was 65.

"The analysis of financial statements is a process of evaluating the relationship between parts of financial statements to obtain a better understanding of the firm's position and performance" (Metcalf & Titard, 1976, p. 157). Financial measurements have been considered as the main approach in evaluating business performance. Growth in sales, return on assets, return on equity and earnings per share are some of the most common measures of the financial dimension (Dess Gregory & Robinson Jr, 2006). Three simple regression models were used to examine the relationships between cash holdings and firms' profitability measured by Return on Assets (ROA), Return on Equity (ROE) and Earnings per Share (EPS).

4 EMPIRICAL ANALYSIS

Table 1 explores the main descriptive analysis of cash holdings outcomes which are profitability variables over the whole period of the study. It can be concluded that the Return on Assets (ROE) during the period of the study is 3.22 percent which is relatively low. Also the Return on Equity (ROE) is very low around 3.10 percent. Moreover, Table 1 shows that (ROE) is less than (ROA) which means that owners take risks in consideration more than returns in the ASE. The Earnings per Share (EPS) also are very low that are nearly 11 cents per share, which is not satisfying.

Table 2 shows that ROA and ROE decreased after 2007 and show a negative value in 2011. EPS increased from 2000 to 2007, and then decreased to reach six cents in 2011.

Table 3 shows that cash holdings had significant positive correlations with all profitability measurements during the whole period of study. The strongest correlation was with return on assets 29.6 percent, while the weakness correlation was with economic value adder per share which is 7.5 percent.

The results of simple regression analysis have been explored in the table 4, and show a partial significant relationship between cash holdings and profitability. This means that firms' profitability is affected by the cash holdings level. In other words, profitability is an outcome of corporate cash holdings. Before adopting the models which explain the relationships between cash holdings and profitability, the study has tested the assumptions of simple linear regression models, which is required to be achieved in order to ensure the strength of the model and avoids bias. As mentioned earlier, the outliers problems of the dependent variables ROA, ROE and EPS were addressed by ignoring them, using the conditions if -7.8 percent <ROA <16 percent, if -9.8 percent <ROE<22.2 percent and if -0.2JD < EPS <0.29JD. The residuals of the modeles were found to normally distributed, as seen in figure 1.

The fixed effect model has been used to estimate linear equation of the relationship between cash holdings and profitability as Hausman test suggested (see Table 4). Table 5 shows a positive significant relationship between cash holdings and profitability measurements ROA, ROE, and EPS at one percent significance level. This means that ROA, ROE, and EPS increased in firms which hold vast cash. In other words, the positive performance represented in ROA, ROE and EPS is an outcome of holding vast cash and vice versa. Table 5 also shows that F statistic is significant at one percent significance level, as the corresponding p value of F test is zero. Therefore, the independent variable, which is cash holdings, influences firm's performance, which is a good sign for the model. Moreover, the R-Squared for the relationships between cash holdings and ROA, ROE and EPS are 0.44 0.408, and 0.4811 respectively, which means that the independent variable explains 44 percent, 40.8 percent and 48.11 percent from the ROA, ROE and EPS changes respectively.

5 CONCLUSION

This study focuses on cash holdings decisions and their significant role in enhancing the financial performance of firms and ensuring the required funds in time. The results of simple regression analysis have been explored in the table 5 are contrast with the risk return theory; which states a direct relationship between risk and return, according to this theory is expected to observe a negative relationship between liquidity and risk which implies a negative relationship between liquidity and profitability. The results of this paper show a positive partial significant relationship between cash holdings and profitability. This means that firms' profitability is affected positively by cash holdings level. In other words, a good corporate profitability is an outcome of holding vast cash.

The positive relationship between cash holdings and profitability reflect the effectiveness of hedging behaviors by Jordanian firms' managers that such strategies help Jordanian listed firms avoiding the cash shortages and easily paying obligations which positively affected on the firm's profitability. Moreover, these results imply that the disruption in production and sales effects on inventory and causes a technical insolvency represented on inability to pay the creditors in time due to the restrictive policy. Finally, the results of this paper are expected to help investors and firms' managers to

understand the effects of cash holdings on profitability and take the right decisions insured the ongoing good performance of the firm. The previous relationship, supported by each explanatory measurements of profitability used in this study, except growth of market share, suggests that a cash buffer is only to protect firms against predator behavior of competitors, while giving them a room to survive exogenous against shocks in the product market. These results go in line with the results of Martínez-Sola et al. (2013), Morellec and Schürhoff (2011), and Bates et al. (2009) among others, which argued that cash holdings increase the ability on competition in financial markets. Also, it goes in line with the study of Mikkelsen and Partch (2003) which concludes that hold vast cash support investment without hindering corporate performance.

The results of Abuhammous (2013), which found that non-financial Jordanian firms listed in ASE are financially constrained, strongly justified the results of this study that proved the positive relationship between cash holdings and financial performance. Therefore, cash holdings decisions depend on various frictions that financially constrain a firm; this is because financially constrained firms do not enjoy unrestricted access to external capital markets. Thus, financially constrained firms tend to hold vast cash from current cash inflows in order to increase the likelihood of funding investment opportunities. In this vein, cash holdings management becomes a strategic issue for financially constrained firms that strive to maintain optimal cash holdings that balance the profitability of current and future investments. This study contributes to the practical world. It helps firms in the markets of emerging countries in general and in ASE in particular, manages their liquidity and cash. Furthermore, the study helps firms hold the percentage of cash, which lead to efficient financial performance. Moreover, the study recommends that future research to deliver empirical justifications beyond not affecting cash holdings by inflation and cash surplus. Additionally, the study recommends that future research focuses on the impact of cash holdings on the value of firm. The positive relationship between cash holdings and financial performance in ASE during the period from 2000 to 2011 encourages finding out the suitable strategies related to cash holdings in future research.

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APPENDIX

Table 1. Descriptive analysis of profitability variables

	ROA	ROE	EPS
Mean	3.23	3.11	0.11
Median	3.99	5.77	0.07
Maximum	43.94	58.05	3.74
Minimum	-58.67	-162.03	-1.06
Std. Dev.	8.99	18.34	0.36
Skewness	-1.17	-3.71	5.06
Kurtosis	9.97	27.72	43.80
Jarque-Bera	1753.67	21657.70	57297.20
Probability	0.00	0.00	0.00

Note. These variables are; return on assets (ROA) which is net profit after taxes to total assets, return on equity (ROE) which is earnings before tax, depreciation and amortization to stockholder's equity, earnings per share (EPS) which is net profit after taxes to number of shares.

Table 2. Annually descriptive analysis of profitability variables

		ROA	ROE	EPS	ROE
2000	Mean	2.41	2.40	0.07	2.49
	Std.	7.92	14.40	0.24	14.43
2001	Mean	2.45	3.15	0.08	3.25
	Std.	9.32	13.09	0.19	13.14
2002	Mean	3.56	4.25	0.09	4.37
	Std.	6.82	9.64	0.18	9.73
2003	Mean	3.18	2.40	0.09	2.53
	Std.	8.20	22.14	0.21	22.21
2004	Mean	5.07	5.43	0.14	5.54
	Std.	7.13	14.66	0.23	14.71
2005	Mean	6.25	7.14	0.18	8.74
	Std.	8.42	12.19	0.32	11.82
2006	Mean	3.70	3.51	0.10	5.33
	Std.	6.70	11.74	0.18	11.51
2007	Mean	5.36	5.81	0.21	7.71
	Std.	9.60	17.25	0.49	17.20
2008	Mean	2.54	-2.51	0.13	0.15
	Std.	12.96	30.59	0.65	28.10
2009	Mean	3.04	0.56	0.09	3.28
	Std.	8.25	15.28	0.29	14.09
2010	Mean	1.56	-2.00	0.08	0.58
	Std.	8.95	17.88	0.34	15.67
2011	Mean	-0.75	-10.29	0.06	-6.71
	Std.	10.50	36.08	0.54	30.45

Note. These variables are; return on assets (ROA) which is net profit after taxes to total assets, return on equity (ROE) which is earnings before tax, depreciation and amortization to stockholder's equity, earnings per share (EPS) which is net profit after taxes to number of shares.

Table 3. Correlation matrix between cash holdings and profitability variables

Probability	LOGCASH	ROA	ROE	EPS
LOGCASH	1.00			
ROA	0.304*	1.00		
ROE	0.218*	0.828*	1.00	
EPS	0.205*	0.648*	0.551*	1.00

Note: *P < 0.01 **P < 0.05 and ***P < 0.10

Note, the variables in this table are; cash holdings (LOGCASH) the natural logarithm of cash and cash equivalents to net assets, return on assets (ROA) which is net profit after taxes to total assets, return on equity (ROE) which is earnings before tax, depreciation and amortization to stockholder's equity, earnings per share (EPS) which is net profit after taxes to number of shares.

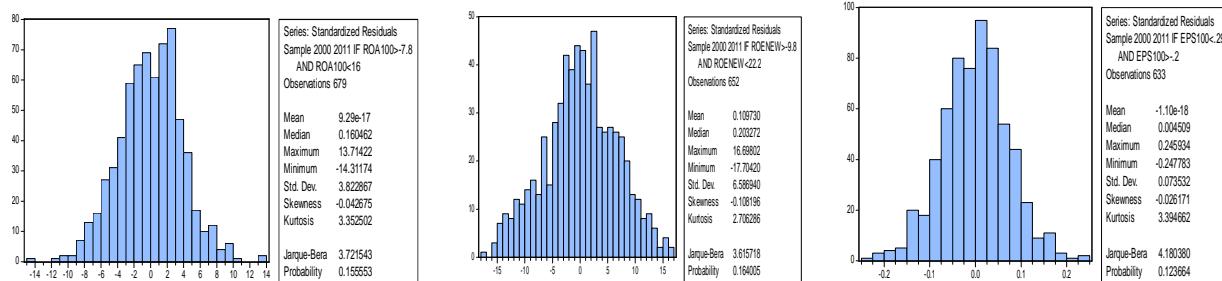


Figure 1 the Residuals Normal Distribution (ROA), (ROE) (EPS)

Table 4. Hausman Test (ROA), (ROE) and (EPS)

Correlated Random Effects - Hausman Test Test cross-section random effects		
Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.
Cross-section random (ROA)	6.867797	1*
Cross-section random (ROE)	4.337958	1**
Cross-section random (EPS)	5.004541	1**

Note: *P < 0.01 **P < 0.05 and ***P < 0.10

Table 5. The Relationship between Cash Holdings and Profitability

No.	Variable	OLS1 Coefficient	OLS2 Coefficient	OLS3 Coefficient
1.	LOGCASH	0.423817*	0.510547*	0.007508*
2.	C	5.698319*	8.178252*	0.083522*
	R-squared	0.44	0.408	0.4611
	Adjusted R-squared	0.38	0.342	0.399
	Durbin-Watson stat	1.26	1.324	1.352
	F-statistic	7.427*	6.206*	7.463*

Note: *P < 0.01 **P < 0.05 and ***P < 0.10

Dependent Variable: ROA Dependent Variable: ROE Dependent Variable: EPS

Note. Dependent Variables in this table is return on assets (ROA) which is net profit after taxes to total assets, return on equity (ROE) which is earnings before tax, depreciation and amortization to stockholder's equity, earnings per share (EPS) which is net profit after taxes to number of shares, while the independent variable is cash holdings (LOGCASH) the natural logarithm of cash and cash equivalents to net assets.

Interstitial Pregnancy: Two Case Reports and Review of the Literature

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ABSTRACT: Interstitial pregnancy is a rare form of ectopic pregnancy, but it is associated with the highest risk of morbidity and mortality and needs early diagnosis. Interstitial, angular and cornual pregnancies are mistakenly and frequently confused and need a strict distinction. Interstitial pregnancy refers to an ectopic pregnancy that is implanted in the interstitial portion of the fallopian tube. Its correct diagnosis can be quite difficult; it relies heavily on quantitative beta-hCG assays and ultrasound and potentially on laparoscopic evaluation. The diagnosis by transvaginale ultrasonography is based on multiple criteria. Several effective treatment options for treatment of interstitial pregnancy have been described but the most appropriate technique remains controversial. Managing an interstitial pregnancy is dependent upon whether the ectopic pregnancy has ruptured, the stability of the patient, the gestational age at diagnosis and the patient's desire for future fertility. The greatest risk to patients after successful treatment remains recurrence of interstitial pregnancy and the uterine rupture during subsequent pregnancy this is why a transvaginale ultrasonography should be performed 5-6 weeks after the last menstrual period and a cesarean delivery should be planned at term or performed, if tocolysis fails in cases of preterm labor. To illustrate the particularities of this form of ectopic pregnancy we report two cases with a brief up date.

KEYWORDS: ectopic pregnancy, interstitial pregnancy, cornual pregnancy, angular pregnancy, transvaginale ultrasonography, laparoscopy.

1 INTRODUCTION

Interstitial pregnancy is a rare form of ectopic pregnancy, but it is associated with the highest risk of morbidity and mortality and needs early diagnosis. Interstitial, angular and cornual pregnancies are mistakenly and frequently confused and need a strict distinction because the behavior, management, and outcomes the 3 conditions are different. Compared to the others forms of fallopian pregnancies the interstitial pregnancy has its particularities that must be known for its well managing.

2 CASES REPORT

CASE REPORT 1

A 28-year-old woman, gravida 3 para 2, with uneventful past medical history, presented with amenorrhea, lower pelvic pain and vaginal bleeding started 3 days before presentation. On the general examination the patient appeared to be in fairly general good condition with blood pressure 110/70 mmHg. On the abdominal examination abdominal tenderness is noted, and the pelvic examination showed adnexal tenderness at the right with no bleeding at the time of the axamination or adnexal mass. The findings of the ultrasonographic examination (figure 1) were consistent with ruptured ectopic pregnancy; it demonstrated a large amount of free fluid in the abdominal cavity, a 3*2.5 cm right laterouterine heterogene image with no intrauterine pregnancy identified. The patient underwent an immediate exploratory laparotomy (figure2). Findings were a massive bleeding in the peritoneal cavity and ruptured and actively bleeding right interstitial pregnancy based on the enlarged angle of the uterus lateral to the round ligament. Right total salpingectomy was performed and hemostasis was achieved. The serum beta- human chorionic hormone level measured 24h after surgery was fallen and the patient had uneventful postoperative recovery.



Figure 1: Ultrasonographic image

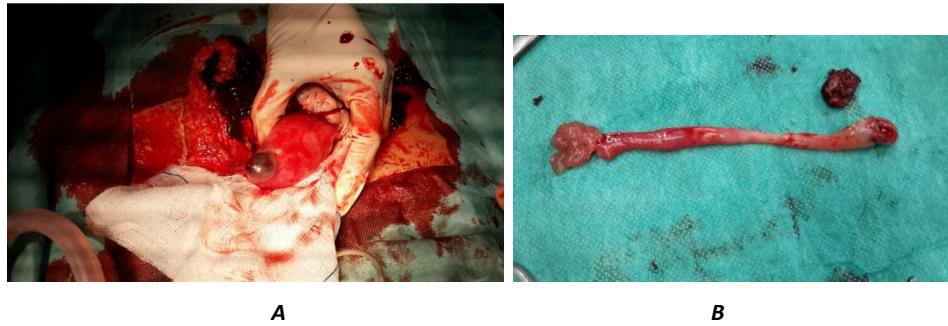


Figure 2: A. Laparotomy of the patient showing heterotopic pregnancy. B. salpingectomy piece and trophoblastic product

CASE REPORT 2

27 years-old woman, gravida 2 para 2, with uneventful past medical history, 8 weeks' pregnant by last menstrual period, presented with lower pelvic pain and vaginal bleeding started one few hours before presentation. The physical examination noted only an abdominal tenderness and an adnexal tenderness at the left with no bleeding or adnexal mass. The ultrasonographic examination demonstrated a free fluid in the abdominal cavity with no intrauterine pregnancy identified. The patient underwent an immediate exploratory laparotomy. Findings were a bleeding in the peritoneal cavity and ruptured left interstitial pregnancy based on the enlarged angle of the uterus lateral to the round ligament. Right total salpingectomy was performed and hemostasis was achieved. The serum beta- human chorionic hormone level measured 24h after surgery was fallen and the patient had uneventful postoperative recovery.

3 DISCUSSION

Interstitial pregnancies accounts for up to 1–3% of all ectopic pregnancies [1] and for only 2-4% of tubal pregnancies [2] but the mortality rate is 2.5%, it is 7 times greater than that of ectopic pregnancies in general [3]. While all ectopic pregnancies are associated with a risk of hemorrhage, interstitial pregnancies are associated with the highest risk of massive and uncontrollable bleeding [4]. Early diagnosis is crucial to reducing its morbidity and mortality [2].

Interstitial pregnancy refers to an ectopic pregnancy that is implanted in the interstitial portion of the fallopian tube [1][2][4]. It is mistakenly and frequently confused with cornual pregnancy and angular pregnancy [2][4]. The interchangeable use of these terms in clinical practice can create problems for clinicians [3]. A strict distinction among the 3 conditions is clinically important because their behavior, management, and outcomes are different. In contrast to interstitial pregnancy, an angular pregnancy refers to an intrauterine pregnancy that is implanted in one of the lateral angles of the uterine cavity, medial to the uterotubal junction[2][4][5]. Cornual pregnancy refers to a pregnancy which occur in a bicornuate uterus horn [2][4][5], rudimentary uterine horn, a unicornuate uterus , the cornual region of a septate uterus or a uterus didelphys [3].

Factors that increase the risk of interstitial pregnancy are similar to those for ectopic pregnancy located in the more distal tube [2][4].

Contrary to common belief, current evidence dispels a long-standing myth that interstitial pregnancies present and rupture at a much later gestational age than other forms of ectopic pregnancy. The most common symptoms of interstitial pregnancy are abdominal pain and vaginal bleeding in the first trimester of pregnancy. Vaginal bleeding appears to be less common in interstitial pregnancy than in other forms of ectopic pregnancy. On physical examination, the classic signs of a

tender adnexal mass and cervical motion tenderness may be elicited. An asymmetric uterine enlargement may be palpable. Signs of acute abdomen may be elicited in cases of cornual rupture and hemoperitoneum; in severe cases, tachycardia and subsequent hypotension may be evident [2]

Correct diagnosis of ectopic pregnancy can be quite difficult. It requires accurate ultrasound interpretation. The diagnosis relies heavily on ultrasound and potentially on laparoscopic evaluation [1]. Since the introduction of high-resolution transvaginal ultrasonography (TVUS) and the highly sensitive quantitative beta-hCG assays, early and accurate diagnosis has become possible. The TVUS is the primary method of diagnosis. Three-dimensional TVUS may offer an advantage over conventional 2-dimensional sonography. Multiple TVUS criteria for diagnosing interstitial pregnancy were reported such as an eccentric gestational sac surrounded by an asymmetric myometrial mantle and an empty uterine cavity, an empty uterine cavity, a chorionic sac separate and at least 1 cm from the lateral edge of the uterine cavity, and a thin (5 mm) myometrial layer surrounding the gestational sac. The interstitial line sign, which refers to the visualization of an echogenic line that runs from the endometrial cavity to the cornual region, abutting the interstitial mass or gestational sac (80% sensitive and 98% specific) [2][4]. Magnetic resonance imaging may be used if ultrasound is inconclusive [2][4]. The same criteria should be used for an MRI diagnosis as with an ultrasonographic diagnosis [3]. At the time of laparoscopy or laparotomy, an unruptured interstitial pregnancy will appear as an asymmetric bulge in the cornual region. During laparoscopy, angular pregnancy appears as an asymmetric bulge in one of the uterine angles, medial to the round ligament and displacing its reflection laterally. On the other hand, interstitial pregnancy appears lateral to the round ligament [2][4].

Several effective treatment options for treatment of interstitial pregnancy have been described but the most appropriate technique remains controversial. Managing an interstitial pregnancy is dependent upon whether the ectopic pregnancy has ruptured, the stability of the patient, the gestational age at diagnosis and the patient's desire for future fertility [2][3]. A ruptured interstitial pregnancy is a surgical emergency that requires surgical intervention with either laparoscopy or laparotomy, depending on the patient's condition and available surgical assets [2][4]. If the diagnosis is made before rupture, conservative treatment options are possible. These options include minimally invasive surgery and nonsurgical treatment [2].

Medical treatment including methotrexate administration (local and systemic) is contraindicated in patient with intra-abdominal bleeding or a concomitant intrauterine pregnancy [3], but it is particularly attractive for patients who desire future fertility and the interstitial pregnancy is medium-sized (<5 cm) [2][3]. Its success can yield up to 94% success rate without surgery. Local methotrexate injection appears to be as effective as systemic administration but requires the expertise of ultrasound guided needle placement [4].

Surgical treatment, however, remains the cornerstone of treatment in women with more advanced interstitial pregnancies, particularly when medical treatment has failed, uterine rupture is suspected, patient adherence with follow up is in question, or recurrent ipsilateral interstitial pregnancy is found or in patients who would not accept transfusion of blood products in case of uterine rupture [2]. In the past, surgical management by laparotomy with cornual resection or cornuostomy has been a method of choice and actually minimally invasive surgery has revolutionized the treatment options. Laparoscopic cornuotomy with salpingostomy and laparoscopic cornual excision or corneal wedge resection for small ectopics can also be successful but with the required laparoscopic skills to do so [2][4]. Surgical methods that minimize potential blood loss must be used diligently and proactively. A wide variety of hemostatic techniques have been used laparoscopically, including intramyometrial injection of diluted pitressin, tourniquet, purse string suture or endoloop or stay sutures, electrocautery, ultrasonic cutting and coagulating surgical device (harmonic scalpel) and fibrin glue [2][3].

Transcervical hysteroscopic suction evacuation with laparoscopic or ultrasonographic guidance has been reported with success [3][4]. Success with selective uterine artery embolization has been reported but required the expertise of experienced interventional radiology [4]. In the case of heterotopic pregnancy, local injection of potassium chloride, have been used [3]. If the ectopic pregnancy is small, solid and nonviable, it can be managed expectantly because of the decreased risk of bleeding and rupture [3]

Patients who receive expectant or medical treatment and conservative surgical treatment are at increased risk of persistent interstitial pregnancy and should be followed for serial beta-hCG levels until resolution. If the serum beta-hCG level plateaus or rises, additional treatments should be used. Asymptomatic women may receive systemic methotrexate therapy and symptomatic patients may be best approached surgically.

Long-term, the greatest risk to patients after successful treatment remains recurrence of interstitial pregnancy and the uterine rupture during subsequent pregnancy. The incidence of recurrent interstitial pregnancy at the same site after non excisional treatment due to the persistence of the same tubal pathologic condition that has led to the cornual implantation in the first place remains unknown. Patients with a history of interstitial pregnancy are at increased risk of recurrent ectopic pregnancy. TVUS should be performed 5-6 weeks after the last menstrual period. Absence of a demonstrable intrauterine pregnancy raises the possibility of a recurrent ectopic pregnancy, and appropriate follow-up evaluation is required. Typically,

a cesarean delivery should be planned at term (≥ 37 weeks of gestation) before the onset of labor or performed, if tocolysis fails in cases of preterm labor, to avoid the catastrophic uterine rupture [2][4].

4 CONCLUSION

Interstitial pregnancy refers to an ectopic pregnancy that is implanted in the interstitial portion of the fallopian tube it must not be confused with angular and cornual pregnancies. Compared to the other forms of tubal pregnancies it is rare but is associated with the highest risk of morbidity and mortality and needs early diagnosis. The diagnosis is based on quantitative beta-hCG assays and transvaginal ultrasonography using diagnostic criteria and potentially on exploratory laparoscopy. The options treatment are dependent upon whether the ectopic pregnancy has ruptured, the stability of the patient, the gestational age at diagnosis and the patient's desire for future fertility. The greatest risk to patients after successful treatment remains recurrence of interstitial pregnancy and the uterine rupture during subsequent pregnancy this is why a transvaginal ultrasonography should be performed 5-6 weeks after the last menstrual period and a cesarean delivery should be planned at term or performed, if tocolysis fails in cases of preterm labor.

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Vulnérabilité Economique des Ménages au Cours d'une Episode du Paludisme dans la Zone de Santé de Miti-Murhesa, République Démocratique du Congo

[Economic Vulnerability of Households During a Malaria Incident in Miti-Murhesa Health Zone, Democratic Republic of Congo]

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ABSTRACT: A transversal and analytic study was conducted to determine the economical factors of vulnerability of the households to malaria in Miti-Murhesa Health Zone during a period of January to December 2010, including 492 respondents. The economical vulnerable household is defined as the one who consumed more than 13 % of his annual income for the refunding of malaria incident. The methodologies of gathering data consist by administrate an individual questionnaire to the respondents and documentary revue. The results of One way analysis show a statistical significant association between the economical vulnerability of the households and the following factors : a household headed by a woman, the cost of the hospitalization spending more than 10\$, an annual income of the household less than 370 \$, a household which is jobless, a household having more than 7 persons inside, a payment of other fees more than 2 \$, a patient who has frequented a tradi-practician before reaching the medical structures. The Two way analysis show that the factor analyzed, annual income of the house hold less than 370 \$ is the most independent but on which we do not have any solutions in short time, followed by the one of the hospitalization spending more than 10 \$, vulnerable factor for which the solution in short time is possible.

KEYWORDS: Economic cost, Vulnerability, Household, Malaria Incident, Miti-Murhesa Heath Zone, Democratic Republic of Congo.

RESUME: Une étude de type transversale et analytique, a porté sur les facteurs de vulnérabilité économique des ménages vis-à-vis du paludisme dans la Zone de Sante de Miti-Murhesa pendant la période allant de Janvier à Décembre 2010 a connu la participation de 492 sujets enquêtés. Le ménage vulnérable économiquement est défini comme celui consommant plus de 13% de son revenu annuel pour la prise en charge des épisodes de paludisme. La méthodologie pour la collecte des données a consisté à l'administration d'un questionnaire individuel aux sujets et la revue documentaire. Les résultats de l'analyse univarié montrent une association statistiquement significative entre la vulnérabilité économique des ménages et les facteurs suivants : un ménage qui a une femme comme responsable, le coût d'hospitalisation dépassant 10 \$, un revenu annuel du ménage inférieur à 370 \$, un ménage pour lequel le responsable n'a pas d'occupation, un ménage ayant plus de 7 personnes en son sein, un payement d'autres frais dépassant 2 \$ en dehors de la facture, un coût indirect dépassant le coût direct des soins, un patient ayant fréquenté le tradi-praticien avant d'atteindre les structures de soins. L'analyse multi variée montre que le facteur, revenu annuel du ménage inférieur à 370 \$ est le plus indépendant mais sur lequel nous ne disposons pas des solutions à court terme et le coût d'hospitalisation dépassant 10 \$, facteur de vulnérabilité pour lequel la solution à court terme est possible.

MOTS-CLEFS: Coût économique, vulnérabilité, Malaria, ménage, Zone de santé, Miti-Murhesa, République Démocratique du Congo.

1 INTRODUCTION

La progression des décès attribuables au paludisme et des chimiorésistances aux antipaludiques contribue à faire du paludisme un problème de santé majeure sur le continent africain et rend la lutte contre cette maladie plus contraignante et plus coûteuse [1] ; [2]. Parmi les principes de la qualité des soins tel que stipulé dans les recommandations de la conférence de Alma Ata en 1978, un accent particulier est mis sur l'accessibilité des soins. Cette accessibilité doit être géographique, socio culturelle mais aussi financière. Une base importante d'informations est aujourd'hui disponible qui soutiennent que des populations en bon état de santé sont des populations productives, et qu'en conséquence, un bon état de santé se traduit en des niveaux de revenus par tête plus élevés. Par contre, un mauvais état de santé, la malnutrition et la forte fécondité sont trois facteurs principaux qui expliquent pourquoi des ménages deviennent ou restent pauvres [3]. Ainsi il s'avère que la bonne santé est un facteur très important dans la production des biens et services pour tout être vivant et particulièrement chez l'homme.

Devant un problème de santé, l'homme est parfois incapable d'appliquer les principes économiques qui régulent la consommation à l'avoir, son souci majeur étant de recouvrer son état naturel d'équilibre à n'importe quel prix. Ce qui souvent l'entraîne dans une situation de consommation plus ou moins égoïste ignorant l'existence d'une planification pour lui garantir un avenir meilleur [4]. En général, environ 70 % de la variation dans les taux de mortalité infantile peut être attribuée à des différences de revenus entre pays et à l'intérieur des pays. Par conséquent, il est clair que l'accès accru des pauvres et d'autres groupes vulnérables à une enveloppe d'interventions sanitaires de base d'un bon rapport coût-efficacité peut améliorer leur état de santé et leur bien-être. En Asie par exemple, la proportion du revenu des ménages dépensée dans le secteur de la santé est typiquement plus élevée chez des groupes à faibles revenus que chez des groupes à revenus plus élevés [5].

A l'échelon individuel, une famille pauvre africaine peut consacrer un quart de son revenu annuel à la prévention et au traitement du paludisme [4]. A la mort et aux souffrances, s'ajoute le poids économique que représente l'achat de moustiquaires, le paiement des honoraires du médecin et des traitements ainsi que le prix du transport jusqu'aux Centres de Santé, souvent à la charge des familles [6]. Malheureusement, la problématique économique du paludisme a souvent été négligée, passée au second plan derrière les questions scientifiques, médicales et sociales soulevées par l'épidémie. La crise économique entraînant la rareté des ressources financières devrait accélérer la prise de conscience par les décideurs de l'impact économique du paludisme sur le développement socioéconomique. Le paludisme affecte la prospérité individuelle et nationale en raison de son poids, de son coût direct et indirect mesurable [1] ; [2]. La lutte pour la maîtrise de l'évolution de l'épidémie de paludisme et à en inverser la tendance, de par ses externalités positives, doit devenir un axe majeur de la stratégie de la réduction de la pauvreté, chaque fois que l'on consacre 500 à 2 000 francs Congolais à une prise en charge efficace d'un épisode de paludisme, la collectivité gagne une année de vie en bonne santé, ce qui fait du traitement du paludisme une activité aussi rentable du point de vue économique que du point de vue de la santé publique [7].

En République Démocratique du Congo, quelques études menées à travers le pays ont décrit les problèmes et les conséquences dues à cette affection. A Kinshasa par exemple, les études menées par le Programme National de Lutte contre le Paludisme (PNLP) ont montré que 86 % des cas reçus à la salle d'urgence pédiatrique de l'Hôpital Général de Kinshasa (HGK) étaient consécutives à une anémie palustre [8]. D'autres études ont révélé que l'enfant congolais de moins de 5 ans faisait en moyenne 8 à 10 épisodes de fièvre palustre par an [9].

Au niveau de la province du Sud-Kivu, le paludisme sévit d'une façon endémique et se range au premier plan de différentes pathologies rencontrées constituant le premier motif de consultation (Rapport IPS, 2011). Plusieurs interventions des partenaires du secteur santé sont en cours dans la province mais la question du gain économique sur les ménages n'a pas encore été abordée.

La population de Miti-Murhesa vit de l'agriculture de subsistance et de petit élevage, qui constituent la ressource principale de près de 70 % de la population. Au niveau de la zone de santé de Miti-Murhesa, les cas du paludisme en général (simple et grave) occupent la première place dans des facteurs liés à la morbidité et à la mortalité par rapport à d'autres pathologies (Rapport Zone de Santé de Miti-Murhesa, 2011). Prenant en compte les données rapportées par le rapport du Système National d'Information Sanitaire [10]; 41036 cas de paludisme simple ont été enregistrés avec 15 décès soit une létalité de 0.036 % sur une population totale estimée à 198223 habitants. Selon ce rapport, le paludisme constitue la première cause des états morbides, d'hospitalisation et la troisième cause de mortalité avec une incidence annuelle de 2070 cas pour 10 000 habitants. Dans la Zone de Santé de Miti-Murhesa, parmi les raisons de la faible fréquentation (évaluée à 53,8% pour l'année 2010) dans certaines structures de soins; figurent la tarification, le recours à la médecine traditionnelle par la population, la faible adhésion des populations à la mutuelle de santé, la faible sensibilisation de la population sur la pratique de la médecine moderne. Audibert [11] souligne que les effets du paludisme ne se limitent pas seulement aux

souffrances physiques ressenties par le malade mais aussi sur le revenu du ménage, la charge de travail du personnel de santé, l'absentéisme scolaire/professionnelle avec une perte de 5 à 20 jours de travail et une réduction de la productivité et des revenus surtout en milieu agricole. S'il s'avère que le paludisme soit le premier motif de consultation dans la zone, la question de son impact économique sur les ménages de Miti Murhesa, qui sont pour la plupart à faible revenu n'est pas encore suffisamment étudiée et par conséquent difficile d'en tirer les leçons pour orienter les interventions contre le paludisme dans la zone.

Cette étude se propose d'évaluer la vulnérabilité économique des ménages au cours d'un épisode du paludisme dans la Zone de Santé de Miti-Murhesa en République Démocratique du Congo.

2 DESCRIPTION DE LA ZONE DE SANTE DE MITI-MURHESA

La Zone de Santé Rurale de MITI-MURHESA est opérationnelle depuis 2005. Elle est située entre $2^{\circ}15'$ - $2^{\circ}30'S$ et $28^{\circ}45'$ - $28^{\circ}85'E$. Elle est limitée au Nord par la Zone de Santé de Katana, au Sud par la Zone de Santé de Kabare, à l'Est par la Zone de Santé de Katana et à l'Ouest par la Zone de Santé de Kalonge (Figure 1).

Elle est issue du découpage de l'ancienne Zone de Santé de KATANA, réalisé en novembre 2003. Elle bénéficie principalement de l'appui des Partenaires (Louvain Développement, AAP : Agence d'Achat de Performance, BDOM : Bureau Diocésaine des Œuvre Médicales, CEPAC : Communauté des Eglises de Pentecôte en Afrique Centrale, CECA : Communauté des Eglises du Christ en Afrique, ASF : Association de Santé Familial, CELPA : Communauté des Eglises Libres Pentecôtiste en Afrique et GIPROCOM). Elle a fonctionné au courant de l'année 2010 avec 19 formations sanitaires dont 1 Hôpital Général de Référence de Kavumu (HGR Kavumu), 1 Centre Hospitalier de Murhesa, l'Hôpital Pédiatrique de Lwiro et 16 Centre de Santé. La population de la Zone de Santé est estimée 198.223 habitants avec une superficie de 522 Km² soit une densité de 359 hab/ Km². L'on note la présence des fonctionnaires de l'état, les pêcheurs artisiaux et les petits commerçants représentant près de 32 %. Le taux d'analphabétisme demeure élevé, surtout chez les femmes où elle avoisine 85 % [12].

L'agriculture de subsistance et le petit élevage jadis considérés comme ressource principale de près de 70% de la population ont connu des ravages importants suite au contexte d'insécurité entraînant une forte paupérisation de la population [13].

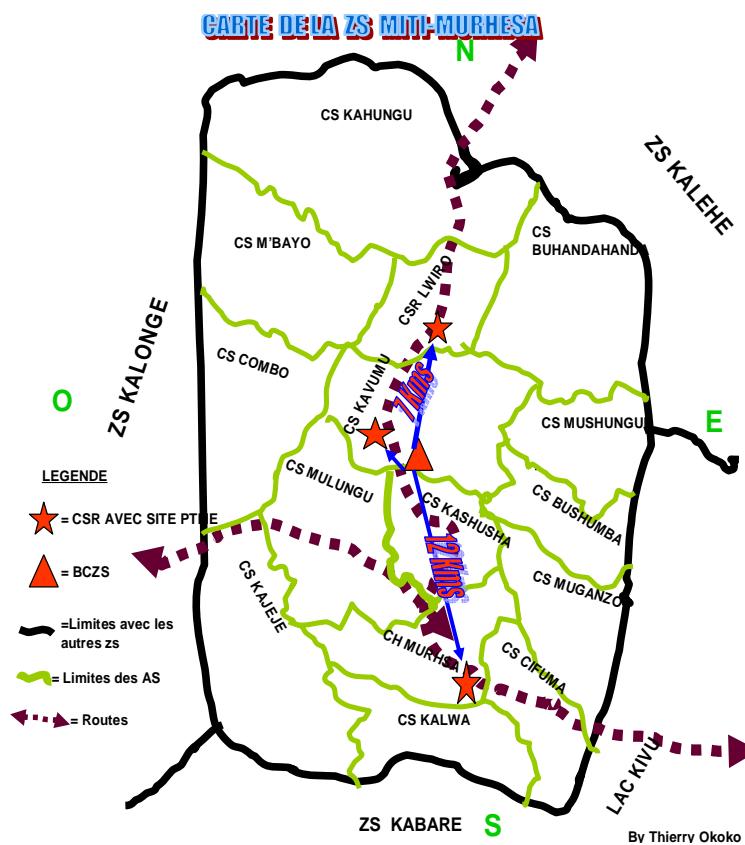


Figure 1. Carte de la Zone de Santé de Miti-Murhesa

3 MATÉRIEL ET MÉTHODES

Une enquête transversale par questionnaire a été réalisée auprès de 492 ménages choisis de manière aléatoire sur la base des données démographiques disponibles des personnes ayant étaient reçus en soins contre la malaria dans la Zone de Santé durant cette période. Cette enquête a été réalisée de Janvier à Décembre 2010 avec deux équipes composées d'un enquêteur et d'un guide dans chaque quartier. Le chef de ménage, à défaut, le ou la conjoint (e) a été l'interlocuteur. Par ailleurs, des entretiens guidés ont eu lieu dans deux Centres de Santé Communautaires (CSC) et aussi avec deux infirmiers privés, deux guérisseurs traditionnels dans chaque quartier et deux pharmaciens à proximité des ménages enquêtés.

L'enquête consistait à estimer les coûts du paludisme et à évaluer la vulnérabilité économique des ménages vis-à-vis du paludisme dans la Zone de Santé de Miti-Murhesa. La méthode d'évaluation de la vulnérabilité économique des ménages développée par Moser [14] et Dubois et Rousseau [15] a été suivie. Elle concerne les coûts directs (frais de consultation, médicaments et frais accessoires) et les coûts indirects (perte de revenu liée à la période d'invalidité). Les dépenses liées au paludisme ont été évaluées par la proportion du revenu consacré aux soins et d'autre part, par le manque à gagner associée à la période d'hospitalisation [16]. Les données collectées ont été codifiées et analysées dans le logiciel Epinfo 6.0. Nous avons calculé le chi carré pour connaître la relation entre les variables dépendantes et indépendantes, alpha= 5%, l'intervalle de confiance à 95% et p est significative si elle est inférieur à 0,05. Pour éliminer le facteur de confusion et obtenir les facteurs clé de la vulnérabilité économique nous avons calculé le odds ratio, l'intervalle de confiance à 95% et elle ne contient pas la valeur 1 pour sa significativité et p sera inférieur à 0,05.

4 RÉSULTATS

Le résultat de l'étude sur la vulnérabilité économique des ménages est un point de départ important dans la réglementation des tarifs des soins. Les caractéristiques socio-économiques des ménages enquêtés durant l'étude sont présentées dans le tableau 1.

Tableau 1. Caractéristiques socio-économiques des ménages de la ZS de Miti-Murhesa (Moyenne ± écart-type)

	Moyenne	± ^δ
Revenu annuel des ménages	316,1	182,2
Montant consommé pour paludisme	78,8	19,2
% revenu consommer pour paludisme	28	4,1

Les résultats présentés dans le tableau ci-dessus montrent que le revenu annuel moyen des ménages est de $316,1 \pm 182,2$ \$ dans la Zone de Santé de Miti-Murhesa. Pour la prise en charge des épisodes palustres, les ménages consomment environ $78,8 \pm 19,2$ par an soit en moyenne 28% de revenu consommé pour le paludisme.

Les résultats de l'analyse unie variée des facteurs de vulnérabilité des ménages vis-à-vis du paludisme dans la Zone de Santé de Miti-Murhesa sont présentés dans le tableau 2.

Tableau 2. Analyse uni variée des facteurs de vulnérabilité des ménages vis-à-vis du paludisme

	Ménage vulnérable	Ménage non vulnérable	OR	IC	P value
Genre responsable du ménage					
Féminin	79	175	2,10	1,34 – 3,29	0,0007
Masculin	42	196			
Coût de l'hospitalisation					
> 10 dollars	192	110	2,09	1,37 – 3,18	0,0004
< 10 dollars	96	94			
Revenu annuel du ménage					
< 370 dollars	231	61	5,91	3,86 – 9,05	0,0000
> 370 dollars	81	119			
Occupation du responsable de ménage					
Sans occupation	100	30	4,61	2,85 – 7,48	0,0000
Avec occupation	152	210			
Nombre des personnes vivant dans un ménage					
> 7 personnes	168	126	3,22	2,16 – 4,81	0,0000
< 7 personnes	58	140			
Autres frais en dehors de la facture demandés par le personnel de santé					
> 2 dollars	98	190	2,07	1,33 – 3,24	0,001
< 2 dollars	41	163			
Coût indirect supporté par le malade / famille lors de l'épisode de paludisme					
> cout direct	192	102	2,55	1,73 – 3,76	0,0000
< cout direct	84	114			
L'itinéraire thérapeutique du malade avant d'atteindre les structures de soin					
Tradi-praticien	188	111	2,03	1,38 – 2,99	0,0002
Soins modernes	88	105			
Adhésion à la mutuelle de santé					
Non adhérent	272	24	1,36	0,70 – 2,62	0,4110
Adhérent	175	21			

Une relation statistiquement significative a été observée entre la vulnérabilité économique du ménage vis-à-vis du paludisme et les variables comme : le ménage qui a une femme comme responsable ($p = 0,001$), le coût d'hospitalisation dépassant 10\$ ($p = 0,0001$), le revenu annuel du ménage inférieur à 370\$ ($p = 0,0000$), le ménage pour lequel le responsable n'a pas d'occupation ($p = 0,0000$), le ménage ayant plus de 7 personnes en son sein : OR 3.70 [(IC : 2,42 – 5,67, $p = 0,0000$), le paiement d'autres frais dépassant 2 \$ en dehors de la facture ($p = 0,0002$), le coût indirect dépassant le coût direct des soins ($p = 0,00000$), le patient ayant fréquenté le tradi-praticien avant d'atteindre les structures de soins ($p = 0,0001$). L'adhésion à la mutuelle par la population de la Zone de Santé de Miti-Murhesa est faible et non significative ($p=0,41$).

Les résultats de l'analyse multi variée des facteurs de vulnérabilité des ménages vis-à-vis du paludisme dans la Zone de Santé de Miti-Murhesa sont repris dans le tableau 3.

Tableau 3. Analyse multi variée des facteurs de vulnérabilité des ménages vis-à-vis du paludisme

	OR	IC	P value
Revenu annuel < 370 \$	28,07	6,30 – 36,31	0,004
Coût d'hospitalisation > 10 \$	12,09	4,22 – 23,08	0,0001
Chef de ménage sans occupation	7,12	3,04 – 10,08	0,0000
Ménage > 7 personnes	5,07	2,13 – 13,09	0,005
Payement autres frais > 2 \$	2,41	1,48 – 3,93	0,0002

Les résultats de l'analyse multi variée indiquent les facteurs de vulnérabilité économique des ménages vis-à-vis du paludisme. Les ménages avec un revenu annuel inférieur à 370 \$ ($p = 0,004$), le coût d'hospitalisation dépassant 10\$ ($p =$

0,0001), un ménage pour lequel le responsable n'a pas d'occupation ($p = 0,0000$), un ménage ayant plus de 7 personnes en son sein ($p = 0,005$) et un ménage ayant payé d'autres frais dépassant 2 \$ en dehors de la facture ($p = 0,0002$) est significative à 95% vis-à-vis du paludisme.

5 DISCUSSION

Ces résultats sont quelque peu en accord avec ceux trouvés par Kouadio *et al.*, [1] dans une étude en Côte d'Ivoire et qui ont montré que le revenu moyen était moins de 1 \$ par personne et par jour (0,66\$), dont 12 à 14% sont consacrés à la prise en charge des épisodes de paludisme. Selon le Programme des Nations Unies pour le Développement, [17], le revenu moyen des ménages dans le pays en développement est de moins de 1\$ par jour et les dépenses consacrées à la prise en charge de paludisme sont de loin supérieures au revenu. Les ménages à faible revenu étant ceux qui dépensent plus pour les soins, le risque de tomber malade est grand à cause des mauvaises conditions de vie.

Notre étude montre une association statistiquement significative entre la vulnérabilité économique du ménage vis à vis du paludisme et le fait que le responsable du ménage soit du sexe féminin. Les ménages ayant une femme comme responsable auraient plus de deux fois de risque d'être vulnérables économiquement vis-à-vis du paludisme que ceux ayant un homme comme chef ($p = 0,001$). Ces résultats sont en accord avec ceux trouvés par Kone [18] qui montraient que les ménages dont le chef est de sexe masculin avaient en moyenne 190 730 F CFA contre 126 063 F CFA pour les ménages dirigés par une femme. Par conséquent la vulnérabilité économique augmentait dans les ménages dirigés par une femme parce qu'elles devraient dépenser beaucoup plus de leur revenu lorsqu'il faut supporter le coût de prise en charge des épisodes de paludisme. Le faible niveau d'éducation et le fait d'être de sexe féminin peuvent être des facteurs de pauvreté, donc avoir des incidents sur la vulnérabilité du ménage face à une hospitalisation dont le coût serait catastrophique pour lui.

Dans la Zone de Santé de Miti-Murhesa, il s'observe de plus en plus des ménages dont le responsable est une femme et dont la plupart ne dispose pas d'emploi rémunérant. Elles sont pour la plupart marginalisées dans la société, et s'occupent plus des activités champêtres. Lorsqu'un membre de son ménage est malade, elle est obligée de dépenser presque tout ce qu'elle a pourvu que la personne retrouve sa santé et ce au détriment des autres dépenses de la maison. Ceci augmente leur vulnérabilité économique vis-à-vis du paludisme. Une association statistiquement significative a été notée entre le coût d'hospitalisation dépassant 10\$ et la vulnérabilité économique du ménage vis-à-vis du paludisme ($p = 0,0001$).

Lorsque le coût d'hospitalisation dépasse 10\$, les ménages ont plus de deux fois de risque d'être vulnérable économiquement que lorsque le coût d'hospitalisation est inférieur à 10\$. Selon Kone [18], près de 70 % des ménages qui ont une facture d'hospitalisation supérieure à leur revenu mensuel sont plus vulnérables économiquement. L'auteur explique ces résultats par le fait que les ménages ayant un revenu faible ont de fortes probabilités d'avoir des problèmes pénibles suite à cette hospitalisation.

Ces résultats s'expliqueraient, dans la Zone de Santé de Miti-Murhesa, par le manque d'une standardisation des prix des soins. L'agence d'achat des performances qui appuie la zone depuis plus de 3 ans, encourage l'autonomie des structures dans la fixation des prix des soins. Ces prix sont de fois fixés sur base d'une estimation ayant pour but d'augmenter les recettes de structures mais sans que des études sur le pouvoir d'achat des populations en donnent des orientations. Cette situation explique en partie la vulnérabilité économique des ménages vis-à-vis du paludisme lorsque les coûts d'hospitalisation sont énormes. Ceci est aussi soutenu par OMS [19] qui souligne que « plus les ménages sont pauvres plus ils sont vulnérables aux dépenses d'hospitalisation et la santé rend le ménage encore plus pauvre».

Le revenu annuel du ménage influence significativement la vulnérabilité économique du ménage ($p = 0,0000$) au seuil de 95 %. Les ménages ayant un revenu annuel de moins de 370 \$ ont environ 7 fois de risque d'être vulnérable économiquement vis-à-vis du paludisme que ceux ayant un revenu annuel de plus de 370 \$. Ces résultats obtenus dans notre étude sont en accord avec ceux obtenus par Soucat *et al.*, [5] dont les résultats confirment une relation significative entre le revenu annuel et la charge liée à la prise en charge du paludisme. Cela s'explique par le fait que les ménages qui ont des possibilités de financer les soins par leurs ressources propres. Par contre, ceux qui n'ont pas assez de possibilité ont tendance à prendre plus de risques, ce qui entraîne des dépenses élevées et augmente leur vulnérabilité. L'adhésion à la mutuelle de santé des populations de la Zone de Santé est faible car les activités de cette structure n'étaient pas assez vulgarisées. Les familles pauvres ne sont guère protégées contre les moustiques dans leurs habitations et elles n'ont peut-être pas les moyens d'acheter des moustiquaires imprégnées d'insecticide.

En Zambie par exemple, dans une enquête réalisée par l'OMS en collaboration avec le Ministère de la santé a établi que la prévalence de l'infection paludéenne était sensiblement plus élevée dans les groupes les plus démunis, les taux de mortalité sont notoirement plus élevés dans les foyers défavorisés et une proportion importante de ces décès était imputable au

paludisme. L'enquête explique la situation par le fait que les personnes démunies courrent davantage le risque d'être infectées et celui d'être infectées plus fréquemment [19].

L'OMS/ l'UNICEF [20] soulignent que la plupart des coûts de prévention et de traitement du paludisme en Afrique de nos jours sont en fait assumés par la population elle-même, qui est obligée d'acheter les moustiquaires, les insecticides, les spirales anti-moustiques et de dépenser des sommes considérables pour le traitement antipaludique.

6 CONCLUSION ET RECOMMANDATIONS

Notre étude de type transversale analytique qui a porté sur les facteurs de vulnérabilité économique des ménages vis-à-vis du paludisme dans la zone de santé de Miti-Murhesa pendant la période de Janvier à Décembre 2010 a connu la participation de 492 sujets. Le ménage vulnérable économiquement étant défini comme celui qui consomme plus de 13 % de son revenu annuel pour la prise en charge des épisodes de paludisme.

Les résultats de l'analyse uni varié montrent une association statistiquement significative entre la vulnérabilité économique des ménages et les facteurs suivants : un ménage qui a une femme comme responsable, le coût d'hospitalisation dépassant 10 \$, un revenu annuel du ménage inférieur à 370 \$, un ménage pour lequel le responsable n'a pas d'occupation, un ménage ayant plus de 7 personnes en son sein, un paiement d'autres frais dépassant 2 \$ en dehors de la facture, un cout indirect dépassant le cout direct des soins, un patient ayant fréquenté le tradi-praticien avant d'atteindre les structures de soins.

L'analyse multi variée montre que le facteur, revenu annuel du ménage inférieur à 370 \$ est le plus indépendant mais sur lequel nous ne disposons pas des solutions à court termes et celui du coût d'hospitalisation dépassant 10 \$, facteur vulnérable pour lequel la solution à court terme est possible.

Ainsi nous recommandons :

Au Ministère provincial de la santé :

- Assurer un plaidoyer pour la mise en place des activités visant l'amélioration du pouvoir d'achat des populations de la zone de santé (agriculture moderne, création des entreprises, distribution des espaces d'agriculture...)
- Faire un plaidoyer auprès des bailleurs de fonds et autres partenaire pour appuyer les activités de lutte contre le paludisme dans la zone de santé de Miti Murhesa.

A l'Inspection provinciale de la santé du Sud Kivu :

- Accompagner de façon rapprochée l'ECZ dans la planification, la mise en œuvre, le suivi et l'évaluation des activités de lutte contre le paludisme dans la zone
- Former l'ECZ dans la réalisation des études sur les effets de coûts de soins dans la zone de santé

A l'Equipe Cadre de la Zone de santé :

- Initier des enquêtes ménage pour adapter la tarification des soins par rapport au pouvoir d'achat des populations
- Assurer le suivi de l'application des tarifs épisode paludisme dans les structures de soins et dans le cas échéant, infliger des sanctions contre les malfaiteurs
- Planifier, mettre en œuvre, suivre et évaluer les activités de sensibilisation des populations sur la pratique de la médecine moderne
- Assurer la collaboration entre les mutuelles de santé et la population pour augmenter le taux d'adhésion

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Prise en charge et coût des soins d'un épisode du paludisme dans la zone de santé de Miti-Murhesa, République Démocratique du Congo

[Taking in charge and cost of malaria treatment in Miti-Murhesa health zone, Democratic Republic of Congo]

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ABSTRACT: Malaria is one of the main of Public Health problems, which threatened the development of poor countries and the wellbeing of the population. It has an important measured direct and not direct cost which restraint the economic development. This work evaluates the cost of taking in charge treatment due to simple malaria in a rural health Zone of Miti-Murhesa, Democratic Republic of Congo. Data collection has been facilitating by an individual questionnaire half-structured administrate to 492 houses hold. Results shown that the medium of malaria episode in the house hold in the Health Zone was of 2 varied between 1 and 4 episodes for percentile 25 and percentile 75 per year. The high direct cost for the taking charge of malaria is the hospitalization with a mean of 10.7 ± 5 \$ followed by consultation (1.7 ± 1.3 \$). But when we evaluate the no direct cost, the others expense which contribute negatively on the income of the family was 11.1 ± 7.6 \$, followed by the transport 2.7 ± 1.8 \$. The economic lost due to an episode of malaria is important for the population in the Health Zone of Miti-Murhesa and need assistance for the charge and the cost of care for the government or others partners working in the Health Zone.

KEYWORDS: Taking in charge, cost of treatment, malaria, Miti-Murhesa Health Zone, Democratic Republic of Congo.

RESUME: Le paludisme est l'un de principaux problèmes de santé publique menaçant le développement des pays les plus pauvres et le bien-être des populations. Il a un important coût direct et indirect mesurable qui entrave sérieusement le développement économique. Ce travail évalue le coût de la prise en charge des soins d'un épisode de paludisme simple dans la population rurale de la Zone de Santé de Miti-Murhesa. La collecte des données a été facilitée par un questionnaire individuel semi-structuré administré à 492 ménages. Les résultats montrent que la médiane d'épisodes de paludisme enregistrés dans les ménages de la Zone de Santé était de 2, variant entre 1 et 4 épisodes au percentile 25 et percentile 75 par an. Le coût direct pour la prise en charge du paludisme le plus élevé est l'hospitalisation avec une moyenne de $10,7 \pm 5$ \$ suivi de celui de la consultation avec une moyenne de $1,7 \pm 1,3$ \$. Par contre, lorsqu'on évalue les coûts indirects, les autres dépenses sont celles qui pèsent sur le revenu de la famille avec une moyenne de $11,1 \pm 7,6$ \$ et celle de transport avec une moyenne de $2,7 \pm 1,8$ \$. Les pertes économiques liées à un épisode du paludisme sont d'autant plus importantes pour la population de la Zone Santé de Miti-Murhesa et nécessitent une assistance de la prise en charge et coût de soins de la part du gouvernement et des partenaires œuvrant dans la Zone Santé.

MOTS-CLEFS: Prise en charge, coût des soins, paludisme, Zone de Santé, Miti-Murhesa, République Démocratique du Congo.

1 INTRODUCTION

Le paludisme est l'un de principaux problèmes de santé publique menaçant le développement des pays les plus pauvres et le bien-être des populations [1] ; [2]. L'Afrique est la plus concernée en ce sens que l'immense majorité (90%) des décès dus au paludisme y survient [3] ; [4]. Dans cette partie du continent, on reconnaît aujourd'hui que, le paludisme est à la fois une maladie due à la pauvreté et une cause de pauvreté [2]. Il contribue au processus d'épuisement des capitaux des ménages et de perte de revenu et fait donc baisser la consommation de ceux-ci [5] ; [6].

Le paludisme est à l'origine de 25 à 35% des consultations en ambulatoires dans les pays d'endémie, de 20 à 45% des hospitalisations et de 15 à 35 % des décès à l'hôpital, faisant ainsi peser une lourde charge sur des systèmes de santé déjà fragiles [7] ; [8]. En Afrique aujourd'hui, on reconnaît que le paludisme a un important coût direct et indirect mesurable et il entrave sérieusement le développement économique. Le coût direct du paludisme recouvre les dépenses individuelles et publiques pour la prévention et le traitement de la maladie. Les dépenses individuelles incluent les moustiquaires imprégnées d'insecticide, les honoraires médicaux, les antipaludiques, le transport jusqu'aux services de santé, et le soutien au malade et parfois à un membre de la famille qui l'accompagne pendant son hospitalisation. Le coût indirect du paludisme inclut la perte de productivité ou de revenu associée à la maladie ou au décès. Il peut s'exprimer en termes de coût des journées de travail perdues ou de l'absentéisme et de valeur du travail non rémunéré accompli à domicile par les hommes et par les femmes. En cas de décès, le coût indirect comprend le revenu futur escompté du défunt. Le coût indirect s'exprime aussi en termes de risque de dissuader les investisseurs, nationaux ou étrangers, et affecter les décisions personnelles ou familiales de nombreuses façons ayant des effets négatifs sur la productivité et la croissance économiques [9].

Les économistes attribuent au paludisme un déficit de croissance annuel pouvant atteindre 1,3% dans certains pays d'Afrique. Au fil des années, l'écart se creuse entre le Produit Intérieur Brut (PIB) des pays selon qu'ils sont touchés ou non par le paludisme et c'est la croissance économique de toute la région qui est pénalisée [3]. Dans certains pays fortement impaludés, les dépenses peuvent représenter jusqu'à 40% des dépenses de santé publique, 30-50% des admissions hospitalières et jusqu'à 50% des consultations externes.

Les considérations générales sur les coûts alloués à la prise en charge du paludisme dans le monde, renseignent que ces derniers constituent un véritable problème macro et micro-économique dont l'impact négatif sur les familles pauvres n'est plus à démontrer dans les pays en voie de développement. Le paludisme contribue au processus d'épuisement des capitaux des ménages et de perte de revenu et fait donc baisser la consommation de ceux-ci [10]. Dans ces pays, les coûts directs du paludisme en rapport avec les soins, la prévision et les médicaments sont ressentis par la population, les pouvoirs publics, les entreprises privées et les organisations non gouvernementales.

Le coût total de la stratégie mondiale de la prise en charge du paludisme est estimé à une moyenne de 5,9 milliards de \$US par an de 2011 à 2020 et la mise en œuvre dans les pays a coûté environ 5,3 milliards de \$US en 2009, 6,2 milliards en 2010 et en moyenne 5,1 milliards de \$US par an de 2011 à 2020. La Recherche et le développement coûteront environ 750 à 900 millions de \$US par an jusqu'en 2018 pour développer de nouveaux outils (lutte anti vectorielle, médicaments, vaccins et techniques de diagnostic) [11]. Sur le plan continental, le coût économique et social du paludisme est considérable ; les pertes annuelles liées à cette maladie sont estimées à 12 milliards de dollars. C'est la conséquence de l'effet cumulatif sur trente-cinq ans, le PIB des pays africains est aujourd'hui inférieur de 32% à ce qu'il aurait été sans le paludisme [12].

En République Démocratique Congo, le paludisme figure parmi les principales causes de morbidité et de mortalité surtout chez les enfants de moins de 5 ans. En effet, plusieurs études menées à travers le pays ont décrit les problèmes et les conséquences dues à cette affection. A Kinshasa, les études menées par le Programme National de Lutte contre le Paludisme (PNLP) ont montré que 86% des cas reçus à la salle d'urgence pédiatrique de l'Hôpital Général de Kinshasa (HGK) étaient consécutives à une anémie palustre [13]. D'autres études ont révélé que l'enfant congolais de moins de 5 ans faisait en moyenne 8 à 10 épisodes de fièvre palustre par an [14].

Selon les études réalisées par le PNLM [13], le coût des soins d'un épisode de paludisme simple chez les enfants de moins de 5 ans supporté par les patients (malades) est plus élevé dans les Zones de Santé rurales. Cela est dû au fait que la population de ces Zones de Santé possède un revenu faible comparativement au cout de soins de santé. Cette situation est à la base des complications d'une prise en charge incorrecte des malades, qui du reste est à la base de près de 60% des cas de morbidité et de mortalité de cette tranche d'âge [15] ; [16] ; [6]. La politique sanitaire de la République Démocratique du Congo recommande aux structures des soins de respecter les échelons pour la prise en charge du paludisme. En effet, pour le cas de paludisme simple, le patient doit nécessairement commencer son traitement au Centre de Santé (1^{er} échelon). Une fois que la maladie se complique (paludisme grave), il est transféré au niveau du centre hospitalier ou au centre de santé de référence (2^{ème} échelon), ou encore au niveau de l'hôpital général de référence (3^{ème} échelon). La situation socio-

économique que traverse le pays ne permet pas aux congolais d'être en mesure de payer le coût des soins tel que facturé par les structures des soins pour une prise en charge correcte du paludisme.

Le paludisme, bien qu'il soit un problème majeur de santé et de développement, a bénéficié de peu de recherches consacrées à la relation entre son incidence, le statut socioéconomique et la vulnérabilité des ménages. En effet, selon l'OMS/UNICEF [17], les personnes démunies courrent davantage le risque d'être infectées fréquemment. Les taux de mortalité sont notamment plus élevés dans les foyers défavorisés et une proportion importante de décès est imputable au paludisme. Pourtant, en République Démocratique du Congo, peu d'études analysent le lien direct entre paludisme et pauvreté économique des ménages. Dans la Zone de Santé de Miti-Murhesa, les risques de la maladie sont plus importants chez les ménages démunis qui sont par ailleurs les plus exposés à la contraction de la maladie [18]. C'est dans ce cadre que ce travail évalue le coût de la prise en charge des soins d'un épisode de paludisme dans la population rurale de la Zone de Santé de Miti-Murhesa, République Démocratique du Congo en vue de déceler les raisons de la différence des coûts.

2 MATERIEL ET METHODES

2.1 DESCRIPTION DE LA ZONE DE SANTE DE MITI-MURHESA

La Zone de Santé Rurale de Miti-Murhesa est opérationnelle depuis 2005. Elle est située entre $2^{\circ}15'$ - $2^{\circ}30'S$ et $28^{\circ}45'$ - $28^{\circ}85'E$. Elle est limitée au Nord par la Zone de Santé de Katana, au Sud par la Zone de Santé de Kabare, à l'Est par la Zone de Santé de Katana et à l'Ouest par la Zone de Santé de Kalonge (Figure 1).

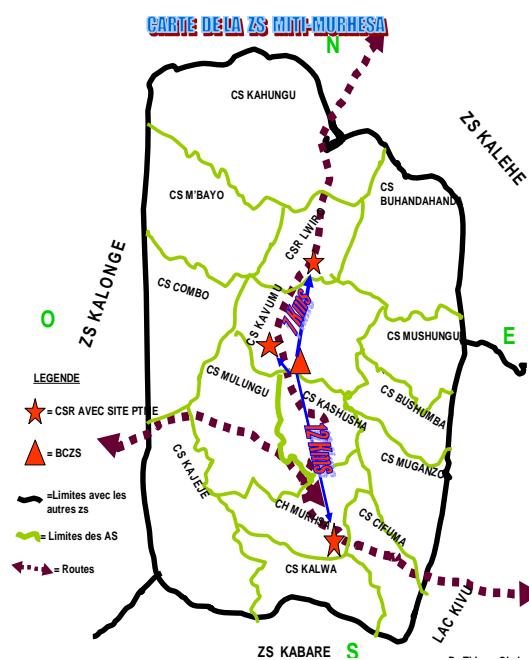


Figure 1. Carte de la Zone de Santé de Miti-Murhesa.

Elle est issue du découpage de l'ancienne Zone de Santé de Katana, réalisé en novembre 2003. Elle bénéficie principalement de l'appui des Partenaires (Louvain Développement, AAP : Agence d'Achat de Performance, BDOM : Bureau Diocésaine des Œuvres Médicales, CEPAC : Communauté des Eglises de Pentecôte en Afrique Centrale, CECA : Communauté des Eglises du Christ en Afrique, ASF : Association de Santé Familial, CELPA : Communauté des Eglises Libres Pentecôtiste en Afrique et GIPROCOM [18]). Elle a fonctionné au cours de l'année 2010 avec 19 formations sanitaires dont 1 Hôpital Général de Référence de Kavumu (HGR Kavumu), 1 Centre Hospitalier de Murhesa, l'Hôpital Pédiatrique de Lwiro et 16 Centres de Santé. La population de la Zone de Santé est estimée 198.223 habitants avec une superficie de 522 Km² soit une densité de 359 hab/ Km². L'on note la présence des fonctionnaires de l'état, les pêcheurs artisiaux et les petits commerçants représentant près de 32 %. Le taux d'analphabétisme demeure élevé, surtout chez les femmes où elle avoisine 85 % (Rapport annuel de la Zone de Santé de Miti-Murhesa, 2010). L'agriculture de subsistance et le petit élevage jadis

considérés comme ressource principale de près de 70% de la population ont connu des ravages importants suite au contexte d'insécurité entraînant une forte paupérisation de la population [19].

2.2 ENQUETE DANS LA POPULATION

La population d'étude est constituée des personnes qui ont souffert du paludisme durant la période d'étude (Janvier – Décembre 2010) et qui ont consulté les services de santé et disposant d'une adresse précise dans la Zone de Santé. L'échantillon était reconstitué au moyen des adresses indiquées dans le registre de consultation /hospitalisation. La taille de l'échantillon a été calculée en utilisant la formule de Schwartz [20] avec une prévalence de 50 % et qui avait un nombre minimale de 384 ménages à visiter car une marge d'environ 30 % a été respecté pour d'éventuels cas qui ne seraient pas retrouvés [3]. Une enquête transversale par questionnaire a été réalisée auprès de 492 cas. La technique d'échantillonnage est probabiliste utilisant l'échantillonnage en grappe. Les sujets ont été répartis en grappes qui sont constitués des villages des Aires de Santé de la Zone Santé. Le nombre des sujets interrogés dans chaque village était proportionnel au nombre des malades enregistrés [10].

Les enquêteurs ont été recrutés sur base de leurs expériences antérieures en matière d'enquêtes dans la communauté. Une formation leur a permis de maîtriser les techniques de communication et le remplissage correct du questionnaire. En plus de la formation, un pré-test a été fait et a permis de standardiser l'outil de collecte des données. Les sujets ont été contactés à leur domicile en dehors des heures de travail entre 16 heures et 18 heures.

Les questions de l'enquête portaient sur : le coût de prise en charge du paludisme (direct et indirect), le coût d'hospitalisation, la taille du ménage, le sexe du responsable de ménage, les autres coûts demandés en dehors de la facture des soins, la profession du chef de ménage, le recours aux soins traditionnels avant les soins modernes, le nombre d'épisodes de paludisme par an enregistré dans la famille par personne, le fait qu'une partie du coût des soins est supportée par la Mutuelle de Santé (MUSA) et le revenu annuel du ménage.

Les tests statistiques ont été effectués à l'aide du logiciel d'analyse statistique Epi Info 6.0, le seuil de signification étant fixé à 0,05.

3 RESULTATS ET DISCUSSION

Le paludisme est parmi les premières causes de mortalité pour les enfants de moins de 5 ans. Les conséquences sociales et économiques sont également très lourdes pour les populations des pays les plus pauvres (OMS, 2005). Le défi actuel est d'assurer que les mesures de prévention et de prise en charge (diagnostic et traitements efficaces) soient accessibles aux populations qui en ont besoin [11]. La couverture de ces besoins est en effet essentielle afin d'agir sur la mortalité et la morbidité. Les résultats des caractéristiques sociodémographiques des ménages de la Zone de santé de Miti-Murhesa sont présentés dans le tableau 1.

Tableau 1. Caractéristiques Sociodémographiques des ménages de la Zone de Santé de Miti-Murhesa, (Janvier – Décembre 2010).

	Effectif	%
Occupation des chefs des ménages de la Zone de Santé de Miti Murhesa		
Sans emploi	48	9,8
Agriculture/ Pêche	318	64,6
Débrouillard privé	27	5,5
Employé	65	13,2
Commerçant	34	6,9
Instruction des chefs des ménages		
≤ niveau primaire	414	84,2
≥ niveau secondaire	78	15,8
Composition des ménages		
Ménage avec ≤ 7 personnes	178	36,2
Ménage avec > 7 personnes	314	63,8
Statut matrimonial des responsables des Ménages		
Ménages vivant en couple	426	87,6
Ménages ne vivant pas en couple	66	13,4

Les résultats présentés dans le tableau ci-dessus montrent qu'environ 65% de chef des ménages ont comme activité principale l'agriculture et 13% vivent du commerce avec un niveau d'instruction inférieur ou égal au niveau primaire (84,2%). Les ménages vivant avec plus de 7 personnes sont les plus représentés (63,8%) par rapport à ceux ayant moins de 7 personnes (37,2%). Les ménages vivant en couple sont 87,6%.

OMS/UNICEF [17] soulignent dans un rapport sur le paludisme en Afrique que la plupart des coûts de prévention et de traitement du paludisme en Afrique de nos jours sont en fait assumés par la population elle-même, qui est obligée d'acheter les moustiquaires, les insecticides, les spirales anti-moustiques et de dépenser des sommes considérables pour le traitement antipaludique [3]. Ce qui contribue sans doute à la pauvreté ambiante. Et recommande en priorité augmenter la rentabilité des dépenses directes des ménages, ce qui peut être réalisé si l'Etat appuie les interventions de lutte contre le paludisme et adopte une réglementation appropriée pour assurer que seuls des moyens sûrs et efficaces sont vendus et que le public est dûment informé de la manière de les utiliser et de leur efficacité.

Dans la zone de santé de Miti-Murhesa, le revenu des populations n'échappe guerre à celle de l'ensemble de la province et du pays. La grande part de la population ne vit que de l'agriculture (environ 65% sujets interrogés). L'agriculture elle-même moins payante à cause sans doute des problèmes d'accès aux terres, des difficultés d'évacuation, tracasseries administratives, l'infertilité du sol, une main d'œuvre insuffisante [3]. En présence d'un cas de paludisme, les ménages sont obligés de dépenser plus que leur revenu, de recourir aux dettes au détriment des autres dépenses familiales, ce qui augmente leur vulnérabilité économique. Ceci a été aussi observé ailleurs dans d'autres structures sanitaires [3] qui ont montré qu'il existait une différence statistiquement significative entre les tailles des ménages et le niveau de vie (très pauvre, pauvre contre non pauvre). L'étude constate que plus le niveau de vie est élevé, plus faible est la taille du ménage. La vulnérabilité augmente en présence de la maladie lorsque la taille du ménage est grande. Dans la zone de santé de Miti-Murhesa, environ 64% des ménages ont plus de sept personnes sous leur toit. Ces résultats s'expliqueraient par la faible utilisation des méthodes de planification familiale par les couples.

Les caractéristiques épidémiologiques dans les ménages de la Zone de Santé de Miti-Murhesa sont compilées dans le tableau 2.

Tableau 2. Caractéristiques épidémiologiques (paludisme déclaré) dans les ménages de la Zone de Santé de Miti-Murhesa

	Effectif	%	Mediane ± δ
Episodes enregistrés / an			
≤ 4	84	17,1	
5 – 10	392	79,7	
11 – 15	11	2,1	
≥ 16	5	1,1	
Total	492		3,2 ± 2,8

L'épisode de 5 – 10 /an est très fréquent (79,7 %) tandis que l'épisode le moins fréquent est celui de ≥ 16 /an (1,1 %). La moyenne d'épisode de paludisme enregistré par an pour les ménages de la zone de santé de Miti-Murhesa est de $3,2 \pm 2,8$. Ces résultats montrent que la médiane d'épisodes de paludisme enregistrés dans les ménages de la Zone de Santé était de 2, variant entre 1 et 4 épisodes au percentile 25 et percentile 75. Les conditions d'insalubrité dans la zone ainsi que l'insuffisance de sensibilisation des populations sur les mesures hygiéniques sont en grande partie des facteurs influençant cette situation. Cette idée est partagée par les résultats de MICS [22] qui souligne que l'amélioration de la salubrité et des installations sanitaires améliorées peuvent réduire de plus d'un tiers les maladies et réduire considérablement les effets négatifs d'autres troubles qui sont responsables des décès et des maladies chez des millions d'enfants des pays en développement. Ces résultats s'approchent de ceux trouvés par Kouadio *et al.*, [3] qui souligne que la moyenne d'épisode du paludisme enregistrés était de 3. L'auteur explique les résultats par les conditions d'insalubrité précaires, la quasi absence des mesures de lutte anti vectorielle mises en place par les autorités tant sanitaires que politiques.

Le coût direct, indirect et le coût d'opportunité de prise en charge de paludisme supporté par les ménages de la Zone de Santé de Miti Murhesa sont présentés dans le tableau ci-dessous.

Tableau 3. Coût de prise en charge de paludisme supporté par les ménages de la Zone de Santé de Miti-Murhesa (moyenne ± écart-type)

	Moyenne en \$	± δ
Coût direct		
Consultation	1,7	1,3
Médicaments	1,2	1,1
Hospitalisation	10,7	5
Traitements	1,1	0,9
Coût indirect		
Transport	2,7	1,8
Alimentation	1,6	1,1
Autres dépenses*	11,1	7,6
Coût d'opportunité		
Jour de travail perdu – Malade	2,9	1,8
Jour de travail perdu - Garde	2,6	1,5

*Autres dépenses : transport du garde malade, communication et le pourboire du personnel soignant

Si l'on évalue le coût direct pour la prise en charge du paludisme, celui de l'hospitalisation est le plus élevé avec une moyenne de $10,7 \pm 5$ \$ suivi de celui de la consultation avec une moyenne de $1,7 \pm 1,3$ \$. Par contre, lorsqu'on évalue les coûts indirects, les autres dépenses sont celles qui pèsent sur le revenu de la famille avec une moyenne de $11,1 \pm 7,6$ \$, suivi de celle de transport avec une moyenne de $2,7 \pm 1,8$ \$. Ces résultats sont semblables à ceux trouvés dans d'autres aires d'étude comme en Côte d'Ivoire [3] et dans autres pays [23] ; [5]. En effet, la différence entre les coûts du paludisme peut être due à la définition et les méthodes utilisées pour le calcul de ces coûts [5]. Les résultats de Russell ne précisent pas les éléments pris en compte dans le calcul des coûts directs notamment les coûts médicaux (consultation, hospitalisation, médicaments), les coûts non médicaux ont concernés le transport et les dépenses alimentaires sur les lieux des soins. Pour Abdel-Hameed *et al.*, [24], les coûts varient selon le type de traitement, type de fournisseur et de la sécurité sociale.

Dans la Zone de Santé de Miti-Murhesa comme d'ailleurs dans toute la province, se pose des problèmes de transport des malades (surtout en saison de pluie) et de restauration, ce qui augmente les coûts indirects. Les malades décident de fréquenter les structures de soins que lorsque la maladie s'est aggravée ; ils sont obligés de parcourir des distances moyennant le paiement d'un taxi avant d'atteindre la structure. D'autres mobilisent les gens du quartier en utilisant le moyen de bord pour le transport des malades. Environ 3 jours en moyenne sont perdus par le malade et 2,6 pour le garde malade lors qu'un épisode de paludisme se déclare dans le ménage, ce qui fait environ 6 \$ perdus (dont 3\$ pour le malade et 3\$ pour le garde malade) par épisode déclaré de paludisme. C'est ainsi que dans la zone de santé de Miti-Murhesa, les populations sont rattachées à la médecine traditionnelle depuis plus d'un siècle, c'est le cas avec la doctrine des Bantous. Il se pose encore avec accuité deux autres problèmes, celui de la sensibilisation des populations sur l'importance de fréquenter les services de santé en cas de maladie et celui du revenu des ménages. A la situation du revenu déjà fragile, ajoutée au manque des stratégies de sensibilisation des populations par les prestataires obligent les malades à fréquenter d'abord les tradi-praticiens au détriment des services de santé.

Bien qu'elle accuse des limites, les résultats de l'étude ne sont pas à mettre en cause dans la mesure où ils donnent des orientations non négligeables sur les facteurs qui augmenteraient la vulnérabilité économique des ménages dans la Zone de Santé de Miti-Murhesa, ce qui est un point de départ important dans la réglementation des tarifs des soins mais aussi un plaidoyer pour appuyer le programme dans la Zone de Santé.

4 CONCLUSION ET RECOMMANDATIONS

La prise en charge et le coût de soins dans un épisode du paludisme sont d'importants facteurs de développement dans les ménages de la Zone de Santé de Miti-Murhesa où la population est au départ pauvre. Ces résultats montrent que la médiane d'épisodes de paludisme enregistrés dans les ménages de la Zone de Santé était de 2. Parmi le coût direct pour la prise en charge du paludisme, l'hospitalisation est le plus élevé suivi de celui de la consultation. Par contre, lorsqu'on évalue les coûts indirects, les autres dépenses (transport du garde malade, communication et le pourboire du personnel soignant) sont ceux qui pèsent sur le revenu de la famille suivi de celui de transport. Le coût direct pour la prise en charge du paludisme le plus élevé est l'hospitalisation avec une moyenne de $10,7 \pm 5$ \$ suivi de celui de la consultation avec une

moyenne de $1,7 \pm 1,3$ \$. Par contre, lorsqu'on évalue les coûts indirects, les autres dépenses sont celles qui pèsent sur le revenu de la famille avec une moyenne de $11,1 \pm 7,6$ \$ et celle de transport avec une moyenne de $2,7 \pm 1,8$.

Nous recommandons d'encourager toute action visant une protection durable des plus pauvres contre les maladies en général et les paludisme en particulier qui devra s'appuyer sur le renforcement des dotations en capital des ménages à travers par exemple un appui aux associations de développement à la mutuelle de santé.

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Corruption and Economic Growth: Empirical Evidence from Algeria

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ABSTRACT: This study investigates the impact of corruption on economic growth in Algeria over the period 1995-2011 by using the Heritage Foundation's freedom from corruption index and the World Bank's control of corruption indicator. The Johansen cointegration test has been applied in order to investigate the existence of long-run relationships among the tested variables. As well as, the vector error correction model (VECM) has been employed to analyze the long-run and short-run dynamic relationships among the various time series. The initial findings indicate that both 'freedom from corruption' and 'control of corruption' have long run positive effects on enhancing economic growth in Algeria. It is also revealed that the human capital has an insignificant positive impact on economic growth in the long term. Moreover, VECM analysis suggests that all explanatory variables have positive and insignificant short-run effects on promoting economic growth except the 'control of corruption' indicator. These results support the view that corruption sands the wheels of economic growth. Thus, the Algerian government should root out this scourge by finding the relevant solutions that must be supported with effective weapons such as transparency and tougher accountability standards.

KEYWORDS: Corruption, Freedom from Corruption, Control of Corruption, Economic Growth, Algeria, Johansen Cointegration Test, VECM.

1 INTRODUCTION

Corruption is a widespread scourge in the past, present and future, in Third World and Western societies, it threatens economic growth and country's economic and political stability, this phenomenon has received much attention of international organizations, economists and politicians who focused on investigating its causes and consequences, as well as the implementation of the proposed solutions.

There is broad consensus that corruption is considered as a deadly disease which destroys the economic tissue cells. Further, it is more prevalent in natural resource-rich countries (especially those dependent on oil manna).

Corruption is a global problem that has been triggered by many structural and institutional factors such as the nature of the political system, the sociocultural background, low salaries, low risk of detection and punishment (Xiaobo Lu, 2000; Quah, Jon S.T, 2002) ([1], [2]). Moreover, it exacts many economic and social costs, and distorts the composition of government spending at the expense of health and education sectors, it also steers resources allocation towards unproductive direction, further, it discourages the entry of FDI, and thus harms economic growth (Vito Tanzi 2002, Ali M. Kutan, Thomas J. Douglas, William Q. Judge, 2009; Ebben & Albert de Vaal, 2011) ([3], [4], [5]). On the other hand, corruption can be considered as the oil that greases the economic growth engine (Emmanuel Anoruo and Habtu Braha, 2005) [6], but it is broadly perceived that its disadvantages far outweigh its advantages.

Algeria is one of the developing countries that are well endowed with natural resources. Hence, the Algerian economy is largely dependent on oil and gas sector, where corruption could find a place especially with rising rent seeking activities. Therefore, this scourge has a role to play in frustrating economic growth, especially that Algeria has been scored very low in terms of corruption by many international organizations such as: Transparency International, World Bank and Heritage

Foundation. Thus, this paper investigates the impact of corruption on economic growth in Algeria over the period (1995-2011). For this purpose, the remainder of this paper is organized as follows:

Section 2 presents a review of the theoretical and empirical evidence on the relationship between corruption and economic growth, section 3 describes and discusses corruption and economic growth in Algeria, section 4 introduces the data and econometric model, then section 5 analyzes the empirical results and finally section 6 concludes the paper.

2 THEORETICAL AND EMPIRICAL EVIDENCE ON THE RELATIONSHIP BETWEEN CORRUPTION AND ECONOMIC GROWTH

The impact of corruption on economic growth has occupied the attention of researchers especially in last decades. In fact, corruption is a serious institutional vacuum, based on North's (1990) [7] well-known definition: institutions are "the rules of the game in a society or, more formally, the humanly devised constraints that shape human interaction".

Corruption has been defined in many different ways and the commonly used definitions of corruption in the literature are as follows:

Joseph Nye (1967) defined corruption as "the behavior which deviates from the formal duties of a public role because of private-regarding (personal, close family, private clique) pecuniary or status gains; or violates rules against the exercise of certain types of private-regarding influence" [8].

The World Bank (1997) defined corruption as "the abuse of public office for private gain" [9].

Transparency International has defined corruption as "the abuse of entrusted power for private gain" [10].

Several global organizations have focused on corruption measurement for quantizing its effects on the whole economy. The more recent survey-based measures of corruption are as follow:

- ***Transparency International's Corruption Perceptions Index (CPI):***

Transparency International (2012) defined the circumstances in which corruption occurs, as follows: "When politicians put their own interests above those of the public, when officials demand money and favours from citizens for services that should be free" [11].

Corruption Perceptions Index ranks countries according to the level of corruption in the public sector, and this ranking is based on experts' opinions. Before 2012 the CPI scored countries on a scale from 0 (highly corrupt) to 10 (very clean), but since 2012 all countries have been scored on a scale from 0 (highly corrupt) to 100 (very clean).

- ***World Bank's Control of Corruption Indicator (CC) :***

Kaufmann, Daniel, Aart Kraay and Massimo Mastruzzi (2008) introduced the Control of Corruption Indicator which indicates to "the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests" [12]. This index is scaled between -2.5 and +2.5, where a higher score means better control of corruption.

- ***Heritage Foundation's Freedom From Corruption Index (FFC) :***

In 1995, Heritage Foundation and Wall Street Journal introduced the Index of Freedom from Corruption, which one of the ten components of the Economic Freedom Index. Heritage Foundation (2013) defined corruption as "the failure of integrity in the economic system, a distortion by which individuals or special-interest groups are able to gain at the expense of the whole" [13]. Moreover, this foundation asserts that the size of government intervention in economic activity is closely linked with the level of corruption, because the excessive regulations and restrictions induce paying bribes, smuggling activities, and engaging in the informal sector. In general, the Freedom from Corruption Index reflects the level of corruption in the business climate, and it is scored on a scale of 0 (highly corrupt) to 100 (highly clean); the higher the level of corruption, the lower the level of Freedom from Corruption Index.

Corruption has highly damaging qualitative effects for example, it drives resources into unproductive ways; generally, it is associated with large public spending and low quality of public infrastructure. Also, it reduces the state's ability to exercise control and correct the market distortions, in addition to inducing political instability and violence (Ali M. Kutan, Thomas J. Douglas, William Q. Judge, 2009) [14]. Additionally, corruption creates uncertainty and reduces productivity, and thus harms economic growth (Ebben & Albert de Vaal, 2009) [15].

Vito Tanzi (2002) [16] indicated that corruption distorts fiscal policy by reducing public revenue and rising government spending and hence hinders government efforts to embark on the necessary fiscal adjustments for boosting the long-run growth potential. As well as, it further deepens the poverty gap by decreasing the average income of the poor, and thus pulling down the growth prospects. Furthermore, corrupt practices mislead the state's focus and force it to concentrate on eliminating corrupt bodies instead of finding effective solutions aimed at stimulating economic activity.

Pak Hung Mo (2001) [17] stated that corruption has a negative spillover effect on innovative activities and it steers talented people towards rent-seeking activities rather than productive business. In other words, individuals seek positions of bureaucratic authority in order to reap more benefits through corruption. However, in the presence of corrupt behavior, natural-resource rents could be used for private gain instead of exploiting them in human capital accumulation, productivity or even innovation.

McMillan, Margaret and Dani Rodrik (2011) [18] pointed out that rent-seeking activities reduce the potential for structural change aimed at maximizing productivity, because the natural resources abundance especially oil does not provide many job opportunities unlike manufacturing industries and associated services. In other words, corruption leads to a structural change which does not fit with the target of enhancing economic growth.

Corruption alters the composition of public spending and raises the public projects that are considered as a loophole for this scourge's entrance, or rather a hotbed of corruption. As well as, it encourages tax evasion and thus a limited number of companies and individuals will bear the tax burden. Furthermore, corruption leads to lower quality of public goods and services (Sergio Díaz-Briquets, Jorge Pérez-López, 2006) [19], it also reduces the share of health and education expenditures in total government spending, and thus erodes the human capital (Erwin Tiongson, Hamid Reza Davoodi, Sanjeev Gupta, 2000) [20].

In general, corruption results from government intervention in the economy (Isaac Ehrlich, Francis T. Lui, 1999) [21]. A high level of corruption is often associated with a lack of democratization and low levels of economic freedom, thereby it destroys the investment climate and discourages foreign investors (Claire Wallace, Christian W. Haerpfer, 2000) [22].

Corruption is deemed a form of taxation; it not only reduces FDI inflows but also changes the type of inward FDI. It also raises the cost of starting and doing business in the host country, because foreign investors may not know the unwritten rules, in this way, corruption can impede economic growth (John H. Dunning and Serianna M .Lundan, 2008) [23].

On the other hand, Corruption helps in providing fast and efficient public services and it is useful to gain time, for example: public service agents can reduce restrictions that hamper economic activity, when they receive bribes (Mushfiq us Swaleheen and Dean Stansel, 2007) [24]. Therefore, corruption is considered as the oil that greases the economic growth engine (Emmanuel Anoruo and Habtu Braha, 2005) [25]. But in general, the growth effects of corruption largely depend on institutional quality (Toke S. Aidt, 2009) [26].

The quantitative impact of corruption on economic growth has been a subject of intense debate over the past two decades; numerous studies have produced conflicting results: some of them suggest that corruption is highly and negatively correlated with economic growth, these studies are as follows:

Moe Farida and Fredoun Z. Ahmadi-Esfahani (2008) [27] studied the effect of corruption on economic growth in Lebanon between 1985-2005 by using the ordinary least squares (OLS) estimates , the main results indicated that corruption adversely affect economic growth by decreasing productivity, also indirectly by restricting investment. Similarly, Balamoune-Lutz, Mina and Ndikumana, Léonce (2008) [28] employed the GMM estimation technique in a panel framework for testing the impact of corruption on economic growth through public and private investment channels in a sample of 33 African countries from 1982 to 2001. Findings suggested that corruption hampers economic growth directly by affecting public investment, especially when bureaucrats exploit the public spending for their own narrow ends.

As well as, A.Cooper Drury, Jonathan Krieckhaus and Michael Lusztig (2006) [29] investigated the growth effect of corruption in a sample of 100 countries between 1982 and 1997 by using the panel data analysis. Their study revealed that corruption exhibits an insignificant negative effect on economic growth. Furthermore, Alfredo Del Monte and Erasmo Papagni (2001) [30] explored the influence of corruption on economic growth through public expenditures channel by implementing a dynamic panel data approach for 20 regions in Italy during the period 1963-1991. They found that corruption has a significant and negative impact on growth, because corruption can change the composition of the government spending when corrupt decision-makers prefer non-productive activities.

In contrast, others support the positive impact of corruption on economic growth for example: Jac C. Heckelman, Benjamin Powell (2008) [31] examined the effect of corruption on economic growth in a set of 83 nations from 1995 to 2005 by using the ordinary least squares with a panel analysis, they found that corruption positively affects economic growth when economic freedom stays in low levels and vice versa. Mushfiq us Swaleheen and Dean Stansel (2007) [32] studied the impact of corruption on economic growth in 60 countries from 1995 to 2004 by using the ordinary least square (OLS); the results indicated that there is a positive and insignificant relationship between corruption and GDP growth rates.

Justifying this point of view, Boris Podobnik, Jia Shao, Djuro Njavro, Plamen Ch. Ivanov and H.E. Stanley (2008) [33] argued that there exists a positive relationship between corruption and economic growth over the period (1999 -2004) by using panel data analysis for all countries in the world.

In addition, Fabio Méndez , Facundo Sepúlveda (2006) [34] studied the dependence of growth rates on changes in corruption level by using the fixed effects regression for a large sample of countries from 1960 to 2000; the empirical results revealed that corruption displays a positive impact on growth.

The purpose of this study is to investigate the impact of corruption on economic growth in Algeria, depending on the assumptions derived from the above-mentioned theoretical and empirical studies, these hypotheses are as follows:

Hypothesis 1: High level of corruption impedes economic growth in Algeria.

Hypothesis 2: High scores of both 'Control of Corruption' and 'Freedom from Corruption' have a positive impact on economic growth in Algeria.

3 CORRUPTION AND ECONOMIC GROWTH IN ALGERIA

Algeria is one of the developing countries that are highly endowed with abundant natural resources.

Hence, the Algerian economy is largely dependent on oil and gas sector, where corruption could find a place especially with rising rent seeking activities. Therefore, this scourge has a role to play in frustrating economic growth. In order to analyze this phenomenon, much more light must be shed on economic growth and corruption in Algeria.

3.1 ECONOMIC GROWTH IN ALGERIA

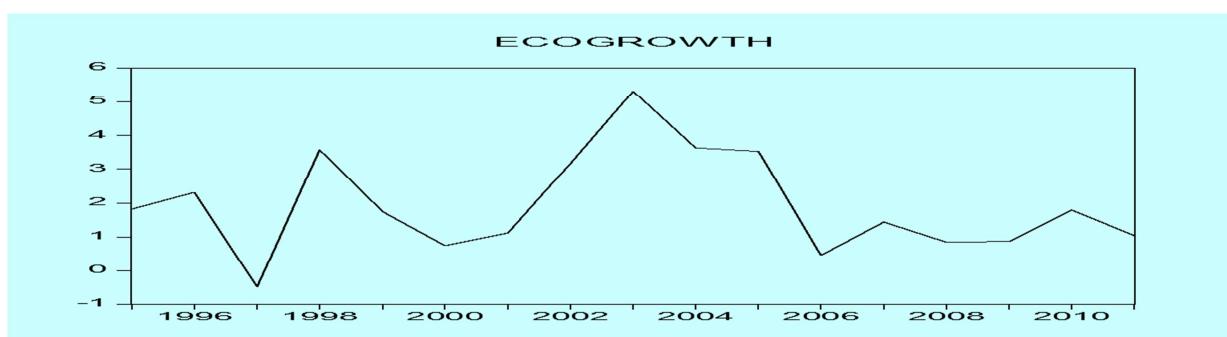


Fig. 1. Economic Growth (the annual percentage growth rate of GDP per capita) in Algeria, 1995-2011.

Source: World Bank, World Development Indicators, the data are available online at: <http://data.worldbank.org> (accessed 26/07/2014).

Algeria had a strong economic growth over the past decade due to high oil revenues and sound macroeconomic policies, especially those that have been taken since 1990 in the context of raising the hydrocarbons income, and this led to the acceleration of economic growth and the creation of a strong financial position with large foreign reserves (IMF, 2012) [35].

In 2003, GDP growth rose significantly as a result of increased oil production and accelerated services, construction and industrial activities, and the positive effects of the economic recovery program that allocated significant funds to improve the country's economic and social conditions (IMF, 2008) [36]. Then, it declined due to lower production and exports of oil and gas resulted from lower global demand for hydrocarbons, in addition to the significant decline in oil prices in 2009 under the impact of the global financial crisis. Further, the realized economic growth during the same period came as a result of good performance in other sectors (African Development Bank Group, 2011) [37].

In 2010, the non-oil economic growth increased by 6% reflecting the strong performance of the sectors that were supported by the public investment program (IMF, 2012) [38].

According to the World Bank (2012) report [39], high oil prices recorded during 2010 and public investment programs undertaken by the Algerian government pushed up the growth rate in 2011, and it is worthwhile to note that among very few countries, Algeria was able to maintain a positive current account to GDP ratio.

3.2 CORRUPTION IN ALGERIA

3.2.1 TRANSPARENCY INTERNATIONAL'S CORRUPTION PERCEPTIONS INDEX (CPI)

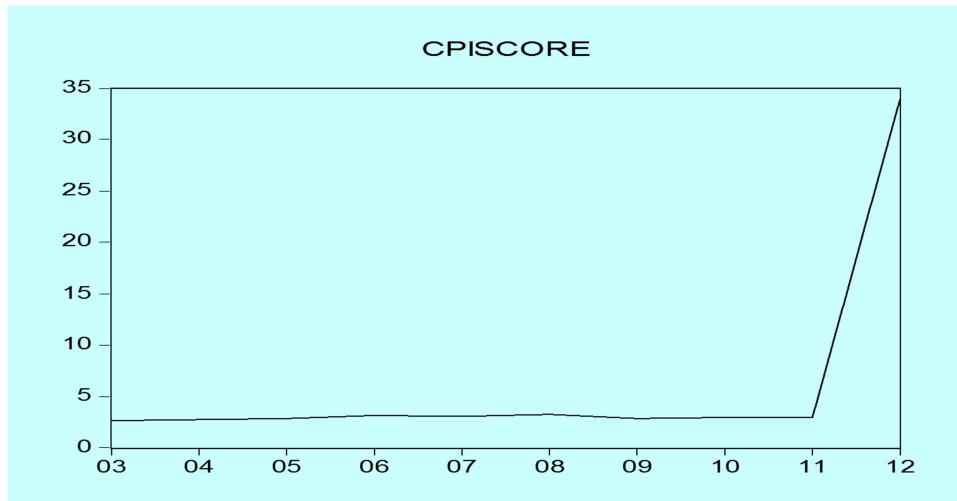


Fig. 2. Corruption Perceptions Index (CPI) Score in Algeria, 2003-2012.

Source: Transparency International's Corruption Perceptions Index, the data are available online at:
<http://www.transparency.org/research/cpi/overview>(accessed 26/07/2014).

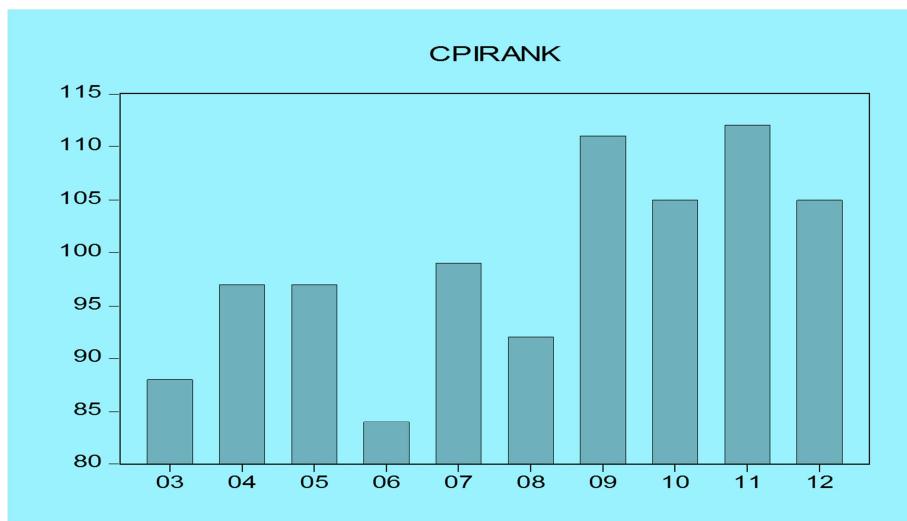


Fig. 3. Corruption Perceptions Index (CPI) Rank in Algeria, 2003-2012.

Source: Transparency International's Corruption Perceptions Index, the data are available online at:
<http://www.transparency.org/research/cpi/overview>(accessed 26/07/2014).

According to Transparency International 2011 Corruption Perceptions Index, Algeria was ranked 112 th with a score of 2.9. In 2012, Algeria moved up seven ranks to the 105 th position out of 176 countries with a score of 34, and it came in the 12th place out of 17 countries in the Middle East and North Africa.

3.2.2 WORLD BANK'S CONTROL OF CORRUPTION INDICATOR (CC)

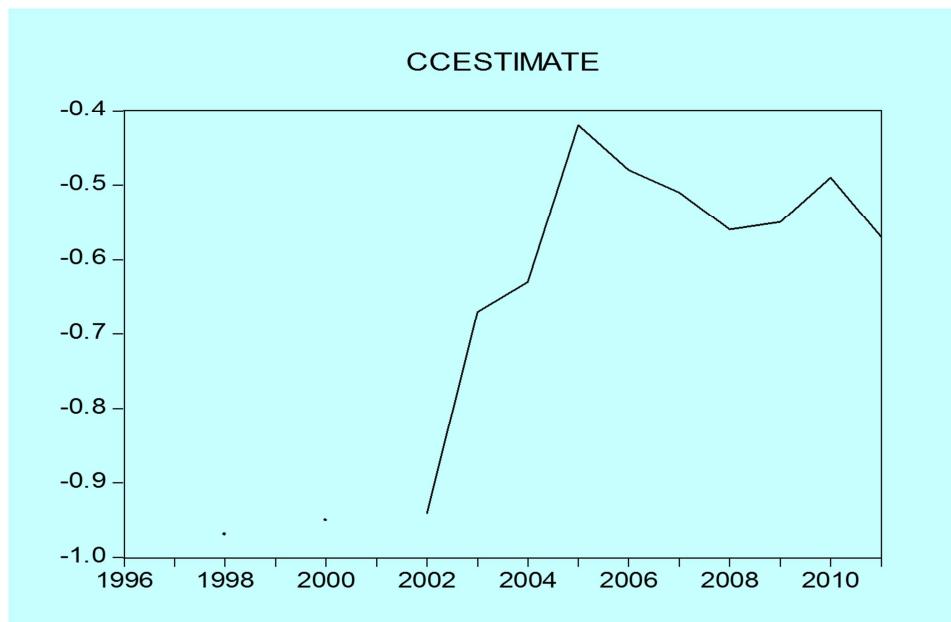


Fig. 4. Control of Corruption Indicator (CC) Esitmate in Algeria, 1996-2011.

Source: World Bank Governance Indicators, the data are available online at: <http://info.worldbank.org/governance/wgi/index.asp> (accessed 26/07/2014).

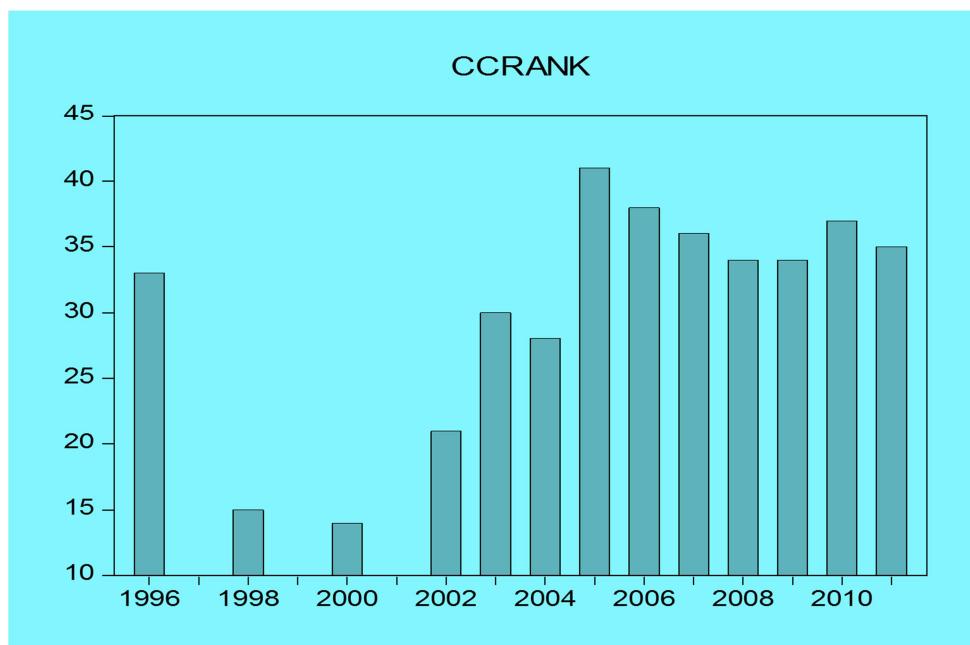


Fig. 5. Control of Corruption Indicator (CC) Rank in Algeria, 1996-2011.

Source: World Bank Governance Indicators, the data are available online at: <http://info.worldbank.org/governance/wgi/index.asp> (accessed 26/07/2014).

According to the World Bank's Control of Corruption Indicator (2011) Algeria was scored -0.57 on a scale from -2.5 to +2.5 with a rank of 35 on a range from 0 to 100 and the lowest rank means that the country has a high level of corruption. As well as, this indicator shows that corruption in Algeria still occupies the negative field, indicating that the targeted efforts to curb this scourge can't redirect corruption in Algeria towards the positive values.

3.3 HERITAGE FOUNDATION'S FREEDOM FROM CORRUPTION INDEX (FFC)

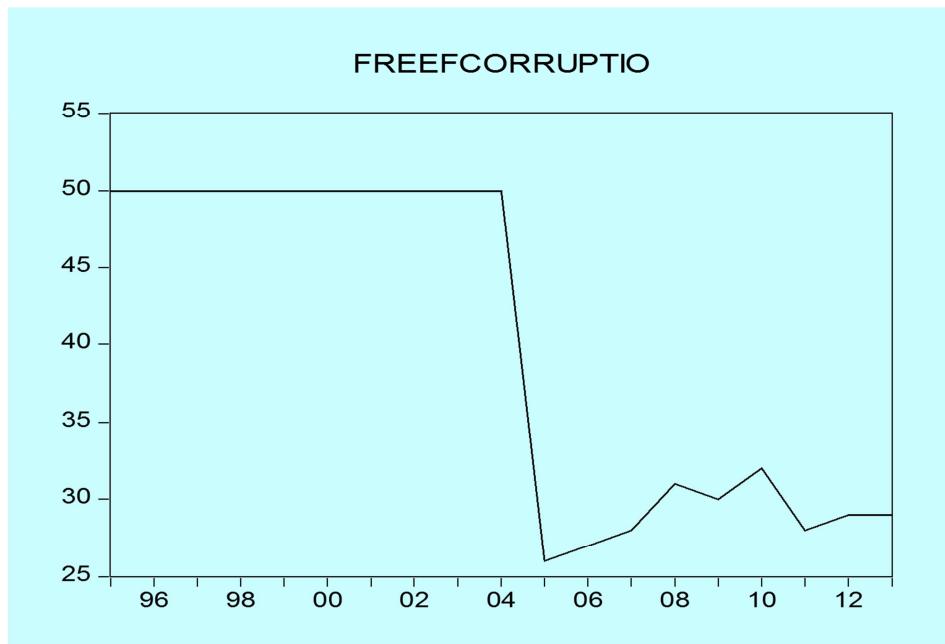


Fig. 6. Freedom from Corruption Index (FFC) Score in Algeria, 1995-2013.

Source: Heritage Foundation's Index of Economic Freedom, the data are available online at:

<http://www.heritage.org/index/explore?view=by-region-country-year> (accessed 26/07/2014).

According to the Heritage Foundation's 2013 Index of Economic Freedom, Algeria was ranked the 145th freest country with a score of 49.6 and this score was 1.4 points lower than in 2012. Freedom from corruption index appeared as one of the reasons for this deterioration with a score of 29 in 2012 and 2013, and the figure above shows that corruption has spread in recent years, especially with high oil and gas revenues and increased government spending. The results of studies conducted by this foundation showed from the citizen's point of view that the pervasive corruption is considered as a big problem that threatens the economy, and it is worthwhile to note that the Algerian government has expanded its efforts in order to root out corruption.

In the Global Competitiveness Report 2012–2013, Algeria was ranked 110 out of 144 countries with a score of 3.7 on a scale of 1-7. The "irregular payments and bribes" is one of the factors that weakened this result with a score of 2.6 (a higher score means less corruption) (Klaus Schwab, 2012) [40].

These ratings were low compared with many other countries, especially that the Algerian government has recently witnessed big scandals in different public sectors.

In 2005, the ministry of justice dismissed 8 judges on charges of corruption and abuse of authority (USA International Business, 2012) [41].

At the end of 2010, seven officials of the Ministry of Public Works were involved in cases of corruption and bribes for providing illegal facilities and services to foreign companies, notably the Chinese company charged with realizing the east - west highway project (Carol Midgalovitz, 2010; Yahia H. Zoubir and Louisa Dris-Aït-Hamadouche, 2013) ([42], [43]), some parts of this road are still under way, while others are repaired. Moreover, the recent bad weather revealed the fragility of materials and the poor quality of work done. In addition to the unsafe working conditions, a number of Algerian workers have been employed unlike what has been agreed.

A major corruption scandal has swept Sonatrach and the former chief executive officer, Mohamed Meziane was sentenced to two years in prison in May 2011 (Freedom House, 2012) [44].

In 2012, the Public Telecommunications Company had a share in the corruption as well; both Mohamed Boukhari and Chami Madjdoub were accused of suspicious transactions and money laundering. The investigation also revealed that they received bribes from two Chinese companies (Freedom House, 2013) [45].

In 2013, the current CEO of the National Gas and Electricity Company Sonelgaz, Noureddine Bouterfa, his predecessor and several executives were charged and placed under judicial supervision, as part of an investigation about the "additional costs" related to the construction of two power plants by the French group Alstom and U.S. General Electric (Les Afriques, 2013) [46].

The causes of this scourge are varied for example: William C. Byrd (2003) [47] pointed out that there is a widespread corruption in Algeria, as well as the cumbersome regulations and slow administrative procedures have contributed to the expansion of the informal sector.

According to Lahouari Addi: "The rise of oil prices drives the billionaires to achieve their desires through bribing state employees, law officers and many others", (Rodriguez, Diana and Ehrichs, Linda, 2007) [48].

Lahcen Achy (2011) [49] indicated that this phenomenon has become increasingly rampant in the Algerian economy that is characterized by a high level of public spending and modest non-oil growth, and this is the result of inadequate institutional quality; thus, the government must embark on important reforms in the judicial and administrative system to enhance transparency and release many transactions from the state intervention.

In fact, many prominent measures have been taken by the Algerian government in order to fight against corruption such as: the implementation of the anti money laundering legislation especially that the informal financial system had the lion's share in this scourge. In 2006, the government has ratified the anti corruption bill and created a national commission for the prevention and fight against corruption in August 2010 (USA International Business, 2011) [50], and this is important step forward in promoting transparency in government and public procurement and strengthening the existing penal sanctions (Doing Business in Algeria, 2011) [51].

The President of the Algerian Association to Fight against Corruption, Djilali Hadjadj, confirmed that the solution to corruption is to ratify international treaties against corruption and the most important is to find ways to make them more effective (Stephen J. King, 2009) [52].

In general, corruption is a serious threat to the Algerian economy, it can even make matters worse by damaging the country's image abroad, and it is worthwhile to note that this poison has emanated from the dominant public sector where actors commit irregularities (Freedom House, 2011) [53].

The opinions of international organizations, economists and politicians have shown that any weaknesses in the control of corruption or even the lack of freedom from corruption will severely impede Algeria's economic growth prospects, and this must be confirmed by conducting an empirical study in the next sections.

4 DATA AND ECONOMETRIC MODEL

This study examines the impact of corruption on economic growth in Algeria over the period (1995-2011) using the following variables:

GDP: the annual percentage growth rate of GDP per capita is used as a proxy for economic growth, from the World Bank's World Development Indicators (WDI).

FFC: Freedom from Corruption introduced by the Heritage Foundation.

CC: Control of Corruption from the World Governance Indicators database.

HC: Human Capital proxied by secondary school enrolment which is obtained from WDI database.

Transparency International's Corruption Perceptions Index is not included in this study because of missing data.

Johansen cointegration test which is based on both trace and maximum eigenvalue statistics has been employed in order to investigate the existence of long-run relationships among the variables included in the model, then we apply the Vector Error-Correction Model (VECM) to test the long-run and short-run dynamic relationships among the various time series,

besides using both impulse response functions and variance decomposition that facilitate the VAR model interpretation, through employing Eviews 8.0 software package.

5 ANALYSIS OF EMPIRICAL RESULTS

5.1 PHILLIPS PERRON UNIT ROOT TEST

According to the table below, the Phillips Perron value is greater than the critical t-value at 5% level of significance for the following variables: GDP, FFC, CC and HC. Thus, null hypothesis of a unit root cannot be rejected and these variables are not stationary at their levels. Then again, after first differencing the previously mentioned variables, the null hypothesis of a unit root in the PP test can be rejected at the 5% level, so these variables are integrated of the order one I(1). Hence, we can now proceed with the Johansen cointegration test.

Table 1. Unit Root Test Results

	Level			First Difference		
	Trend & Intercept	Intercept	None	Trend & Intercept	Intercept	None
GDP	-2.834644 (-3.733200)	-2.904053 (-3.065585)	-1.477177 (-1.964418)	-6.341016* (-3.759743)	-6.042986* (-3.081002)	-6.283741* (-1.966270)
FFC	-2.219441 (-3.733200)	-0.919555 (-3.065585)	-1.147916 (-1.964418)	-3.850062* (-3.759743)	-3.994064* (-3.081002)	-3.903816* (-1.966270)
CC	-2.264972 (-3.733200)	-1.650359 (-3.065585)	-0.311759 (-1.964418)	-4.786945* (-3.759743)	-4.102923* (-3.081002)	-3.889907* (-1.966270)
HC	-1.863533 (-3.733200)	1.227385 (-3.065585)	3.805719 (-1.964418)	-4.569406* (-3.759743)	-3.670717* (-3.081002)	-2.706724* (-1.966270)

*indicates statistically significant at 5% level of significance.

(Test critical values at 5% level of significance).

5.2 TRACE AND MAX EIGEN VALUE TESTS

According to the trace test, the null hypothesis which indicates 1 cointegrating equation cannot be rejected because the Trace value is less than the critical value at 5% level of significance. Thus, there is one long-run relationship between GDP, FFC, CC, and HC. But this hypothesis cannot be accepted by the Max Eigen Value test because the value of this statistic is greater than the critical value at 5% level of significance, while the next null hypothesis which indicates 2 cointegrating equations cannot be rejected. Hence, the Max Eigen Value test confirms the existence of two cointegrating eqn(s) between the following variables: GDP, FFC, CC and HC (see Appendix A, Table A.1).

Despite these conflicting results, we rely on the trace test results because G. S. Maddala and In-Moo Kim (1999) have confirmed that the trace test is found to be more robust to skewness, excess kurtosis and nonnormality than the Maximum Eigen value test.

5.3 COINTEGRATING EQUATION

$$\text{GDP} = 1.059194 \text{ FFC} + 25.73915 \text{ CC} + 0.615047 \text{ HC} \text{ (see Appendix A, Table A.2)}$$

According to the cointegrating equation, there is a positive long-run relationship between economic growth and freedom from corruption. Likewise, control of corruption exerts a positive long run impact on economic growth. As well as, the human capital displays a positive influence on economic growth in the long term.

5.4 VECTOR ERROR CORRECTION MODEL

Using VAR lag order selection criteria, it is found that one (1) lag is the suitable lag length for the vector error correction model (VECM) (see Appendix B, Table B.1).

The table in (see Appendix B, Table B.2) does not show the probability value of all coefficients, thence, the VECM equation (where GDP is a dependent variable) has been estimated using the least squares method in order to obtain the probability value of each coefficient (see Appendix B, Table B.3).

5.4.1 THE LONG RUN CAUSALITY

The error correction term C(1) carries the expected negative sign, emphasizing the existence of a long run cointegrating relationship among economic growth, freedom from corruption, control of corruption and human capital (see Appendix B, Table B.3).

5.4.2 THE SHORT RUN CAUSALITY

The coefficients of freedom from corruption, human capital C (3), C (5) respectively appear with positive signs and insignificant values at 5 % level of significance in the short term. In contrast, control of corruption C (4) exhibits a negative but statistically insignificant effect on economic growth (see Appendix B, Table B.3).

- ***The shortrun causality of freedom from corruption***

The p-value of the Wald test chi-square statistic (0.5520) is greater than 0.05. Thus, the null hypothesis (which indicates that FFC doesn't cause GDP in the short term) has been accepted (see Appendix B, Table B.4).

- ***The shortrun causality of control of corruption***

The Wald test chi-square statistic is statistically insignificant at the 5% significance level. Hence, the alternative hypothesis has been rejected and CC doesn't cause GDP in the short term (see Appendix B, Table B.5).

- ***The shortrun causality human capital***

The p-value of the Wald test chi-square statistic (0.5158) is greater than 0.05. Thus, the null hypothesis (which indicates that HC doesn't cause GDP in the short term) has been accepted (see Appendix B, Table B.6).

5.5 DIAGNOSTIC TESTS OF VECTOR ERROR CORRECTION MODEL (VECM)

5.5.1 HETEROSKEDASTICITY TEST: BREUSCH-PAGAN-GODFREY

Prob (χ^2) = 0.4701 that accompanies the amount ($Obs * R^2$) is greater than 0.05. Thus, the null hypothesis (which refers that there is homoskedasticity) can be accepted (see Appendix C, Table C.1).

5.5.2 HETEROSKEDASTICITY TEST: ARCH

ARCH test asserts the absence of ARCH effect because Prob (χ^2) = 0.2578 is greater than 0.05 (see Appendix C, Table C.2).

5.5.3 BREUSCH-GODFREY SERIAL CORRELATION LM TEST

The null hypothesis of no serial correlation can be accepted, because the Prob (χ^2) = 0.3606 is greater than 0.05 (see Appendix C, Table C.3).

5.5.4 JARQUE-BERA NORMALITY TEST

Prob (Jarque Bera) = 0.9562 is greater than 0.05. Hence, the null hypothesis which indicates that the residuals are normally distributed has been accepted (see Appendix C, Fig C-4).

All these diagnostic tests confirm that the VECM is well specified.

5.6 IMPLUSE RESPONSE FUNCTION OF GDP, FFC, CC, HC RELATION (SEE APPENDIX D, TABLE D.1, FIG D-1)

5.6.1 THE RESPONSE OF GDP TO ONE STANDARD DEVIATION GDP SHOCK

By giving one standard deviation GDP shock, GDP decreases to 0.81 units in the second period but it rises to 1.04 units in the third year, and it falls again to its lowest value of 0.66 units in the fourth year, then it keeps fluctuating up and down in the positive field.

5.6.2 THE RESPONSE OF GDP TO ONE STANDARD DEVIATION FFC SHOCK

GDP rises to 1.05 units in the second year as a result of giving one standard deviation FFC shock, then it decreases to 0.82 units in the next third year, but it increases slightly again to 1.07 units in the next fourth period, after that it sees a smooth fluctuation in the positive area.

5.6.3 THE RESPONSE OF GDP TO ONE STANDARD DEVIATION CC SHOCK

A positive CC shock has an immediate negative impact on GDP which reaches its lowest value of -0.60 units in the second year, and then it continues fluctuating in the negative field.

5.6.4 THE RESPONSE OF GDP TO ONE STANDARD DEVIATION HC SHOCK

A positive HC shock causes a rise of 0.33 units in GDP in the second year, then GDP goes down to its lowest value of 0.01 units in the next fifth year and it continues fluctuating around the line zero.

5.6.5 VARIANCE DECOMPOSITION OF GDP, FFC, CC, HC RELATION (SEE APPENDIX E, TABLE E.1, FIG E-1)

The forecast error variance in GDP reaches 1.73 units in the first period, then it rises to 4.56 units in the tenth period and this is due to the interaction between the following independent variables FFC, CC, HC.

In the short term (the second year), 69.62 % of the forecast error variance of GDP is explained by its own innovations, followed by FFC (21.13 %), CC (7.06 %) and HC (2.18 %).

In the medium term (the fifth period), 53.57 % of the variability in GDP is explained by its own shocks, while 35.38% is due to FFC's shocks, 9.98% of CC's shocks and 1.14% to HC's shocks.

In the long term (the tenth period) GDP's innovations explain 47.49 % of its forecast error variance while FFC's innovations, CC's innovations and HC's innovations explain 40.76 %, 10.72%, 1.01 % respectively.

These results indicate that freedom from corruption explains the largest proportion of the forecast error variance of GDP, while control of corruption is the second key determinant of GDP, whereas human capital plays a minor role in interpreting the forecast error variance of GDP.

6 CONCLUSION

This study has examined the effect of corruption on economic growth in Algeria over the period 1995-2011 using Johansen cointegration test and vector error correction model (VECM). The main results indicate that both 'freedom from corruption' and 'control of corruption' have positive long-run effects on economic growth in Algeria. It is also revealed that the human capital has an insignificant positive impact on economic growth in the long term. Moreover, the VECM confirmed the existence of a long-run relationship between economic growth, freedom from corruption, control of corruption and human capital. Furthermore, it indicated that both 'freedom from corruption' and 'human capital' have an insignificant positive impact on economic growth in the short term. These empirical results proved the validity of the previously mentioned assumptions, and support the view that corruption sands the wheels of economic growth.

Thus, the Algerian government must root out this scourge by finding the most relevant solutions to the country's political and economic situation. It is also recommended that enhancing transparency and implementing tougher accountability standards will definitely fight corruption. Indeed, there is a need to change the structure of the economy in order to reduce the heavy dependence on oil manna. In other words, greater economic diversification in Algeria is a priority

for expanding the productive sectors. Additionally, more attention should be paid to strengthening institutional quality that plays an intrinsic role in boosting Algeria's long term growth prospects.

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APPENDIX A. TRACE AND MAX EIGEN VALUE TESTS, AND COINTEGRATING EQUATION

Table A.1 Trace and Max Eigen Value Tests

Sample (adjusted): 1997 2011
 Included observations: 15 after adjustments
 Trend assumption: Linear deterministic trend
 Series: GDP FFC CC HC
 Lags interval (in first differences): 1 to 1
 Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.880139	61.34020	47.85613	0.0017
At most 1	0.775698	29.51881	29.79707	0.0538
At most 2	0.376056	7.097404	15.49471	0.5663
At most 3	0.001464	0.021976	3.841466	0.8821

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.880139	31.82139	27.58434	0.0134
At most 1 *	0.775698	22.42141	21.13162	0.0328
At most 2	0.376056	7.075428	14.26460	0.4803
At most 3	0.001464	0.021976	3.841466	0.8821

Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Table A.2 Cointegrating Equation

1 Cointegrating Equation(s):	Log likelihood	-86.14131	
Normalized cointegrating coefficients (standard error in parentheses)			
GDP	FFC	CC	HC
1.000000	-1.059194	-25.73915	-0.615047
	(0.12137)	(4.88365)	(0.11825)
Adjustment coefficients (standard error in parentheses)			
D(GDP)	-0.018020		
	(0.09146)		
D(FFC)	0.725347		
	(0.31891)		
D(CC)	0.003743		
	(0.00816)		
D(HC)	0.259715		
	(0.29442)		

APPENDIX B. VECTOR ERROR CORRECTION MODEL (VECM)*Table A.1 VAR Lag Order Selection Criteria*

VAR Lag Order Selection Criteria

Endogenous variables: GDP FFC CC HC

Exogenous variables: C

Sample: 1995 2011

Included observations: 16

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-135.5601	NA	443.2577	17.44501	17.63815	17.45490
1	-100.4459	48.28201*	44.28889*	15.05573*	16.02147*	15.10519*

* indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

Table A.2 Vector Error Correction Model (VECM)

Vector Error Correction Estimates
 Sample (adjusted): 1997 2011
 Included observations: 15 after adjustments
 Standard errors in () & t-statistics in []

Cointegrating Eq:	CointEq1			
Error Correction:	D(GDP)	D(FFC)	D(CC)	D(HC)
CointEq1	-0.018020 (0.09146) [-0.19704]	0.725347 (0.31891) [2.27442]	0.003743 (0.00816) [0.45885]	0.259715 (0.29442) [0.88212]
D(GDP(-1))	-0.259529 (0.25701) [-1.00979]	0.500141 (0.89622) [0.55806]	0.007091 (0.02292) [0.30935]	1.135666 (0.82739) [1.37260]
D(FFC(-1))	0.054828 (0.09218) [0.59479]	0.139607 (0.32144) [0.43432]	0.005620 (0.00822) [0.68356]	0.235388 (0.29675) [0.79322]
D(CC(-1))	-6.805341 (4.50922) [-1.50921]	5.551020 (15.7239) [0.35303]	0.320459 (0.40218) [0.79680]	3.238545 (14.5163) [0.22310]
D(HC(-1))	0.063393 (0.09755) [0.64982]	0.284288 (0.34018) [0.83571]	0.008968 (0.00870) [1.03067]	0.274282 (0.31405) [0.87337]
C	-0.191409 (0.51949) [-0.36846]	-2.022676 (1.81149) [-1.11658]	-0.021901 (0.04633) [-0.47267]	2.351610 (1.67236) [1.40616]
R-squared	0.485437	0.431025	0.196619	0.298260
Adj. R-squared	0.199568	0.114928	-0.249703	-0.091595
Sum sq. resids	26.93988	327.5778	0.214310	279.1916
S.E. equation	1.730121	6.033037	0.154312	5.569676
F-statistic	1.698111	1.363585	0.440532	0.765053
Log likelihood	-25.67576	-44.41164	10.57879	-43.21294
Akaike AIC	4.223434	6.721552	-0.610506	6.561725
Schwarz SC	4.506654	7.004772	-0.327286	6.844945
Mean dependent	-0.084503	-1.466667	-0.006000	2.768920
S.D. dependent	1.933812	6.412785	0.138037	5.330882
Determinant resid covariance (dof adj.)	8.822469			
Determinant resid covariance	1.143392			
Log likelihood	-86.14131			
Akaike information criterion	15.21884			
Schwarz criterion	16.54053			

Table A.3 Vector Error Correction Model (VECM) using Least Squares Method

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.018020	0.091457	-0.197036	0.8482
C(2)	-0.259529	0.257013	-1.009792	0.3390
C(3)	0.054828	0.092181	0.594788	0.5666
C(4)	-6.805341	4.509219	-1.509206	0.1655
C(5)	0.063393	0.097554	0.649823	0.5320
C(6)	-0.191409	0.519489	-0.368456	0.7211
R-squared	0.485437	Mean dependent var		-0.084503
Adjusted R-squared	0.199568	S.D. dependent var		1.933812
S.E. of regression	1.730121	Akaike info criterion		4.223434
Sum squared resid	26.93988	Schwarz criterion		4.506654
Log likelihood	-25.67576	Hannan-Quinn criter.		4.220418
F-statistic	1.698111	Durbin-Watson stat		1.468746
Prob(F-statistic)	0.230779			

Table A.4 The Shortrun Causality of freedom from corruption

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
F-statistic	0.353773	(1, 9)	0.5666
Chi-square	0.353773	1	0.5520

Table A.5 The Shortrun Causality of control of corruption

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
F-statistic	2.277703	(1, 9)	0.1655
Chi-square	2.277703	1	0.1312

Table A.6 The Shortrun Causality of human capital

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
F-statistic	0.422270	(1, 9)	0.5320
Chi-square	0.422270	1	0.5158

APPENDIX C. DIAGNOSTIC TESTS OF VECTOR ERROR CORRECTION MODEL (VECM)**Table C.1 Breusch-Pagan-Godfrey Test**

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	0.777079	Prob. F(8,6)	0.6395
Obs*R-squared	7.632995	Prob. Chi-Square(8)	0.4701
Scaled explained SS	2.382501	Prob. Chi-Square(8)	0.9670

Table C.2 ARCH Test

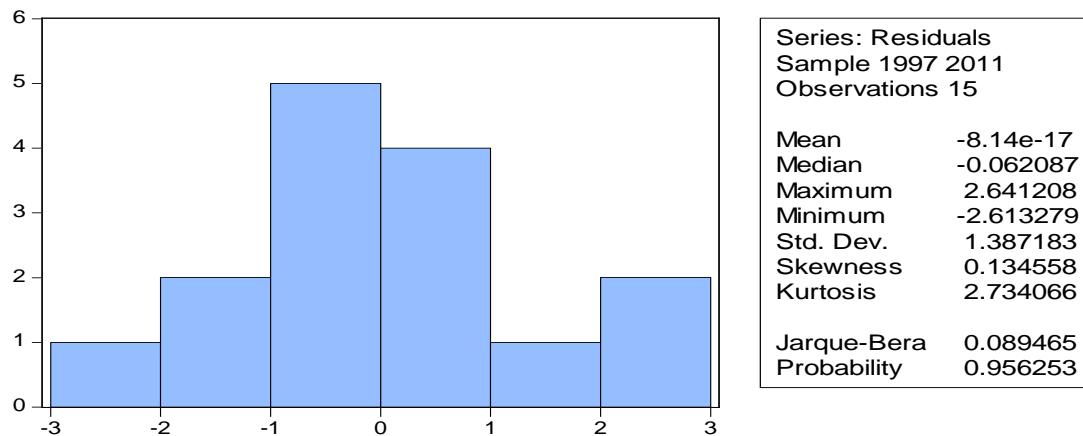
Heteroskedasticity Test: ARCH

F-statistic	1.208253	Prob. F(1,12)	0.2932
Obs*R-squared	1.280680	Prob. Chi-Square(1)	0.2578

Table C.3 Breusch-Godfrey Serial Correlation LM Test

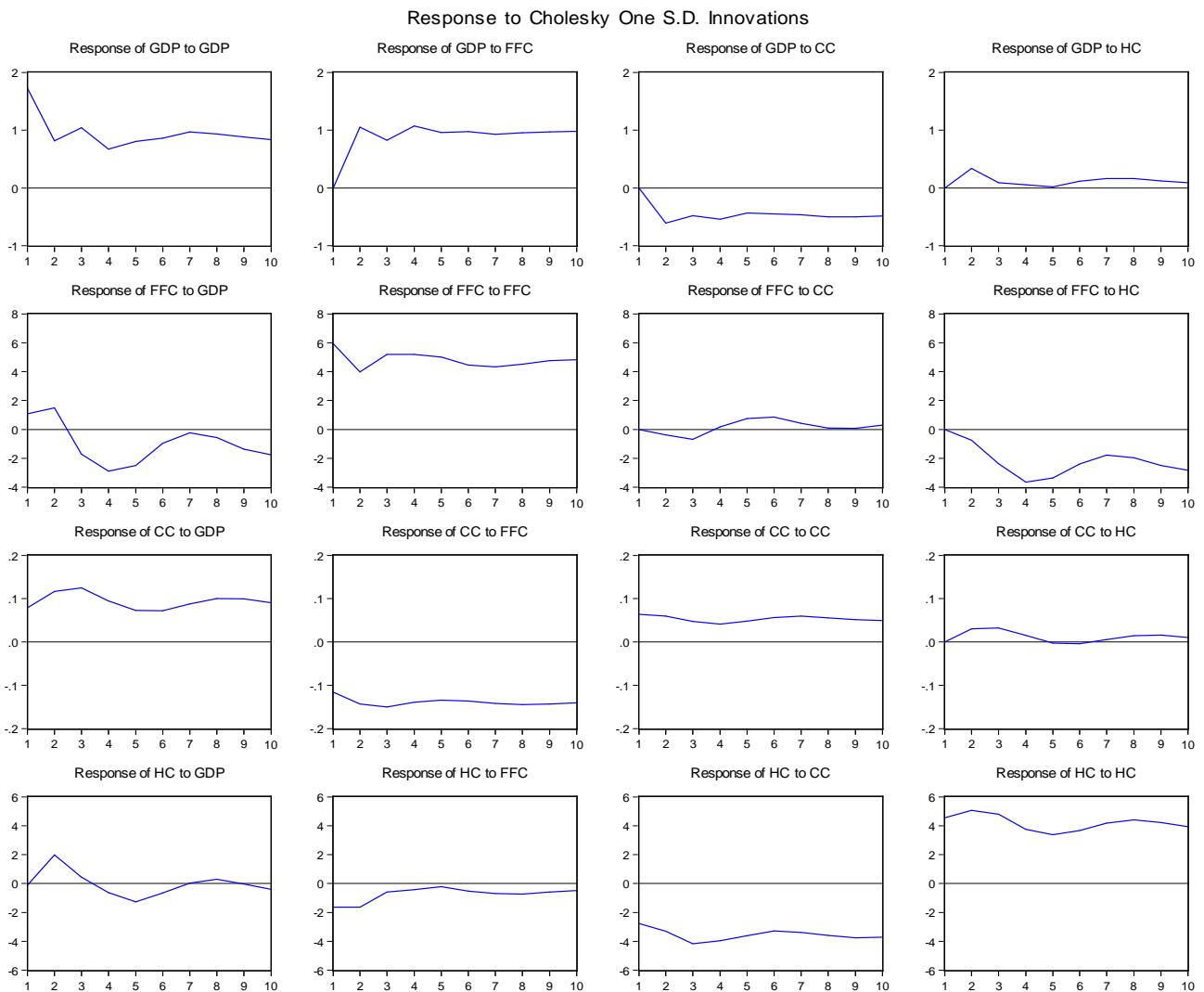
Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.472056	Prob. F(1,8)	0.5115
Obs*R-squared	0.835788	Prob. Chi-Square(1)	0.3606

**Fig C-4. Jarque Bera Normality Test**

APPENDIX D. IMPLUSE RESPONSE FUNCTION**Table D.1 Impulse Response Function of GDP, FFC, CC, HC Relation**

Respo nse of GDP: Period	GDP	FFC	CC	HC
1	1.730121	0.000000	0.000000	0.000000
2	0.817629	1.054327	-0.609496	0.338754
3	1.044658	0.829133	-0.483240	0.087270
4	0.669062	1.072767	-0.538320	0.052110
5	0.809168	0.957587	-0.432050	0.019148
6	0.860408	0.972715	-0.446471	0.113323
7	0.968139	0.928737	-0.461558	0.161241
8	0.935630	0.954538	-0.499631	0.162145
9	0.881496	0.967919	-0.501343	0.117596
10	0.837617	0.980350	-0.486918	0.088611

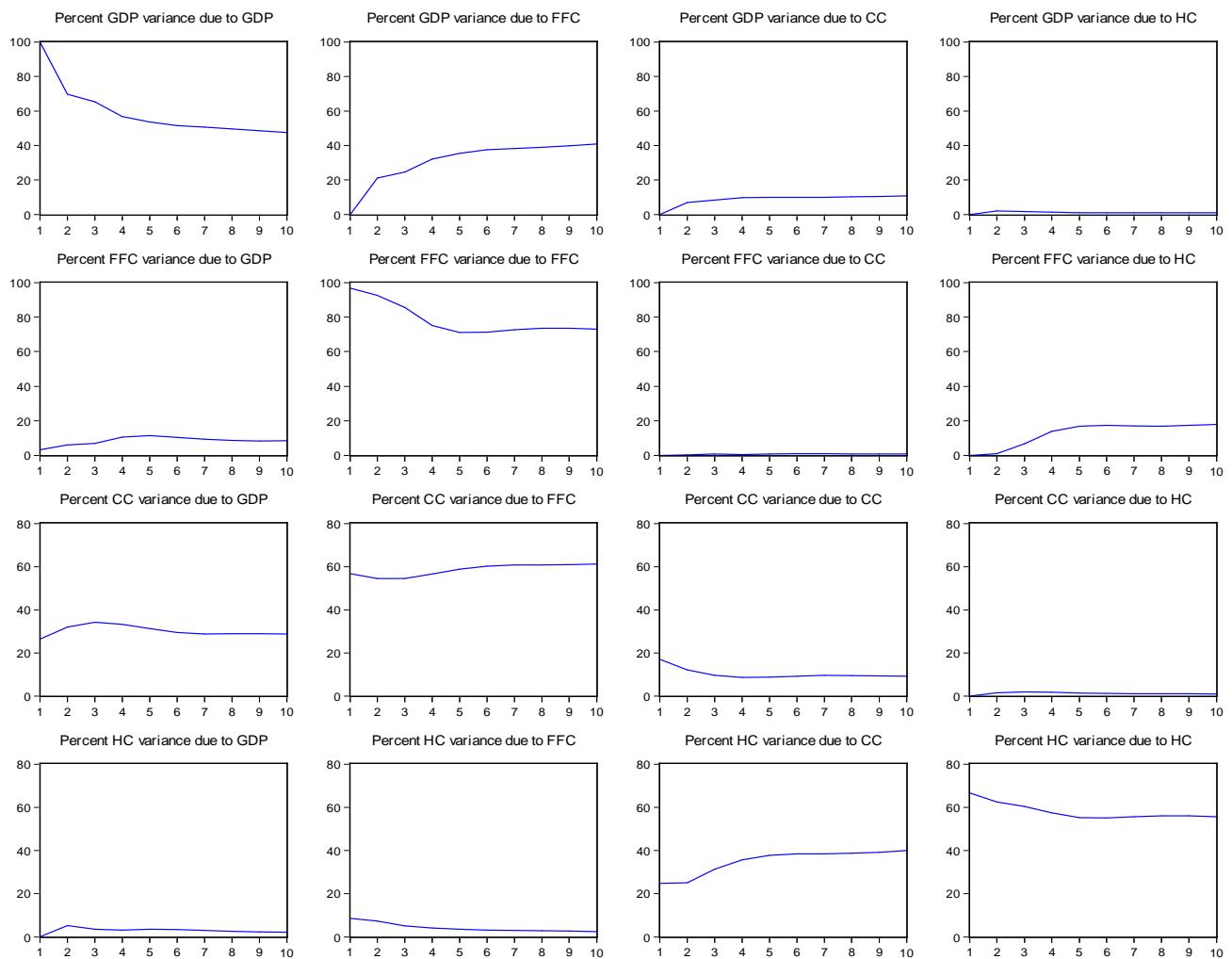
**Fig D-2. Impulse Response Function of GDP, FFC, CC, HC Relation**

APPENDIX E. VARIANCE DECOMPOSITION

Table E.1 Variance Decomposition of GDP, FFC, CC, HC Relation

Varian ce Decom position of GDP: Period	S.E.	GDP	FFC	CC	HC
1	1.730121	100.0000	0.000000	0.000000	0.000000
2	2.293399	69.62090	21.13445	7.062883	2.181769
3	2.698071	65.29418	24.71383	8.310984	1.681004
4	3.028294	56.71178	32.16699	9.757238	1.363990
5	3.305953	53.57644	35.38067	9.895037	1.147850
6	3.581617	51.41765	37.51988	9.984403	1.078068
7	3.855757	50.67068	38.17615	10.04808	1.105095
8	4.114527	49.66849	38.90726	10.29849	1.125762
9	4.348380	48.57934	39.78974	10.54986	1.081069
10	4.562459	47.49790	40.76036	10.72202	1.019717

Variance Decomposition

**Fig E-2. Variance Decomposition of GDP, FFC, CC, HC Relation**

Comparative analysis of offshore companies based on characteristics, administration and costs

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ABSTRACT: A number of Overseas Countries and Territories (OCTs) having links to EU Member States were listed in 2000 under the tax haven headline by the Organization for Economic Cooperation and Development (OECD). A series of measures had been taken in order for them to adopt the OECD's internationally agreed tax standard and to become compliant to the EU's Code of Conduct for business taxation. At the same time a number of both fiscal and corporate advantages make these territories attract significant business activity. The aim of this article is to present a comparative analysis of two types of offshore companies: the international business company (IBC) and the exempt company, offered by six OCTs having links to the United Kingdom: Anguilla, Bermuda, British Virgin Islands, Cayman Islands, Montserrat, Turks and Caicos Islands. These companies are being analyzed in terms of characteristics, administration and Governmental fees for incorporation and continuation. Although the international business company (IBC) is seen as the emblem of the offshore sector, the results of the comparative analysis performed have shown that the exempt company is similar to the IBC structure in many respects. The lack of taxation of the revenues generated outside the territory of incorporation, the lax company administration conditions and the low Governmental fees are common features of these two corporate structures which are part of the offshore sectors of these territories.

KEYWORDS: Tax haven, OECD, Overseas territory, International Business Company, Exempt Company.

1 INTRODUCTION

The European Union is linked to 25 countries and territories through four of its member states: Denmark, France, the Netherlands and the United Kingdom. These Overseas Countries and Territories are associated with the European Union through the provisions of the Treaty on the functioning of the EU. The purpose of the association is to promote economic and social growth in these countries and territories and to establish close economic relations between them and the European Union [1]. Cooperation is also promoted in terms of taxation between the EU and the OCTs in order to facilitate the collection of legitimate tax revenue and to adhere of the principles of good governance in the tax area, including transparency, exchange of information and fair tax competition [2].

United Kingdom has 12 OCTs out of which six territories had been listed in 2000 by the Organization for Economic Cooperation and Development on the black list of tax havens: Anguilla, Bermuda, British Virgin Islands, Cayman Islands, Montserrat and Turks and Caicos Islands [3]. The amendments made to both their tax and commercial legislation imposed by the EU under the Code of Conduct for business taxation together with the implementation of the OECD's standards of transparency and exchange of information for tax purposes made these states being erased from the tax haven headline.

Also, their current tax systems complemented by the juridical structures found in their commercial legislations present significant advantages such as: 0% tax rate on profits derived from activities conducted outside the territory where the company is incorporated; advantageous conditions in terms of administration of the company; low company incorporation fees and annual fees.

The purpose of this paper is to present a comparative analysis of two offshore corporate structures: the international business company (IBC) and the exempt company found in the commercial legislations of the six OCTs: Anguilla, Bermuda, British Virgin Islands, Cayman Islands, Montserrat and Turks and Caicos Islands. The companies are analyzed in terms of their characteristics, including fiscal advantages, administration criteria as well as the Governmental fees for incorporation and annual fees. The results stand to reflect the similarities between the two corporate structures although the international business company (IBC) continues to be the emblem of the offshore sectors, while the exempt company, is seen as being compliant to the international requirements. On the other hand, these two forms of companies are also the reason why these territories continue to attract business activity and have developed into important global financial centers, as it is the case of the Cayman Islands and the British Virgin Islands [4].

In the first part of the paper it is presented the evolution of the tax havens under the close supervision of the OECD and EU, followed in the second part by an introduction to the six OCTs: Anguilla, Bermuda, British Virgin Islands, Cayman Islands, Montserrat and Turks and Caicos Islands in regard to their implementation of the OECD's internationally agreed tax standard. The third part presents the tax systems of the six OCTs and the types of companies that can be found in there commercial legislation, with an accent on the offshore structures. The paper continues with a comparative analysis between the international business company and the exempt company on: the functioning conditions, setting up requirements, administration and Governmental fees for incorporation and continuation. The conclusions come to reflect on the results of this analysis.

2 TAX HAVENS` EVOLUTION UNDER THE OECD AND THE EU

The OECD can be considered the most fervent opponent to the tax legislation promoted by the tax havens and its actions against the harmful tax measures adopted by these states is summarized in the following paragraphs.

In 1998 the organization presented a report called 'Harmful tax competition: An emerging global issue', where it draw the key factors in identifying a tax haven, namely: No or only nominal tax rates; Lack of effective exchange of information; Lack of transparency; and No substantial activities [5].Therefore, the fact that a state had in place a tax policy promoting 0% tax rates or an indirect taxation system was not considered the main reason for placing it under the tax haven headline, unless all the four criteria was met.

In order to put pressure on the targeted territories, in 2000 the OECD published a name and shame list where a number of 35 countries and territories were presented as meeting the tax haven criteria [3]. Among the territories that made advanced commitments to eliminate their harmful tax practices were: Bermuda and Cayman Islands. Commitment letters from the nominated states by which they declared adherence to the principles of transparency and exchange of information for tax purposes followed immediately after the publication of the black list.

The key principles of transparency and exchange of information for tax purposes refer to the implementation of a mechanism for the exchange of information upon request between countries; the strict confidentiality of the information exchanged and the availability of reliable information (bank, ownership, identity and accounting information) and power to obtain and provide such information upon request [6].

Under the supervision of the Global Forum on Transparency and Exchange of Information for Tax Purposes set up in 2000, the nominated states took important steps in the implementation of the OECD's principles and Peer Review reports had been issued in order to summarize on the progress achieved and areas where improvement was necessary.

The latest OECD's Progress Report on the jurisdictions surveyed by the Global Forum in the implementation of the internationally agreed tax standard from December 2012, reveal the fact that at the moment there are only two jurisdictions to meet the tax haven criteria: Nauru and Niue, as all the other states took important steps in the standards' implementation [7].

The European Union also took steps in order to create better tax coordination at the level of the Community and a level playing field in the area of taxation. Therefore, in December 1997, it introduced the Code of Conduct for Business Taxation which aimed at reducing distortions in the single market, preventing significant loss of tax revenue and helping states in creating tax structures that encourage employment [8]. Given these objectives, both Member States and their dependent and associated territories had to adopt the principles of the code and review their tax legislation in order to become Code compliant. A Code of Conduct Group was set up in 1998 in order to provide assistance in the restructuring of the fiscal policies.

The tax legislation of the OCTs also came under the review process as they were bound to cooperate in order to implement the principles of good governance in the tax area, including transparency, exchange of information and fair tax

competition. Also, these territories had to promote regulatory convergence with recognized international standards, including OECD's Agreement on exchange of information for tax purposes [2].

The specialty literature, on the other hand presents tax havens from different angles. In 2005, Hines was presenting tax havens as locations with very low tax rates and numerous tax incentives meant to attract investors [9]. Four years later, Dharmapala and Hines conducted a more comprehensive research by which they presented the following characteristics of these territories: Small countries, predominantly islands, with a population below 1 million; Good communication infrastructure; Few natural resources; British legal origins with English as an official language; Parliamentary systems; Proximity to the large capital-exporter countries; More affluent than other countries as they attract significant foreign investment due to the low tax rates and opportunities for tax avoidance; and High-quality governance institutions that can be translated in political stability, government effectiveness, rule of law and control of corruption [10]. All these features represent important aspects that are looked for by the potential investors and business people.

Given the phenomenon of globalization, tax havens have been analyzed by the role they play in the global marketplace. According to Hines, the favorable fiscal systems of these territories have attracted massive foreign investment and they had registered important growing rates in the last 25 years [9]. At the same time, tax havens provide numerous tax planning opportunities for the multinationals through the profit shifting schemes [11]. Tax havens' effects over the other economies have also been analyzed. The results show that these territories divert activity from the high tax jurisdictions and enhance tax competition between countries that would eventually lead to a race to the bottom [12]. Contrary to these observations, Desai, Foley and Hines provide evidence that tax havens' operations enhanced activity in the nearby high-tax jurisdictions [13].

3 OCT'S IMPLEMENTATION OF THE OECD'S INTERNATIONALLY AGREED TAX STANDARD

The Global Forum conducts peer reviews in order to assess the jurisdictions' ability to exchange information upon request with other states on tax matters according to the internationally agreed tax standard. The peer reviews examine in Phase 1 the legal and regulatory aspects of the exchange of information and in Phase 2, the exchange of information in practice.

In respect of the six states under analysis, Anguilla and Montserrat are still at the Phase 1 review as they do not have in place some of the legal elements required while the other four states have already gone through the Phase 2 review process and their degree of compliance is summarized in Table 1.

In order to pass to the Phase 2 review, Anguilla is required to further amend its legislation in order to ensure that ownership and identity information is available for all entities. Also, it should ensure that accounting records are maintained, that they include the underlying documentation and they are kept for a minimum of five years. At the same time, legal provisions regarding the express power of the competent authorities to access information should be enforced. The rest of the elements are considered to be in place [14].

In the case of Montserrat, the Peer Review Report identified at Phase 1 that the legislation in place did not ensure the availability of full ownership information on Montserratian companies, on foreign companies and the beneficiaries of trusts. Similar to Anguilla, Montserrat does not have binding requirements on the maintenance of the underlying accounting documentation and neither on the minimum term of five years for which the accounting records are to be kept. In addition provisions must be introduced in order for the accounting records to be sufficient to record and explain the transactions and to enable the financial position of the entity at any time [15].

Therefore, in the case of both Anguilla and Montserrat, the legislative amendments that are to be introduced relates to the availability of ownership and identity information as well as to the need for accounting records to be kept for all entities.

The practical implementation of the international standard had been tested through the Peer Review Report Phase 2, where Bermuda, British Virgin Islands, Cayman Islands and Turks and Caicos Islands had to prove their compliance.

Table 1. Degree of implementation of the internationally agreed tax standard

	Bermuda	British Virgin Islands	Cayman Islands	Turks and Caicos Islands
Objective	Jurisdictions should ensure that ownership and identity information for all relevant entities and arrangements is available to their competent authorities.			
	largely compliant	partially compliant	largely compliant	compliant
Objective	Jurisdictions should ensure that reliable accounting records are kept for all relevant entities and arrangements.			
	largely compliant	non-compliant	largely compliant	largely compliant
Objective	Banking information should be available for all account-holders.			
	compliant	compliant	compliant	compliant
Objective	Competent authorities should have the power to obtain and provide information that is the subject of a request under an exchange of information arrangement from any person within their territorial jurisdiction who is in possession or control of such information.			
	compliant	non-compliant	compliant	compliant
Objective	The rights and safeguards that apply to persons in the requested jurisdiction should be compatible with effective exchange of information.			
	compliant	compliant	compliant	compliant
Objective	Exchange of information mechanisms should allow for effective exchange of information.			
	compliant	compliant	compliant	compliant
Objective	The jurisdictions' network of information exchange mechanisms should cover all relevant partners.			
	compliant	compliant	compliant	compliant
Objective	The jurisdictions' mechanisms for exchange of information should have adequate provisions to ensure the confidentiality of information received.			
	Largely compliant	compliant	compliant	compliant
Objective	The exchange of information mechanisms should respect the rights and safeguards of taxpayers and third parties.			
	compliant	compliant	compliant	compliant
Objective	The jurisdiction should provide information under its network of agreements in a timely manner.			
	compliant	non-compliant	compliant	largely compliant

Source: [16], [17], [18], [19]

It can be observed that Cayman Islands and Turks & Caicos Islands meet the highest number of objectives, as compared to the other two territories under analysis.

4 OFFSHORE TAX SYSTEMS AND CORPORATE STRUCTURES

The six OCTs under analysis: Anguilla, Bermuda, British Virgin Islands, Cayman Islands, Montserrat and Turks and Caicos Islands are all self-governed overseas territories of the United Kingdom. The Queen of England is the Head of State and she is represented by a Governor who retains responsibility for internal security, civil service, defense, external affairs and international financial services. Their legal system is based on English Common law.

In terms of the sectors seen as the primary drivers of their economies, Anguilla and Turks and Caicos Islands are mainly dependent on tourism and financial services [14], [19]. On the other hand, the financial services sectors sustain the economies of Bermuda, Cayman Islands and British Virgin Islands [16], [17], [18]. Montserrat's Government services represent the largest contributor to the island's GDP [15].

From a taxation point of view these territories are free to construct their tax systems in order to respond to their internal necessities but with the condition to be in line with the international tax standards: The internationally agreed tax standard developed by the OECD and the EU's Code of Conduct for Business Taxation.

4.1 TAX SYSTEMS

The fiscal systems presented by the six OCTs under analysis can be classified as indirect and mixed (direct as well as indirect) tax systems, the latter being characteristic to Montserrat.

Anguilla, Bermuda, British Virgin Islands, Cayman Islands and Turks and Caicos Islands have in place a fiscal system based on indirect taxation. There is no income tax, corporate tax, capital gains or estate tax as well as other forms of direct taxation neither for residents or non-residents. The state collects revenues through a system of indirect taxes and fees which are levied in the tourism sector as well as on business licenses, stamp duties on the transfer of properties and custom duties.

Montserrat adopted a tax system based on both direct and indirect taxation. Even if the majority of the islands' tax revenue is generated by indirect taxes, direct taxes are levied on corporate and personal income of residents and non-residents as well. The corporate tax for companies conducting activities within the island is 30%, while the Montserratian exempt company that doesn't generate revenue from activities carried within the island is tax exempt.

Therefore, five out of the six OCTs have in place a consumption based tax system and they do not impose direct taxes on the profits generated by the companies. Yet, given the state of its economy and the fact that its budget is subsidized by substantial contributions made by the United Kingdom and the EU, Montserrat opted for a mixed tax system which put a tax burden on both companies and individuals, yet, leaving an option with the exempt type of company.

4.2 TYPES OF COMPANIES

The territories under analysis present commercial legislation that allow for a differentiation between the companies that can conduct commercial activity within their territory and those that are allowed only to trade outside it. Although the tax systems of Anguilla, Bermuda, British Virgin Islands, Cayman Islands, and Turks and Caicos Islands allow for the tax exempt status for all the legal entities found under their commercial legislation, the difference resides in their ability to trade within the jurisdiction of incorporation or not. A differentiation is made between the local/domestic companies and the offshore companies: the international business companies (IBCs) respectively, the exempt companies.

A company in Anguilla can be either a domestic company or a non-domestic company. Non-domestic companies do not maintain a physical presence, office or staff in Anguilla and do not engage in any revenue generating activities in Anguilla. These companies are also known as the international business companies (IBCs). They are formed under the Anguilla's International Business Companies Act and they need to respect certain conditions of functioning. Therefore, an IBC shall not:

- carry on business with persons resident in Anguilla;
- carry on banking or trust business;
- carry on business as insurance or a reinsurance company, insurance agent, insurance broker, or insurance manager;
- carry on company management business; or
- own or hold an interest, whether legal or beneficial, in real property situated in Anguilla [20].

An IBC is not subject to any corporate tax, income tax, withholding tax or capital gains tax. Also, any dividend distributions by an IBC to another such company, or to individuals or entities which are not citizens or residents of Anguilla are exempt from any tax [20].

Bermuda provides legislation that distinguishes between the status of a local company and that of an exempt company. A local company is one in which the percentage of shares beneficially owned by Bermudians is not less than 80% of the total issued share capital of that company. On the other hand the exempt company shall not: acquire or hold land in Bermuda; acquire any bonds, or debentures secured on any land in Bermuda; or carry on business in Bermuda [21].

In order to become compliant to the EU's Code of Conduct for business taxation, British Virgin Islands had to amend both its commercial and tax legislation and therefore, it abolished its International Business Company Act which conferred tax exempt status on revenues generated outside the island. In 2005, it was introduced a uniform 0% tax regime applicable to all the entities and individuals. Under the new legislation the IBC became known as the BVI Business Company.

The new BVI Business Companies Act provides a distinction between the BVI business company which is incorporated under this Act and the foreign company which is a body corporate incorporated, registered or formed outside the British Virgin Islands. Yet, both of them may conduct business within and outside the territory upon licensing [22].

Although benefiting from tax neutrality, the Cayman Islands present on one hand the resident type of company which is allowed to conduct business activity within the islands and the exempt company whose business activities are carried out mainly outside the Islands [23].

Despite having in place a corporate tax rate of 30% applicable to the revenue generated by the companies conducting business within Montserrat, the existence of the offshore sector characterized by the existence of the International Business Companies Act brings the level of taxation to 0% for the entities incorporated under this Act. Following the same legislation pattern, the IBC does not:

- carry on business with persons resident in Montserrat;
- own an interest in real property situated in Montserrat;
- accept banking deposits from persons resident in Montserrat; or
- accept contracts of insurance from persons resident in Montserrat [24].

A Montserratian IBC is exempted from tax, for a time period of no less than 25 years, on: all dividends, interest, rents, royalties, compensations and other amounts paid by the company to non-residents; capital gains realized with respect to any shares, debt obligations or other securities of a company incorporated under this Act by non-residents [24].

The introduction of the exempt company within the Turks and Caicos Companies Ordinance provide for the 0% taxation on the profits generated by the companies incorporated under this Act on the profits generated outside the island. An exempted company is exempted from any tax or duty to be levied on profits, income, capital assets, gains or appreciation, for a period of 20 years from its date of incorporation [25].

Therefore, the commercial legislations of the six OCTs present in addition to the local company that trades within the territory of incorporation, two other corporate structures that define the offshore sectors of these islands: the international business company (IBC) and the exempt company. Therefore, Anguilla and Montserrat maintained their IBC legislation, while Bermuda, Cayman Islands and Turks and Caicos Islands eliminated it, while inserting into their commercial laws the exempt company, which in many respects meet the characteristics of the IBC structure. Despite the changes brought to both their commercial and tax legislation, the new BVI Business Company maintains the fundamental characteristics of the IBC.

5 COMPARATIVE ANALYSIS BETWEEN THE IBC AND THE EXEMPT COMPANY

As presented, the IBC legislation can be found in Anguilla and Montserrat, while the British Virgin Islands moved to the BVI Business Company which resembles in many respects the IBC; on the other hand Bermuda, Cayman Islands and Turks and Caicos Islands have in place the exempt type of company. The main advantage presented by these corporate structures is the lack of taxation of the profits realized by the companies outside the jurisdictions where they are incorporated.

5.1 FUNCTIONING CONDITIONS

Both the IBC and the exempt company are not allowed to carry business activities with persons that are resident on the islands where they are incorporated and they should not hold land or own any interest in real property.

Also, the IBC's legislation poses specific restrictions in carrying on banking, insurance or reinsurance business as well as company management business. On the other hand, the exempt company has as general condition that it should not carry on business of any kind or type in the islands.

As opposed to the two types of companies under analysis, the BVI Business Company Act allow for the companies to trade both within and outside the island [22].

5.2 SETTING UP REQUIREMENTS

An IBC is set up under the International Business Companies Act based on the Memorandum of Association and the Articles of Incorporation. In the case of the exempt company, it is registered under the Companies Act, yet with the condition of being stated in the Memorandum of Association that it is an exempted company.

According to the IBC legislation, the shareholders' liability is limited by memorandum to the amount, if any, unpaid on the shares held by them. Therefore, an IBC is always a limited liability company.

The last part of the name of every IBC may be: Limited or Ltd.; Corporation or Corp.; Incorporated or Inc., etc. or any other words or abbreviations that denote the existence of a body corporate with limited liability in a jurisdiction other than that with the IBC legislation.

On the other hand, an exempted company may be with or without limited liability. Hence, an exempted company may be:

- a company limited by shares, where the liability of its members is limited by the memorandum to the amount, if any, unpaid on the shares held by them;
- a company limited by guarantee, where the liability of its members is limited by the memorandum to such an amount as the members may undertake to contribute to the assets of the company in the event of it being wound up; or
- an unlimited liability company where there is no limit on the liability of its members [21].

Therefore, in the case of the limited liability company and the company limited by guarantee, the last part of the name may be Limited, whereas in the case of the unlimited liability company the last name will be Unlimited. By exception, the Turks and Caicos Islands` Company legislation stipulates that the name of an exempt company may end with the words International Business Company or IBC in order to identify the status of the company [25]. Yet, the Turks and Caicos Islands do not have IBC legislation.

The BVI Business Company Act also provides for the three types of companies: the limited liability company, the company limited by guarantee and the unlimited company. The name of a limited company shall end with the word: Limited, Corporation, Incorporated, etc. On the other hand the name of an unlimited company shall end with the word Unlimited.

5.3 MANAGEMENT AND ADMINISTRATION

Every IBC must have a registered office and a registered agent in the island where it is incorporated. On the registration of the IBC, its registered office, respectively its registered agent is specified in the articles. Both the registered office and the registered agent of an IBC must be provided by persons who hold a relevant license. A BVI Business company is also required to have a registered agent in the British Virgin Islands who can also provide a registered office for the company.

The exempt company is also required to have a registered office in the island where it is incorporated, to which all communications and notices may be addressed. The address of the registered office must be the same as the address of the person licensed by the Authority to provide company management services for the exempted company. Therefore, every exempt company is required to have a resident representative on the island.

The IBC is managed by a board of directors that consists of one or more persons who may be either individuals or companies. The meetings of the directors of an IBC may be held within or outside the jurisdiction of incorporation. Also, the affairs of an exempt company are required to be managed by at least one director.

Bermuda`s Companies Act offers some alternatives to the exempt company which should have either:

- a minimum of one director, who is ordinarily resident in Bermuda; or
- a secretary that is an individual or a company having the status of an ordinarily resident in Bermuda; or
- a resident representative that is an individual or a company having the status of an ordinarily resident in Bermuda [21].

In respect of the secretary requirement, the IBC is not imposed to have a secretary since it has a registered agent. On the other hand the exempt companies of the Cayman Islands and Turks and Caicos Islands must have a secretary. The BVI Business Companies Act does not contain any requirement for the company to have a secretary.

An IBC must keep accounting records that:

- are sufficient to record and explain the transactions of the company; and
- will, at any time, enable the financial position of the company to be determined with reasonable accuracy [20].

The accounting records must be kept at the registered office of the IBC or at any other place outside the island of incorporation. Yet, in the case of Montserrat, if the accounting records of the IBC are kept outside Montserrat, the company must have a written record at its registered office in which it is mentioned the place outside Montserrat where its accounting records are kept [24].

The BVI Business Companies Act provides the same set of rules in respect of the accounting records. Yet, there is no clause specifying whether the accounting records can be kept at a location different from the registered office.

The exempt companies of Bermuda, Cayman Islands and Turks and Caicos Islands must keep proper records of account with respect to:

- all sums of money received and expended by the company and the matters in respect of which the receipt and expenditure takes place;
- all sales and purchases of goods by the company;
- the assets and liabilities of the company [21].

The records of account may be kept at the registered office of the company or at any other place within or outside the islands.

In the case of Bermuda, if the records of account are kept at some place outside Bermuda, at the company's registered office in Bermuda there should be kept records based on which it can be determined with reasonable accuracy the financial position of the company at the end of each three month period [21].

The Cayman Islands' legislation states that no matter where a company keeps its books of account, upon a request of the Tax Information Authority, it must make available in electronic form or any other medium, at its registered office copies of its books of account [23].

Yet, the Turks and Caicos Islands' Companies Ordinance does not specify whether the accounting records can be kept at a location different from the registered office.

In terms of the OECD's internationally agreed tax standard that requires companies to keep reliable accounting records for at least five years, the IBC's legislation does not include any clause in this respect, while the legislation of the exempt companies does.

The requirement for preparation of the financial statements can be found only in Bermuda's Companies Act. Therefore, every Bermudian exempt company must prepare financial statements which include:

- a statement of the results of operations for the period;
- a statement of retained earnings or deficit;
- a balance sheet at the end of such period;
- a statement of changes in financial position or cash flows for the period;
- notes to the financial statements [21].

The notes should include a description of the generally accepted accounting principles used in the preparation of the financial statements. These principles may be: those of Bermuda or a country other than Bermuda. Where the generally accepted accounting principles used are other than those of Bermuda, the notes should specify the generally accepted accounting principles used [21].

5.4 INCORPORATION FEES AND ANNUAL FEES

Upon incorporation and each year thereafter, an IBC is due to pay to the local Government a fixed fee established according to the authorized share capital of the company, as presented in Table 2. Therefore, depending on whether the company decides to have a share capital below or above 50,000 USD, it will pay the corresponding fee.

Anguilla's IBC is charged the lowest incorporation fee when the company has a share capital below 50,000 USD but when the company has a share capital above 50,000 USD, Montserrat's IBC pays less. In terms of annual fees to be paid to the local Government, Anguilla's IBC pays the least amount.

On the other hand the BVI Business Company presents the highest fees among the three. This can be explained by the fact that once the British Virgin Islands introduced the uniform 0% tax rate on the income of both residents and non-residents, the local budget had to be sustained by the increased Government fees.

Table 2. IBC's incorporation fees and annual fees

Authorized share capital of an IBC (USD)	Anguilla		Montserrat		British Virgin Islands	
	Fee for incorporation (USD)	Annual fee (USD)	Fee for incorporation (USD)	Annual fee (USD)	Fee for incorporation (USD)	Annual fee (USD)
50,000 or less	265	215	300	300	350	350
Exceeds 50,000	1,015	715	1,000	1,000	1,100	1,100

Source: [22], [26], [27]

The incorporation fees as well as the annual fees established by Bermuda, Cayman Islands and Turks and Caicos Islands for an exempt company are also set according to the authorized share capital of the company. As it can be seen in Table 3, Table 4 and Table 5, unlike the criteria set for determining the fees for an IBC, the fees set for an exempt company differ according to a wider range of share capital values.

It can be observed that in the case of the Bermudian exempt company both the incorporation fee and annual fee are of a same amount. On the other hand, the two fees differ for a Cayman Islands' exempt company, while the Turks and Caicos Islands' exempt company has the annual fee fixed to 350 USD, regardless of the share capital that the company has.

Table 3. Incorporation fee and annual fee for a Bermudian exempt company

Authorized share capital of an exempt company (USD)	Bermuda	
	Fee for incorporation (USD)	Annual fee (USD)
0-12,000	1,995	1,995
12,001- 120,000	4,070	4,070
120,001-1,200,000	6,275	6,275
1,200,001-12,000,000	8,360	8,360
12,000,001-100,000,000	10,455	10,455
100,000,001-500,000,000	18,670	18,670
500,000,001 or more	31,120	31,120

Source: [21]

Table 4. Incorporation fee and annual fee for a Cayman Islands` exempt company

Authorized share capital of an exempt company (USD)	Cayman Islands	
	Fee for incorporation (USD)	Annual fee (USD)
Less than 50,400	720	840
50,401-984,000	1080	1,200
984,001-1,968,000	2,261	2,381
1,968,001 or more	2,962	3,082

Source: [23]

Table 5. Incorporation fee and annual fee for a Turks and Caicos Islands` exempt company

Authorized share capital of an exempt company (USD)	Turks and Caicos Islands	
	Fee for incorporation (USD)	Annual fee (USD)
Less than 5,000	150 USD	350 USD
5,001 - 50,000	150 USD + 1% of the amount by which the share capital exceeds 5,000 USD	350 USD
50,001- 100,000	600 USD + 0.5% of the amount by which the share capital exceeds 50,000 USD	350 USD
100,001-1,000,000	850 USD + 0.1% of the amount by which the share capital exceeds 100,000 USD	350 USD
1,000,001 or more	2,000 USD	350 USD

Source: [25]

Given the fact that the IBCs and the BVI Business Company present two fixed incorporation fees set according to a share capital above or below 50,000 USD, they can be considered the most cost effective structures, as compared to the incorporation fees of the exempt companies which grow progressively according to the value of their share capital.

In terms of the annual fees payable to the local Government, both the IBCs and the Turks and Caicos Islands` exempt company pay the lowest amounts for a share capital below 50,000 USD, as for a share capital above 50,000 USD, the Turks and Caicos Islands` exempt company pays the lowest amount.

6 CONCLUSION

The IBC and the exempt company remain the most well-known and frequently used offshore structures of the six OCTs. Following the comparative analysis performed, it can be observed that the main competitive advantage of these structures is the 0% level of taxation on the various sources of revenue generated from outside the island of incorporation. Also, the characteristics of the two juridical entities as well as the rules for administration are in many respects the same. The area that presents certain differences is in terms of the Governmental fees that both an IBC and an exempt company must pay and which at a certain point may represent a decisional criterion.

Despite many of the similarities between the two structures, the IBC legislation continues to be seen as the emblem of the `tax haven` jurisdictions and this was the main reasons why Bermuda, British Virgin Islands, Cayman Islands and Turks and Caicos Islands eliminated this legislative act and introduced within their Companies Act a revised form of the IBC, known as the exempt company.

Following the six OCTs` adherence to both the OECD`s internationally agreed tax standard and to the EU`s Code of Conduct for Business taxation, their Companies` Laws have seen numerous amendments and this is the reason why today both the IBC and the exempt company present many similar characteristics.

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Controlling Unmanned Ground Vehicle using Stationary Airborne System

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ABSTRACT: Communication is one of the important parameter which barricades itself during disasters. Along with this, the other problem is measurement of physical conditions of the calamity struck region. There must be simple ways to tackle them. The purpose of this paper is to unveil such a system which remains active at all times, and is fault-tolerant with respect to any unexpected events such as a natural disaster. Hence, it mainly involves transmission of distress signals, warning signals and other information related to disaster relief. These signals are acquired using an all terrain Unmanned Ground Vehicle. The signals and the physical properties of the region like gas leakage, damaged terrain etc. are sent to the ground station using a high altitude repeater called the airborne system, which is tethered to the ground.

KEYWORDS: Unmanned Ground Vehicle (UGV); Airborne system; pulse width modulation (PWM); payload; ground station; communication; ultrasonic transceiver; Zigbee transceiver; flight termination unit (FTU).

1 INTRODUCTION

A lot of damage is caused every year due to the impact of disasters and other emergency situations. Many lives are lost because they cannot get assistance from disaster relief services in time [1]. When such a situation strikes, each and every second is valuable and the sooner action can be taken, the more lives that can be saved. If it is possible to establish a system where a distress signal is sent out from the site of the disaster to multiple ground stations in all the surrounding directions, then the one nearest to its location can rush over there and begin relief operations. This may enable many lives to be saved in time and also improves the efficiency and effectiveness of the disaster relief operations [2]

A UGV [3] sends details of the disaster struck area to the high altitude repeater which in turn sends these data to the ground station for analysis. The control of UGVs is accomplished remotely, through a command system that allows the operator(s) to receive sensor data from the UGV and send motion commands to the vehicle [4]. The ground station, the airborne system and the UGV, each have Zigbees for the exchange of data and for control.

2 PRINCIPLE

The Unmanned Ground Vehicles are moving units that can readily face the harshest terrains maintaining sufficient speed, depending on the application for which it has been deployed. These vehicles can be wirelessly controlled so that they can traverse through the disaster struck area and send the data to the airborne system [5].

Apart from saving time, the above mentioned concept also provides another critical service in times of emergency: communication services. Once the disaster relief operations get underway, it is essential that all operations are carried out in a planned and co-ordinate manner. For this purpose, the communications established may improve the quality of disaster relief and ensure that all operations are carried smoothly.

The construction of the UGV is achieved by calibration and application of high accuracy sensors, analyzers and transduction technologies such as proximity sensing using Ultrasonic trans-receivers, GPS and Gas sensors. There have been

UGVs used for military [3] and industrial [6] purposes, but they are not very economical, and more importantly, the principles that we are prototyping has not been exploited in these fields. Also, most of the UGVs deployed are single purpose in nature. But the aim here is to showcase the importance of different principles demonstrated by the UGV, such as remote gas sensing with high accuracy, terrain analysis using GPS and high accuracy Ultrasonic transducers. The basic vehicle is implemented by syncing the motors and implementing the steering system. The UGV is interfaced with a remote control which communicates using signals in the radio frequency range. A Zigbee transceiver is mounted on it to communicate with the airborne system.

The airborne system contains a payload and parachute attached to a high altitude air balloon [7]. The balloon is filled with hydrogen gas to achieve better lift [8]. The payload consists of circuitry for communication with the UGV and the ground station(s). The circuit has a microcontroller which sends the signal to the Zigbee transceiver and the cut down mechanism. Depending upon the signal or data sent from the ground station, there can be cut down or communication [9].

3 FEATURES AND WORKING OF THE UGV

ATmega328P – PU, the microcontroller controls the robot. The L298n H -Bridge is an electronics circuit that enables a voltage to be applied across a load in either direction. The circuit allows the dc motors to run clockwise and anti-clockwise. There are six motors and each motor has an individual driver. The dc motors have 100rpm and are used to give torque to the UGV to run on any possible terrain. The SkyNav SKG13 series is a complete global positioning system (GPS) engine module that features super sensitivity. It has n ultra-high sensitivity of -165dBm and consumes only 45mA at 3.3V. Fans are used as coolants to maintain the temperature. The UGV operates in two modes.

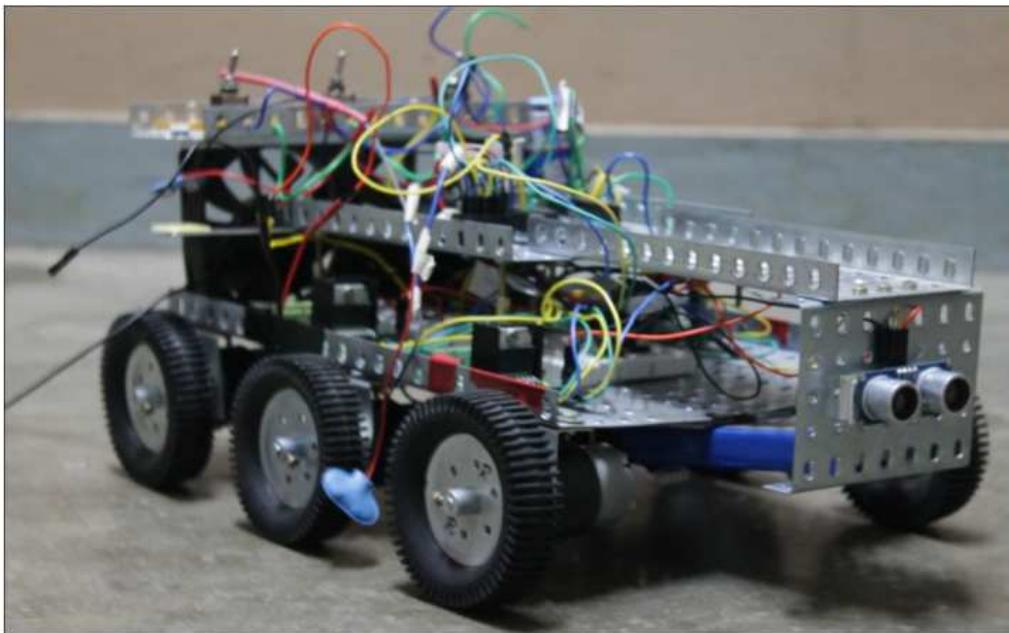


Fig. 1. The constructed Unmanned Ground Vehicle

3.1 MANUAL MODE

In this mode, the UGV is controlled using a Digital Proportional Radio Control System. The three wheels on the left are synchronised and are powered as a single unit. The control of the right side is also similar. The UGV is made to turn either to the left side or right by controlling the current. When the current to the left side is reduced, the UGV takes a left turn. This is true for the right side also. Advantage of this logic is that when the current supply to either right or left is made zero, the UGV can take a complete 360 degree turn. The amount of current that is to be supplied to motor is controlled by pulse width modulation (PWM) through the microcontroller. The PWM signals are input to the motor drivers which draw the current from the battery depending on the signals and hence drive the motor. The PWM signals generated in manual mode depend on the Digital Proportional Radio Control System signals which are controlled manually.

3.2 AUTONOMOUS MODE

In this mode, the PWM generated depends on the output of the ultrasonic sensor. The output of the ultrasonic sensor is interfaced with the microcontroller. A threshold distance is fed to the micro controller and when the sensor senses the threshold distance the UGV is made to turn or deviate from the obstacle depending on its position.

Once the gas sensor detects gas leakage, the micro controller records it and sends it wirelessly to the airborne system. This data is sent to the ground station whose address is mentioned in it. The UGV is controlled such that it is always within the range of the airborne system.

4 FEATURES AND WORKING OF THE AIRBORNE SYSTEM

The airborne system was built using latex balloons [10] filled with hydrogen [8]. To get a better lift so that it can reach a greater height, multiple balloons were used. The deployment of the airborne system is carefully done so that there won't be any mishaps [7]. ATmega328P – PU is the microcontroller used in the airborne system's payload [11]. It controls the transceiver and a part of the flight termination unit. A boot loader from Arduino is burnt in the microcontroller for the easy usage of Arduino C. The parachute is used to make the payload return back to earth safely. When the tethering is detached and the airborne system reaches a certain height, then the balloon and payload are separated.

The FTU is linked to the ground station. The ground station controls when the cutting mechanism must work. Any of the floating ground stations can be used to cut the thread connecting the balloon and payload. Once the command is sent, the nichrome wire heats up for ten second and that is enough time to cut the thread between the payload and the balloon. The circuit has been designed such that the nichrome wire heats up at the cut-down altitude using a current surge from a Lithium-Polymer battery. Once the command to initiate the cut-down mechanism is given by the user, a nichrome wire is heated up by passing a current through it. This heated nichrome wire cuts the balloon from the payload and the payload descends down to ground, by the use of a parachute.

A 5V relay is used in order to switch on the heating circuit. Once the relay is driven, the switching occurs and the heating circuit loop is completed. This heats up the nichrome wire. The entire circuit is controlled by the microcontroller. The ATmega328P-PU required a 5V supply; there is a voltage regulator that steps down the input voltage to 5V and sends to it. Capacitors are used with the regulator to filter out any noise in the input signal. The required current to drive the relay in this circuit was 100 mA. However, the microcontroller is not capable of giving such a large driving current. A transistor acts like a switch and allows that current to flow from the Li-Po battery when a certain amount of current is sent from the microcontroller to the transistor. On giving the cut down command, a base current begins to flow through the transistor, and this causes the corresponding collector current to flow. This closes the loop on one side of the relay, causing the relay coils to get energized and switching occurs. Diodes prevent the reverse flow of current.



Fig. 2. Airborne System with three high altitude balloons for better lift

5 FEATURES OF THE GROUND STATION

There can be any number of ground stations depending upon the requirements. Each of the ground station consists of a Zigbee transceiver and a computer. The computer has the software required to acquire data from the transceiver. Data can be written into the transceiver to send it to the airborne system. The computers used for ground station are connected to the Zigbee and runs on a system built using the Arduino C just like the microcontroller. Whenever there is a requirement for urgent communication between the airborne system and other ground stations, a certain protocol is followed [12]. Each Zigbee has a specific address. Depending upon the address, the message is transmitted or received or a specific task is performed. There are three modes of signals which can be transmitted from the ground station(s).

5.1 MESSAGE MODE

Any ground station whose address is known priorly can be sent a text message from another ground station. It is obvious that the UGV is a mobile ground station due to the Zigbee present on it. The airborne system will act as a network tower in this case.

5.2 BROADCAST MODE

In broadcast mode, a ground station can send message to all the other ground stations which are within the range of the airborne system. The address of the receiver is changed to BROADCAST.

5.3 CUT DOWN MODE

This mode is used to initiate the cut down mechanism. When the address of the Zigbee is changed to CUTDOWN it takes the address of the airborne system's Zigbee by default and initiates cut down.

The ground stations also receive the signals sent from the UGV. This works in the similar principle as the transmission. Since the UGV is in the range of the airborne system, it can easily send the data to its Zigbee. The data is sent back to all the nearest ground stations within the range of the airborne system for further analysis.

6 RESULTS

Various tests were performed using the UGV and the airborne systems. The UGV was tested for sensor and communication range along with manoeuvrability. The airborne system was tested for area covered.

Table 1. Testing of the UGV

Test ^a	Observations ^b	
	Ideal ^c	Practical ^d
Ultrasonic sensor range	0-400 m	20-350m
Gas sensor range	0-20m	0-5m
ASK transmitter range	0-500m	0-200m
Communication range ^e	-	Up to 300 m
Manoeuvrability on sand	Movable on up to 1 inch thick layer of heap of sand depending on the quality of sand	
Manoeuvrability on obstacles	Maneuverable above firm and rigid obstacles with 1-2 inches in height	

^a. The type of test the UGV went through

^b. Observed results for various tests

^c. Results obtained when conditions are ideal

^d. Results obtained during the test

^e. Testing not done above 300 m due to security issues

Table 2. Range of communication

Sl. No.	Communication range covered using the airborne system ^a		
	<i>Distance 1 ^b</i> <i>(meter)</i>	<i>Distance 2 ^c</i> <i>(meter)</i>	<i>Area ^d</i> <i>(meter squared)</i>
1	200	223.61	31415.92
2	400	412.31	125663.71
3	600	608.27	282.743.34

^a. Vertical height of airborne system and the ground is constant at 100m

^b. Distance between two ground stations where one is vertically below the airborne system

^c. Distance between airborne system and ground the station which is slantly below it

^d. Total area covered for the communication

7 CONCLUSION

Thus, a fully functional UGV was constructed. The airborne system fulfilled its purpose of being a high altitude repeater. The ground stations received signals from the UGV and the all three modes of transmission were tested. Many complexities were reduced in this system. The airborne system can be deployed within a period of twenty minutes. The entire setup can be done within thirty minutes. Such a system has wide applications in disaster management, defence, rural communication and industrial plants.

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Intellectual behaviour of module tutors to predict student satisfaction and intention to leave: An empirical study from Malaysian Private Higher Education Institutions

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ABSTRACT: The purpose of this study is identifying the intellectual behaviour of module tutors and its impact on student's satisfaction and intention to leave. A sample size of 151 full-time students was randomly chosen from various educational institutions. A multi-factor leadership questionnaire with a Likert-Scale from 1-5 was used to collected the data to determine students perception of intellectual behaviour displayed by module tutors at various level in key different academic institutions in Malaysia. Intellectual behaviour is measured using five variables namely idealised attributes, idealised behaviour, intellectual stimulations, inspirational motivation and individual considerations. These variables were initially established by previous studies as dimensions of transformational leadership. To ensure reliability and validity of the data set, sample size only includes students who have been with the educational institution for minimum one semester. The correlation analysis shows that all the in IA, IB, IS, IM and IC were significant and highly correlated with student satisfaction. However, this study found only IS is significant and negatively correlated with student's intention to leave. Also this study found increased in level of satisfaction is significant and negatively correlated with intention to leave. In terms of multiple regression analysis, this study found that only idealised attributes (IA) and individual considerations (IC) were significant and positively influences students satisfaction. However, this study shows none of the variables of intellectual behaviour has any significant impact on student's intention to leave. However, the increased level of satisfaction was found to have a significantly negative impact on student's intention to leave. The current study contributes to the body of research by investigating the combined impacts of intellectual behaviour on student satisfaction using one instrument, in cross-sectional area setting. This research shows that intellectual; behaviour of transformational leadership is crucial in improving student satisfaction and intention to leave. Future research should be undertaken on different context or by increasing the sample size by widening the research context to ensure validity and reliability of the results.

KEYWORDS: Transformational leadership (TL), intellectual behaviour, Intellectual Stimulation (IS), Idealised Behaviour (IB), Idealised Attributes (IA), Individual Consideration (IC), Educational settings, students' satisfaction, Malaysia

1 INTRODUCTION

There has been plenty of research conducted on leadership style and its impact on individuals and their commitment to achieve the desired goal. Various leadership theories were introduced such as autocratic, democratic, and lasses-fair fair. Some argues that a leader is a coach, a teacher and a facilitator Some defines leadership as a process of exercising influence on individual behaviour in the form of persuading effective interaction or achievement of the set goal or agreed goal. As there is no universally accepted definition of leadership, this research will not emphasis on discussing the relevance of each definition. However this research will focus mainly on the behavioural aspects of leaders in a class room setting. Therefore dimensions of transformational leadership behaviour are considered as intellectual behaviour of module tutors to develop trust between students and academic staff.

The research is mainly focus on 5 private higher educational institutions in Malaysia who achieved 6 star statuses in 2013. Similarly foreign students in Malaysia represents an important source of foreign income, although creates challenging teaching environment due to the different learning styles, different cultural backgrounds and attitude differences causes many leadership issues for lecturers (Salvarajah, 2006; Larsen, and Vincent, 2006). As most of the studies that were done previously largely ignores to carry-out the research in educational setting. However the intellectual behaviour and its impact on job performance, employee satisfaction, and job stress or innovations (Niehoff, 1990; Berson, and Linton, 2005; Dubinsky, 1998; Tracy and Hinkin, 1994; Gill, Fleischner and Shachar, 2006). However, we found only one study carried-out in linking intellectual behaviour of academic staff or module tutors in Malaysian educational setting (Hassan and Yau, 2013). This study only assesses the influence intellectual behaviour on student satisfaction. This means yet no study are carryout to establish the impact of such behaviour on student satisfaction and intention to leave. Therefore, this study demands to investigate this issue in greater detail and seeks to contribute this inchoate literature. This means this study has formulated the following objectives:

- i) To identify the extent that intellectual behaviour of module tutors displayed by lecturers in private educational setting in Malaysia
- ii) To determine the impact of intellectual behaviour of module tutors on students satisfaction and intention to leave in private educational setting in Malaysia

This paper is divided into four sections: first, it discussed the existing literature regarding transformational leadership (intellectual behaviour). Second, it described a methodology employed for this study. Third, it presents the results and findings of the research and discussion. Finally the conclusion and future research.

2 LITERATURE REVIEW

It was argued that intellectual behaviour of transformational leadership (TL) encourages followers to do more than expected or go beyond the expectation (Sosik et al, 2002), are proactive and help followers to achieve the goal (Antokonaksi et al, 2003) and TL moved the followers beyond immediate requirement(Bass, 1999). The intellectual behaviour of Transformational leadership (TL) is comprised of 4 elements includes intellectual stimulations, idealised influences, inspirational motivation and individual consideration (Bass, 1999 ; Kinicki and Kreitner, 2008; Noorshahi & Sharkhabi, 2008). The module leaders who have often display intellectual behaviour engaged *displays integrity and fairness, set clear goals, have high expectations, provide support and recognition, stire the emotion, and passion of people , and get people to look beyond their self-interest to reach for the impossible* (by Bass (1985; Pierce and Newstrom, 2008; Sadeghi and Pihie, 2012, p.187).

Studies found that lecturers/teachers who have displayed idealised influences (IA and IB) intellectual stimulations, individualised considerations and inspirational motivations were significant and positively associated with student behaviour, perceptions and learning outcomes and building trust (Bolkan and Goodboy, 2009). Many studies show that inspirational motivation and other dimensions of TL are important for student cognitive affective and motivational outcomes in class room settings (Bolkan and Goodboy, 2009; Goody, Gavin Johnson; Hardy et al, 2010, Hoehl, 2008; Ingram, 1997). Knowledge management and student's evaluation of lecturers credibility are positively associated with TL dimensions who demonstrate intellectual stimulations and charisma (Bolkan and Goodboy, 2009; Kuchinke, 1999; Politis, 2001). Another study found that tutor's TL behaviour such as intellectual stimulation and inspirational motivation and extra effort from students' increases student satisfaction and increased student participation for tutor's effectiveness (Pounder, 2008). Also Bolkan and Goodboy (2009) found a strong correlation between intellectual stimulation and inspirational motivation with student communication satisfaction. A study conducted on virtual environment shows that intellectual stimulation, individual consideration and inspirational motivation is positively associated with student's outcomes of increased performance and satisfaction (Eom, 2009). Also more recently, Gill et al (2010) found a positive relationship between each of the dimensions of TL with student satisfaction and level stress. More recently Hassan and Yau (2013) found that intellectual behaviour of inspirational motivation, intellectual stimulations, and individual consideration were significant and positively influence student satisfaction level.

The past literature review shows that none of the study focus student's intention to leave, this study will examine the impact of intellectual behaviour of module tutors and its impact on student's intention to leave.

3 RESEARCH DESIGN AND METHODOLOGY

3.1 SUBJECTS

A total of 200 questionnaires were distributed and a total of 157 questionnaires were returned (response rate 78.5%). However, some of these returned questionnaires were excluded from the sample as some of these questionnaire were not fully complete. This means the study only used 151 completed questionnaires, where 57 respondents were female (37.7%) and 94 respondents of the sample of 151 were male (62.3%). 6% of the respondents were studying at certificate level, 33% respondents were studying in diploma level, 52% respondents were studying at degree level, 4% respondents were studying at master degree level, 2% respondents were studying at PHD level and 3% of respondents were studying professional accounting.

3.2 PROCEDURE

The researchers independently contacted the students using a random sample based on the approximate numbers of students studying in the chosen educational establishments. Additionally, permission from the educational institutions was obtained to meet the students in the hallway, break hours in the canteen and also during the class hours with the help of lecturers. A time period of 6 hours were spent for three weeks were spent on data collection process. The completed questionnaires were collected by the researchers and a follow up were made on the following week during the same hours before the classes were started and during the break-hours.

3.3 MEASURES

The questionnaire's content was administered through various sources which relates with the suitability of instruments (Gill et al, 2010; Bass, 1985; Careless, 1998). Further –more, these instruments have been extensively used in examining the relationship between intellectual behaviour and its impact on student satisfaction, students outcomes and behaviour (Gill et al, 2009; Bolkan and Goodbody, 2009; Gill et al, 2010, Hassan and Yau, 2013).

3.4 DEPENDENT VARIABLE

The first dependent variable, i.e., satisfaction is measured using (8) item scales which reflect various aspects of student's satisfaction. The second dependent variable (intention to leave) is also measure using 8 variables. This study incorporate measures of the expected sources of student satisfaction (SS), namely desire to attend classes, students liking with lecturers, punctual to the class or getting late for classes, and perceived trust or quality of the lectures provided by respective lecturers.

3.5 INDEPENDENT VARIABLES

Independent variables of this study were included to measure the idealised attributes (IA), idealised behaviour (IB), intellectual stimulation (IS), and inspirational motivation (IM) and individualised considerations (IC). All items were rated on five-point Likert-type scale.

Idealised attributes (IA): This is four (4) item scales where it measures the degree of module tutor's displays idealised attributes in the class room and outside class room when dealing with students. This dimension provides information about the intellectual behavioural attributes displayed by module tutors in terms of instills pride, going beyond self-interest to satisfy students, personal sacrifices and level of trust.

Idealised behaviour (IB): This is four (4) item scale where it measures intellectual behavioural practices in terms of discussing important values of students, having strong sense of purpose, considering moral and ethical consequences of decisions, and go beyond the limits to satisfy students.

Inspirational motivation (IM): This is also four (4) item scale where it measure intellectual behavioural practices displayed by module tutors in terms of enthusiastically talk about what to achieve, express confidence in students, talk optimistically about future, and motivates students by providing new challenges.

Intellectual stimulation (IS): This is also four (4) item scale where it measure intellectual behavioural practices displayed by module tutors in terms of re-examining critical assumptions, seeking different point of views, enable students to look problem in different angles, suggest new ways to complete assignments and inspire to be innovative.

Individualised consideration (IC): This dimension also has four (4) item scale where it measure intellectual behavioural practices displayed by lecturers in terms of time spend on teaching and coaching, treating students as individuals, considers differences in needs, abilities and inspire others, helps to build strengths, and listen individual needs carefully.

Results and Findings

Due to the data available, it was possible to examine a variety of sub samples; however for this current paper, only the main finding from reliability and validity analysis based on the respondent's feedback, statistical means, standard deviations, correlation analysis and regression analysis are presented.

3.6 RELIABILITY, VALIDITY AND NORMALITY TESTS

As previously discussed, the scale of dataset is tested for its reliability using Cronbach's Alpha. Validity is tested using component matrix (vari-max). Normality is tested using skewness and kurtosis through descriptive statistics. The table below shows that reliability and normality test results generated from SPSS 22.

Table 1 Reliability and normality of scale

Variables	Number of items	Cronbach's Alpha	Standardised Cronbach's Alpha	Skewness	Kurtosis
Intellectual Behaviour	36	0.885	0.900		
Idealized Attributes	4	0.788	0.787	-0.068	0.240
Idealized Behaviour	4	0.710	0.712	0.240	-0.668
Inspirational Motivation	4	0.735	0.738	-0.163	-0.371
Intellectual stimulation	4	0.748	0.750	-0.161	-0.075
Individualised Consideration	4	0.706	0.707	-0.133	-0.215
Satisfaction	8	0.869	0.869	-0.380	1.040
Intention to leave	8	0.871	0.871	0.075	-0.440

If the association is high, the scale yields consistent result, thus is reliable. Cronbach's alpha is most widely used method. It may be mentioned that its value varies from 0 to 1 but, satisfactory value is required to be more than 0.6 for the scale to be reliable (Malhotra, 2002; Cronbach, 1951). The Cronbach's Alpha value of the overall scale of intellectual behaviour, level of satisfaction and intention to leave is estimated to be 0.900. If we compare our reliability value with the standard value alpha of 0.6 advocated by Cronbach (1951), a more accurate recommendation. Nunnally and Bernstein (1994) or with the standard value of 0.6 as recommended by Bagozzi and Yi's (1988) we find that the scales used by us are highly reliable for factor analysis. The table 1 above shows that the Cronbach's Alpha value is above 0.7 suggesting that the scale is highly reliable.

Similarly, in multivariate analysis, normality is an important assumption and testing that do not vary too much from the normal distribution (Hair et al, 2010, p.71). It argued that too much variation from the normal distribution can cause negative impact on the data analysis. There are two key areas that are being tested in normality are skewness (normally shows that the shape is balance like a bell shaped). The second area is kurtosis, being whether the curve is peaked or flat (Hair et al, 2010). The skewness of this data set sites between -0.380 to 0.240 suggesting that this range falls between -1 to +1 indicating that skewness of this data set is in acceptable range. Also as kurtosis value falls on an acceptable range, suggesting that the data set is normal.

Table 2: Factors Analysis for intellectual behavior and student satisfaction and intention to leave

	Component					
	Satisfaction	Intent. leave	IM and IS	IA and IB	IA and IB	IC
Q25	.753					
Q28	.710					
Q26	.674					
Q23	.651					
Q21	.645					
Q24	.635					
Q27	.630					
Q22	.597					
Q16						
Q35		.806				
Q36		.786				
Q34		.740				
Q32		.704				
Q33		.703				
Q31		.692				
Q30		.622				
Q29		.616				
Q12			.768			
Q10			.749			
Q14			.719			
Q11			.709			
Q13			.609			
Q15						
Q6				.781		
Q2				.710		
Q8				.699		
Q4				.658		
Q9				.638		
Q1					.739	
Q3					.664	
Q7						
Q5						
Q20						.682
Q19						.627
Q17						
Q18						.605
Eigen Value	10.173	4.544	2.050	1.806	1.358	1.311
Cumul.Var%	28.258	40.880	46.573	51.590	55.362	59.004

The factor analysis further grouped the IA and IB (idealized influences) as one factor. An analysis of the Eigen values and the scree plot for intellectual behaviour suggested that four factors related to the intellectual behaviour (Table 2). The total variances extracted by the 4 factors were 59%. To retain the dimensions, the Eigen value must be 1.0. or must exceed 1.0. All the components in used in the construct , including intellectual behaviour associated with student satisfaction and intention to leave is more than 1.0 and cumulative variance for all the items included in the construct exceeded 60%, we decided to retain all the items falls under each variable.

3.7 SAMPLE ADEQUACY TEST

After checking the reliability and validity of scale, we tested whether the data so collected is appropriate for factor analysis or not. The appropriateness of factor analysis is dependent upon the sample size. A study conducted by MacCallum, Windaman, Zhang and Hong (1999) have shown that the minimum sample size depends upon other aspects of the design of the study. According to them, as communalities become lower, the importance of sample size increases. They have argued that if all communalities are above 0.5, relatively small samples (less than 300) may be perfectly adequate. It is clear that a sample size of 151 as is used in this current research is good for a suitable factor solution because all communalities are 0.5 and above.

Table 3: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	.836
Approx. Chi-Square	2853.754
Bartlett's Test of Sphericity df	630
Sig.	.000

Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy is still another useful method to show the appropriateness of data for factor analysis. The KMO statistics varies between 0 and 1. Kasier (1974) recommends that values greater than 0.5 are acceptable. Between 0.5 and 0.7 are mediocre, between 0.7 and 0.8 are good, between 0.8 and 0.9 are superb (Field, 2000). In this study, the value of KMO for customer perceived value or the whole construct is 0.865 suggesting that the factor analysis is good and statistically significant (Kaiser-Meyer- Olkin = 0.836, Bartlett's test of sphericity was significant at p = 0.000 level).

3.8 DESCRIPTIVE MEANS AND STANDARD DEVIATION

Table 4: Mean and Standard deviation

	N	Minimum	Maximum	Mean	Std. Deviation
	Statistic	Statistic	Statistic	Statistic	Statistic
IA	151	1.25	5.00	3.7235	0.69830
IB	151	2.00	5.00	3.6556	0.68723
IM	151	1.75	5.00	3.7070	0.72959
IS	151	1.25	5.00	3.6159	0.73811
IC	151	1.50	5.00	3.6821	0.71352
SATISFACTION	151	1.00	5.00	3.5604	0.72152
INT.LEAVE	151	1.00	5.00	2.6482	0.94873
Valid N (listwise)	151				

The table 4 above shows the statistical mean and standard deviation for each dimension of intellectual behaviour of module tutors in the measurement construct. Results shows that among the five dimensions of intellectual behaviour, the most often displayed behavior among the module tutors are idealized attributes (IA) with mean value of 3.7235 ($SD=0.69830$), followed by inspirational motivation (IM), individual considerations (IC), followed by idealized behavior (IB) and lastly intellectual stimulations with mean value of 3.7070, , 3.6821. 3.6556 and 3.6159 respectively in an educational setting.

3.9 CORRELATION ANALYSIS

In the second stage of analysis, stepwise a correlation analysis was done on all constructs to determine Pearson's Correlation Coefficients with a Two-tailed significance test. Intellectual behavioural dimensions such as idealized attributes, idealized behavior, intellectual stimulations, inspirational motivations and individual considerations are considered as independent variables and student satisfaction and intention to leave are considered as dependent variable.

Table 5: Relations of intellectual behavioural dimensions with the student satisfaction

	IA	IB	IM	IS	IC	SATISFACION	INTEN.LEAVE
IA	1						
IB	0.716**	1					
IM	0.582**	0.607**	1				
IS	0.571**	0.526**	0.814**	1			
IC	0.473**	0.538**	0.601**	0.590**	1		
SATISFACTION	0.537**	0.484**	0.504**	0.522**	0.588**	1	
INTEN.LEAVE	0.069	0.089	-0.108	-0.165*	-0.136	-0.192*	1

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

With reference to the above table 5, the result shows that all the dimension of intellectual behaviour (intellectual stimulations, inspirational motivations, individual considerations and idealized behavior and idealized attributes) has a strong relation with the value of correlation of coefficient of student satisfaction, where Pearson correlation coefficient of R=0.522, 0.504, 0.588, 0.484 and 0.537 respectively. However the study found that the correlation coefficient values of intellectual behavioural dimensions do not associated with student's intentions to leave except intellectual stimulations. Intellectual stimulation was found to have a significantly negative relationship ((where P<0.05) with student's intentions to leave suggesting that increased perceived behaviour of intellectual stimulation will reduce student's intention to leave. Similarly this research found that student satisfaction (where Pearson correlation coefficient , R=0.192) is significant and negatively associated with intention to leave suggesting that high satisfaction would reduce student's intention to leave Higher Education Institution currently studying in Malaysia.

3.10 REGRESSION ANALYSIS

For this study, regression analysis was performed to predict the level of student satisfaction and intention to leave based on five independent factors. The five independent factors are idealized attributes, idealized behavior, intellectual stimulations, inspirational motivation and individual consideration.

Table 6: Model 1 Summary in predicting student satisfaction

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	F	Sig.
1	0.666 ^a	0.443	0.424	0.54770	23.063	0.000 ^b

a. Predictors: (Constant), IC, IA, IM, IB, IS

b. SATISFACTION

The Table 6 summary in predicting the student satisfaction level shows R is 0.666, R square is 0.443 and adjusted R square is 0.424, meaning that 42.4% of the variance in student satisfaction level can be predicted by independent variables of idealised attributes, idealised behavior, inspirational motivation, intellectual stimulation and individual considerations. However as a general rule (where a good fit is considered to predict minimum of 60% of the variation of dependent variables), this model is considered to be a poor fit.

Table 7: Result of regression analysis for predicting level of student satisfaction

Model	Unstandardized Coefficients		Standardized Coefficients Beta	t	Sig.
	B	Std. Error			
1	(Constant)	0.586	0.286	2.045	0.043
	IA	0.277	0.097	2.850	0.005
	IB	0.022	0.102	0.213	0.831
	IM	0.000	0.115	-0.004	0.997
	IS	0.139	0.109	1.277	0.204
	IC	0.370	0.083	4.439	0.000

a. Dependent Variable: SATISFACTION

The result of regression analysis shows that out of the five indicators of intellectual behaviour in influencing student satisfactions, only two are significant as shown in Table 7. The two significant factors are idealized attributes with P value =0.005 (P<0.05), and individualised considerations with a P value=0.000 (P<0.05). The constant is significant indicating that there is some level of satisfaction among the students (0.586) with the absence of intellectual behaviour.

Therefore the empirical model can be written as:

$$\text{Student Satisfaction level} = 0.586 + 0.268 (\text{IA}) + 0.366 (\text{IC})$$

This model suggest that when the most significant two (2) variables of intellectual behaviour of module tutors is not displayed, student satisfaction is positive and by displaying any of the two (2) behaviours in the empirical model can increase the level of satisfaction when other things remain constant. The model above suggested that the changes in perceived practices of individualised consideration of intellectual behaviour of module tutors can have the biggest influence on level of student satisfaction as its Beta coefficient is the most significant and highest.

Table 8: Model 2 Summary in predicting student's intention to leave

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	F	Sig.
2	0.308 ^a	0.095	0.064	0.91808	3.036	0.012 ^b

a. Predictors: (Constant), IC, IA, IM, IB, IS

b. INTEN.LEAVE

The Table 8 summary in predicting the student's intention to leave shows R is 0.308, R square is 0.095 and adjusted R square is 0.064, meaning that 6.4% of the variance in student's intention to leave can be predicted by independent variables of idealised attributes, idealised behavior, inspirational motivation, intellectual stimulation and individual considerations. However as a general rule this model is considered to be a very poor fit.

Table 9 Result of regression analysis for predicting student's intention to leave

Model	Unstandardized Coefficients		Standardized Coefficients Beta	t	Sig.
	B	Std. Error			
2	(Constant)	2.875	0.480	5.987	0.000
	IA	0.199	0.163	1.220	0.225
	IB	0.301	0.170	1.765	0.080
	IM	-0.042	0.192	-.218	0.828
	IS	-0.310	0.183	-1.698	0.092
	IC	-0.214	0.140	-1.534	0.127

a. Dependent Variable: INT.LEAVE

With reference to the table 9, it was indicated that none of the intellectual behaviour is significantly influence student's intention to leave as all the P values are above 0.05. Therefore this research rejected the earlier assumptions made stating that intellectual behaviour influences student's intention to leave. However it is evident that there is a intention to leave even though intellectual behavioural variables are not significant in influencing student's intention to leave as constant (B=2.875) is significant where P=0.05.

Table 10: Model 3 Summary in predicting student's intention to leave using satisfaction

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	F	Sig.
3	0.192 ^a	0.037	0.031	0.93414	5.720	0.018 ^b

The Table 10 summary in predicting the student's intention to leave shows R is 0.192, R square is 0.037 and adjusted R square is 0.031, meaning that 3.1% of the variance in student's intention to leave can be predicted by independent variables of satisfaction. However as a general rule this model is considered to be a very poor fit.

Table 11 Result of regression analysis for predicting student's intention to leave

Model	Unstandardized Coefficients		Standardized Coefficients Beta	t	Sig.
	B	Std. Error			
3	(Constant)	3.548	0.384	9.241	0.000
	SATISFACTION	-0.253	0.106	-2.392	0.018

a. Dependent Variable: INT.LEAVE

The result of regression analysis shown in table 11 indicates that there is a significant and negative influence of satisfaction on intention to leave. Similarly the empirical model indicated that with if the level of satisfaction is Zero (0), then the intention to leave is 3.548 units. This means that the level of satisfaction is increased by 1 unit, then the intention to leave will reduced by 0.192 units.

Therefore the empirical model is written as follows

$$\text{INTEN.LEAVE} = 3.548 - 0.192 (\text{SATISFACTION})$$

4 DISCUSSIONS AND CONCLUSION

There appears to be little research available on predicting students satisfaction and intention to leave the institution using intellectual behaviour of module tutors are carried out in developing countries, particularly in Malaysia. Numerous theories on intellectual behaviour through transformational leadership practices in educational setting have emerged (Mosses and Ritossa, 2007; Judge and Piccolo, 2004; Antonakis et al, 2003; Bass et al, 2003; Judge & Piccolo, 2004; Harission, 2011; Bolkan and Goodboy, 2009; Hardy et al, 2010, Hoehl, 2008; Ingram, 1997; Griffith , 2004; , Kuchinke, 1999; Politis, 2001), However, Therefore, in this particular research, this research attempted to shed light on the attributes of intellectual behaviour and its impact on student's satisfaction and intention to leave.

The finding of this research is consistent with previous study done on Malaysian context, although the variables used in influencing as the result shows However, because of the small sample size and due to the limited coverage (four educational institutions) of educational providers in Kuala Lumpur itself, it will be appropriate to repeat this research with a large sample size covering the whole Malaysia, especially all the key education providers including public universities. By conducting research on these areas, we can re-examine the impact of intellectual behaviour on student satisfaction and intention to leave to ensure the validity and reliability of the results. Moreover, future research should continue to address specific business sectors (private vs. public) as each educational institution may have different range of students from different countries and may face different challenges in satisfying and retaining students. As this study attempted to cover some of the demographic factors, a future study could examine how each of these factors could affect the way students perceive intellectual behaviour of module tutors teaching in their respective educational institutions.

Overall, we found that this research fulfilled its purposes by identifying the degree of intellectual behavior displayed among the module tutors and to assess the extent which dimensions of intellectual behaviour influences student satisfaction and intention to leave. In short the conclusions are

- Results shows that among the five dimensions of intellectual behaviour, the most often displayed behavior among the module tutors are idealized attributes (IA) followed by inspirational motivation (IM), individual considerations (IC), followed by idealized behavior (IB) and lastly intellectual stimulations in Malaysian educational settings.
- Idealised attributes and individualised consideration of intellectual behaviour among the module tutors in educational institutions in Malaysia are considered to be important behaviours that would affect student's satisfaction level and intention to leave. Therefore it is important to emphasis these intellectual behaviour among the teaching staff, especially module tutors to ensure student satisfaction. Similarly Intellectual stimulation has a negative relationship with student's intention to leave. This indicates that if the intellectual behaviour of intellectual stimulation is emphasis more while module tutors interact with students, student's intention to leave would be reduced.
- This study concluded that the increasing satisfaction among the students would reduce their intention to leave, rather they may continue with further studies with the higher educational institutions contributing to reducing student recruitment cost.

Implications for practice: Based on the findings, it is evident that improving three key aspects of intellectual behaviour can maintain and improves student satisfaction and retention. This means firms in education industry in Malaysia can sustain its market position by emphasizing its module tutors to engage with intellectual behaviour. The significant findings of this study about students' satisfaction and intention to leave has implications for education management policies rather than just teaching and delivering lectures about the subject, and must focus on improve on module tutors intellectual behavior displayed in the class room and while interacting with students to design marketing and operational activities of the institutions.

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An Assessment of Safaricard Systems as a Risk Management Practice and its Effect on Financial Performance of Kenya Wildlife Services

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ABSTRACT: The study analyzed Safari Card system as a revenue risk management practice on financial performance by Kenya Wildlife Services. The target population of the study was 1,286 employees in the National Parks where Safari card System is used to collect the Parks entry charges. The study used systematic random sampling procedure to arrive at the 296 sample size. The study collected both primary and secondary data which was processed to answer the objectives of the study. A descriptive survey research design was used to obtain a description of a particular perception about a situation, phenomena or variable and views were taken to represent those of the entire population. Data was analyzed using descriptive statistics and presented using frequency tables and charts. The relationship between Safari Card as a risk management practice and financial performance was tested using a regression model. The introduction of Safari Card as a transactional risk reduction system made KWS to increase its liquidity as a measure of financial performance, although the system did not improve working capital. Second, the introduction of Safari Card cash handling system positively improved KWS liquidity. Third, the introduction of Safari Card Customers Relations risk management system did not positively influence KWS liquidity, working capital and use of its assets optimally to generate the required short term liquidity. Fourth, the introduction of Safari Card financial information risk management system did not positively influence KWS liquidity, working capital and use of its assets optimally to generate the required short term liquidity.

KEYWORDS: Electronic Revenue System, Financial Information Management, Financial Performance and Financial Risk Management

1 INTRODUCTION

The main aim of KWS is the conservation of wildlife and historical sites for purposes of biodiversity and also conservation of history. The conservation of wildlife, both plants, animals is done in National Parks, Game Reserves and other private Sanctuaries. In order to sustain its programs, KWS charges different fees to tourist who may want to visit the parks where these conservations are done. KWS has evolved through several phases in the methods of revenue collection; from paper ticketing, Smart Card System to the current Safari Card System. KWS introduced Smart Card system as the main payment systems for park entry by visitors and their vehicles. This system was introduced as a strict revenue collection system that was meant to control revenue losses incurred before (KWS, 2011). The main reason of strict revenue collection is to sustain the KWS programs and operations which are financed directly from such collections. It has been noted over years that the organization has suffered many revenue loss. Safari Card was introduced as operational risk management practice by KWS with the main objective of controlling the revenue losses incurred before. Since the introduction of Safari Card in the year 2000, it is not clear whether the system has achieved its objectives and in turn brought effect on KWS financial performance which is the research gap that this study hopes to abridge.

2 LITERATURE

The study adopts Unified Theory of Acceptance and Use of Technology (UTAUT) aims to explain user intentions to use an IS and subsequent usage behavior. The theory holds that four key constructs (performance expectancy, effort expectancy, social influence, and facilitating conditions) are direct determinants of usage intention and behavior (Venkatesh et. al., 2003). Gender, age, experience, and voluntariness of use are posited to moderate the impact of the four key constructs on usage intention and behavior (Venkatesh et. al., 2003). The theory was developed through a review and consolidation of the constructs of eight models that earlier research had employed to explain information system usage behavior (theory of reasoned action, technology acceptance model, motivational model, theory of planned behavior, a combined theory of planned behavior/technology acceptance model, model of PC utilization, innovation diffusion theory, and social cognitive theory).

2.1 ELECTRONIC CARD SYSTEM

The use of Information Technologies (IT) in the day-by-day operations is growing dramatically. Tourism is one of the most affected sectors by the use of IT. Nowadays, it is possible to get information easily about a certain destination, look for flights reaching any place, book a hotel room or even get museum or park tickets, for example. Besides, all these actions can be performed in a notably comfortable way: they can be done at home and there are not temporal restrictions.

The ticket is a contract between a user and a service provider. If the user demonstrates his ownership of the ticket, he obtains the right to use the service under its terms and conditions (Fujimura and Nakajima, 1998) (e.g., ticket validity time). Commonly, the ticket validation is required in order to use the service. Depending on the conditions of the ticket, it can be validated once, a predefined several times or indefinitely until a deadline.

The ticket must include elements to assure the system's security and the users' privacy. The requirements related to security and privacy can vary among different applications of e-tickets. In some cases, security would be critical, such as ticket falsification on air travel. In others, privacy requirements, as the anonymity of the users, are mandatory.

The e-ticketing system is based on the use of Smart-Cards, so the Smart-Card issuer is also included in the system. The system proposed in Jorns et al. (2007) includes user localization, as well as information related to this location. In order to give this service, preserving user anonymity, the network provider is added as a trusted participant. Other systems also consider the possibility to pay for the e-ticket, so that the payment service provider, the bank and the credit card issuer are also participants involved in the system.

In recent years, justification of the use of smart card fare collection systems has been debated in several countries. The major investment required for implementation, along with the technical difficulties that arose in the early installations, have caused hesitation among promoters. However, these days, the technology has improved and the benefits have become evident. On the positive side, authors report long-term cost reduction, flexibility in pricing options, potential information sharing, and better revenue management. On the negative side, the question of the high implementation costs, technological complexity, and slow social acceptance are seen as possible obstacles. In most cases, external funding seems to be necessary to initiate large implementation projects (Iseki et al., 2007). However, there are many organizational patterns that can be used to acquire, operate, and maintain smart card payment systems (Transit Cooperative Research Program, 2006): the private corporation (as in Hong Kong), public single operator ownership (as in London, UK), a joint power authority (as in Singapore), or a public-private partnership (as in Scandinavia). Although the smart card is being used more and more by public transit agencies, this technology is not new.

Possible application areas for microprocessor cards include identification, access control systems for restricted areas and computers, secure data storage, electronic signatures and electronic purses, as well as multifunctional cards incorporating several applications in a single card. Modern smart-card operating systems also allow new applications to be loaded into a card after it has already been issued to the user, without trading off the security of the various applications. This new flexibility opens up completely new application areas for smart cards. For example, personal security modules are essential if Internet commerce and payments are to be made trustworthy. Such security modules could store personal keys and execute high-performance cryptographic algorithms. These tasks can also be performed in an elegant manner by a microprocessor with a cryptographic coprocessor. Specifications for secure Internet applications using smart cards are recently being developed throughout the world. It wouldn't be unrealistic to say; within a few years, we can expect to see every PC equipped with a smart card interface (Hayat, Rössler et al. 2006).

Smart cards, unlike magnetic stripe cards, can carry all necessary functions and information on the card. Therefore, they do not require access to remote databases at the time of the transaction. Compared to magnetic stripe cards, smart cards

have many advantages: - Smart cards provided with Chips with more than 1 MB of memory are currently available, and this figure will multiply with each new chip generation, while magnetic cards can hold only around 1000 bits. This allows the card-transaction participants (Card Company, acquiring bank, issuing bank, retailers, etc.) to store a lot of additional information on the card (Tam and Ho 2007); Data on a smart card can be protected against unauthorized viewing. As a result of this, confidential data (e.g., PINs and passwords) can be stored on a smart card. That is, merchants do not have to go online every time to authenticate a transaction.(Shen, Lin et al. 2003; Tam and Ho 2007). A single smart card can house multiple applications. Just one card can be used as your license, passport, credit card, ATM card, ID card, etc.(Domingo-Ferrer, Posegga et al. 2007; Liu, Yang et al. 2007); The life span of a smart card is longer.(Rankl and Effing 2003) Smart cards cannot be easily replicated and are, as a general rule, much more secure than magnetic stripe cards.(Shen, Lin et al. 2003)

The factors that affect the spread of innovations are described in several well-known theories. Perry declares that academics in the diffusion theory field 'define diffusion as the process through which some innovation is communicated within a social system.' Perry points up 'time' as an important factor in the rate of diffusion. He also emphasizes the role of individuals and their social influence in the diffusion process.

Innovation Diffusion Theory (IDT), which was defined by Everett Rogers in a book called Diffusion of Innovations first in 1962, is a model that explains the process by which innovations in technology are adopted by users. It is the study of how, why, and at what rate new ideas and technology spread through cultures. Rogers defines an innovation as "an idea, practice, or object that is perceived as new by an individual or other unit of adoption" and Diffusion is defined as "the process by which an innovation is communicated through certain channels over time among the members of a social system".

2.2 RISK MANAGEMENT PRACTICES

A company can be exposed to different types of risks; market, operation, business, finance, credit and reputation risks, this study will adopt operation risks which are the main problem that has been affecting revenue at the KWS. There is a growing recognition that a major source of earnings volatility is not due to financial risk. In fact, it is not related to the way a firm finances its business, but rather to the way a firm operates its business, and is called operational risk (King, 2002). Operational risk is concerned with the adverse deviation of a firm's performance, due to the way in which the firm is operated, as opposed to how the firm is financed. It is defined as a measure of the link between a firm's business activities and the variation in its business results (King, 2002).

Operational risk helps management to determine what factors affect earnings, in terms of the overall operation of a company. Factors that cause changes in earnings should be investigated, in order to determine the overall effect. Management must understand the cause of the risk, so as to effectively manage the risk and obtain the desired balance between risk and return. There are many benefits to managing risk and maintaining earnings (King, 2002): Avoid unexpected losses and improve operational efficiency. If management understands operational risk, this will assist in understanding the operational activity of the firm and, thereby, being able to effectively strategize operational risk. This allows management to avoid large losses; Efficient use of capital. Capital is budgeted based on future earnings capital usage helps to optimize the risk return trade-off for capital allocation decisions; Satisfy shareholders. Risk measurement can help influence shareholder views, and improve areas that are needed to avoid shareholder surprises; Comply with regulations. Operational risk management is a board level responsibility which can be effectively maintained through the implementation of corporate governance principles, and the use of operational controls; Most operational risks become potential losses for a company, because they, basically, expose the company to market, credit and liquidity risk.

In its most simple description, cash management represents "the management of cash inflows and outflows of the firm, as well as the stock of cash on hand" (Fabozzi & Petersen, 2003). It consists of taking the necessary actions to maintain adequate levels of cash to meet operational and capital requirements and to obtain the maximum yield on short-term investments of pooled, idle cash.

Cash management can be categorized from different aspects of the firm. From the aspect of financial management, cash management is a part of short-term financial management, also called working capital management. Namely, financial management encompasses all financial decisions made within a company, whose ultimate goal is to maximize shareholder value (Pinches, 1994, p. 4). It is comprised of long- and short term financial management. Long term financial management deals with long term investments, as well as long term financing of the company on the capital markets (Pinches, 1994, p. 635). Short term financial management (also referred to as liquidity management or working capital management) deals with decisions that have a financial impact on the company's operations in the period of less than one year. It aims at constructing

such a combination of short term assets (cash, marketable securities, accounts receivable and inventories) and short term liabilities (short term funds for financing short term assets) that would maximize the shareholder value (Shapiro, 2002).

Cash management can be seen as part of risk management, more specifically as a part of managing liquidity, interest rate and foreign currency risk. Liquidity risk is the risk that a company will not be able to timely acquire the funds necessary to meet its obligations as they come due, either by increasing its liabilities or by converting assets without incurring considerable losses (Lam, 2003, p. 182). As one of the main goals of cash management is ensuring that the company has enough cash to perform its everyday operations and to cover unpredicted outflows, one can easily categorize it as a measure for liquidity risk management.

Depending on how many responsibilities it consists of, cash management can be divided into: treasury management (or basic cash management) and advanced cash management. A study of cash management practices in a sample of Spanish firms done by San José et al. (2008, p. 192) confirm previous findings that treasury management in a narrow sense or basic cash management, which encompasses the fundamental functions of cash management, has evolved into treasury management in a broad sense, or advanced cash management. According to San José et al. (2008) basic cash management involves developing and undertaking administrative measures aimed at establishing the optimal level of cash that would allow the company to make and receive payments in such a way that the normal operations of the company are preserved. Such are: short term cash flow forecasting, setting up an optimum cash level, optimizing the liquidity of the company, monitoring and optimizing the cash cycle, monitoring the banking positions at value date, and finally, controlling the banking positions on a daily basis.

The cash management techniques employed for controlling the cash inflows and outflows are grouped in different ways by different authors: speeding the inflows and controlling the outflows; improving cash flow forecasts, synchronizing cash inflows and outflows, using float, accelerating collections, getting available funds to where they are needed and controlling disbursements (Brigham, 1999); forecasting cash flows, accelerating cash receipts, slowing down disbursements, effective investing of cash surpluses, economical financing of cash shortages (Mramor, 1993).

When looking into the cash management techniques, one has to be aware of the differences that exist between the ones that are used in Europe and the ones used in the United States. The differences stem from the use of different payment instruments. Namely, in the United States the majority of all payments, in terms of volume, especially those involving retail transactions, is conducted through the use of paper based instruments, particularly cheques (Committee on Payment and Settlement Systems, 2003). In Europe on the other hand, electronic payments are the predominant means of payment, especially direct debits, credit transfers and card payments (ECB, 2008). In paper based systems the float arises as a key concept. Float represents "the length of time between when a cheque is written and when the recipient receives the funds and can draw up on them" (Pinches, 1999). The delays in payment settlement caused by float come from the fact that it takes time for the cheque to arrive at the receiving company through the mail, it takes time to process the cheque in the company and finally to clear the cheque through the banking system (Brigham & Daves, 2004). Within the electronic payment systems, funds are transferred in "real time", meaning without any waiting period. That is why the concept of float is not applicable on the territory of Europe. In the US, the cashmanagement techniques mostly focus on reducing the float in receipts, by speeding up cheque collections, and extending the float in disbursements, by slowing down the collection of cheques a company writes (Brigham & Daves, 2004). In Europe this translates as speeding up the collection of accounts receivable and slowing down the payment of accounts payable.

Financial risk management has received increased attention over the past years. The reason for this is that financial risks, though they are not a core competency of non-financial firms, also influence their business operations to a large extend. Financial risks can be of different forms. On the one hand there are external financial risks depending on changes on financial markets. On the other hand there are internal financial risks, where the company itself is the source of the risks (Eichhorn, 2004).

Exchange risk occurs when a company is involved in international business and the cash in or outflows are in a foreign exchange rate. As this rate is not fixed and cannot be fully anticipated a possible change in a foreign exchange rate leads to the risk of changes in the amount of a payable / receivable and by that a change in the amount of money the company has to pay / will receive. This risk is measured by the concept of transaction exposure (Armeanu & Bălu, 2007). Furthermore economic exposure can be included in the evaluation of exchange rate risk. This includes changes in the quantity of future sales due to changes in the exchange rate and therefore relative competitiveness of the company (Nassauer & Pausenberger, 2000). However, the prediction of this sensitivity is difficult and hardly measurable and thus the company cannot manage this risk actively. Most firms therefore concentrate on transaction exposure and by that on the price change and not the quantity change caused by the exchange rate volatility (Smithson, Smith & Wilford, 1995).

Reduced volatility in cash flows or earnings and prevention of losses allow better planning of liquidity needs. This can avoid shortcuts of available funds and consumption of equity (Eichhorn, 2004). However, in order to maintain financially liquid and avoid end of period losses, it needs to be analysed which the maximum tolerated loss is. The focus of the risk management should therefore be in correspondence with the actual financial situation of the company. Then, by managing, among others, internal and external financial risks, also the liquidity risk and solvency risk are taken care of. Financing risk, which needs to be managed directly, mainly depends on a mismatch between the duration of assets and their financing. The company should therefore try to match the two durations in order to avoid problems with high costs of follow-up loans. Furthermore this reduces the risk of having more debt than needed after the asset's lifetime and by that it saves interest costs (Vickery, 2006).

External financial risks depend on changes on the financial markets. One possibility to secure against price or exchange rate volatilities would be to buy or sell the amount, which is needed or will be received in the future, already today. However the organization of the transactions requires administrative work.. Furthermore this is sometimes not possible as the commodities cannot be stored or keeping them causes high costs. Foreign funds or debt causes work and costs in similar ways. Finally, the possibility to secure the interest rate exposure or change the conditions of the contract is often limited. This is because the specifics of debt contracts to a large extend depend on the credibility of the company and are not flexible (Brünger, 2008)

2.3 REVENUE MANAGEMENT

Revenue management (RM), or yield management, is an accepted, essential strategy to maximize revenue for many capacity-limited service industries (Chiang et al., 2007). RM is a demand-based pricing strategy to control for optimal inventory levels and to forecast real-time demand (Choi and Mattila, 2006). Revenue management (RM) manages customer demand for a company's products and services, and incorporates those techniques and decisions based on knowledge derived from interfacing with current and potential customers to grow revenue through pricing and volume. RM requires a focused financial analysis to assess its ability to enhance operating profit and monitor its success in doing so.

A company's ability to increase revenue through effectively managed customer relationships is deemed to be vital in overcoming the uncertain economic outlook worldwide. However, in hospitality and tourism organizations such as airlines, convention centers and hotels, where revenue management is widely practiced, companies may encounter difficulties in accommodating both customer relationship management and revenue management practices. This may be because the former stresses the importance of profitable return from well-managed customer relationships, whereas the latter emphasizes revenue maximization predominately through effective management of perishable inventory.

The effect of revenue management on customer relationships has drawn hospitality and tourism researchers' attention from both operations management and marketing perspectives in recent years. Revenue management studies carried out in the hospitality industry have not only endeavored to harmonize the two practices by identifying areas of customer conflict (Mathies and Gudergan, 2007), but have also recommended a range of functional marketing strategies to reduce these conflicts. Unlike CRM practitioners, whose main priorities are to maintain and develop profitable customer relationships, revenue management users aim to maximize revenue and ultimately profit through improving sales (Anderson et. al, 2010) by increasing operating efficiency and effective management of three main areas: pricing, inventory control and customer mix.

Using revenue management may give a company financial lift by maximizing revenue through selling their fixed asset (capacity), but concerns regarding its effects on customer relationships have been cited by academics as well as by practicing managers. This is considered to be an under-researched area; Wirtz et al. (2003) appropriately pointed out that 'the customer seems to have been relatively forgotten in this [revenue management] stream of research'. Findings from existing revenue management studies suggest that there are a number of causes for potential customer conflicts. The first of these relates to customer perceptions towards the 'fairness' of revenue management practices (Heo and Lee, 2011). Kimes (1994) states that customers may perceive revenue management practice to be unfair if there is a lack of information on transactions and no rationalized pricing decisions are provided, potentially alienating customers. A second cause for conflict lies in the application of different pricing strategies such as those that are demand-oriented (Kimes and Wirtz, 2002), which often leads to unwelcome price fluctuation, especially during peak seasons, and could result in mistrust arising between the customers and the company (McMahon-Beattie et al., 2002). Third, conflict can arise from the use of various allocation and availability inventory control restrictions (Wirtz et al., 2003), such as limited allocation for certain rate categories and availability control restrictions that tend to link to length-of-stay requirements, which are in the best interests of the

company but not the customers; hence researchers ‘concerns over customers’ acceptance towards revenue management practices and its negative effects on customer satisfaction.

2.4 FINANCIAL PERFORMANCE INDICATORS

Evaluating firm performance using financial ratios has been a traditional yet powerful tool for decision-makers, including business analysts, creditors, investors, and financial managers. Rather than employing the total amounts observed on financial statements, these analyses were conducted using a number of financial ratios to obtain meaningful results. Ratio analysis can help stakeholders analyze the financial health of a company. Using these financial ratios, comparisons can be made across companies within an industry, between industries, or within a firm itself. Such a tool can also be used to compare the relative performance of different size companies.

Accounting and finance text books generally organize financial ratios into classes including liquidity, profitability, long-term solvency, and asset utilization or turnover ratios. Liquidity ratios evaluate the ability of a company to pay a short-term debt, whereas long-term solvency ratios investigate how risky an investment in the firm could be for creditors. Profitability ratios examine the profit-generating ability of a firm based on sales, equity, and assets. Asset utilization or turnover ratios measure how successfully the company generates revenues through utilizing assets, collecting receivables, and selling its inventories.

Use of financial ratios to assess the firm performance is not new. A simple literature search can find literally thousands of publications on this topic. The underlying studies often differentiate themselves from the rest by developing and using different independent variables (financial ratios) and/or employing different statistical or machine learning based analysis techniques. Financial ratios, which are calculated by using variables commonly found on financial statements, can provide the following benefits (Ross, Westerfield, & Jordan, 2003): Measuring the performance of managers for the purpose of rewards, measuring the performance of departments within multi-level companies, projecting the future by supplying historical information to existing or potential investors, providing information to creditors and suppliers, evaluating competitive positions of rivals and evaluating the financial performance of acquisitions.

Other than the benefits provided above, financial ratios are also used for the purpose of predicting future performance. For example, they are used as inputs for empirical studies or are used to develop models to predict financial distress or failures. In fact, a vast majority of the recent studies focused on analyzing and potentially predicting bankruptcy as a means to identify characteristics (in term of financial ratios) of good or bad-performing firms and their potential values (Kumar & Ravi, 2007).

CONCEPTUALIZATION

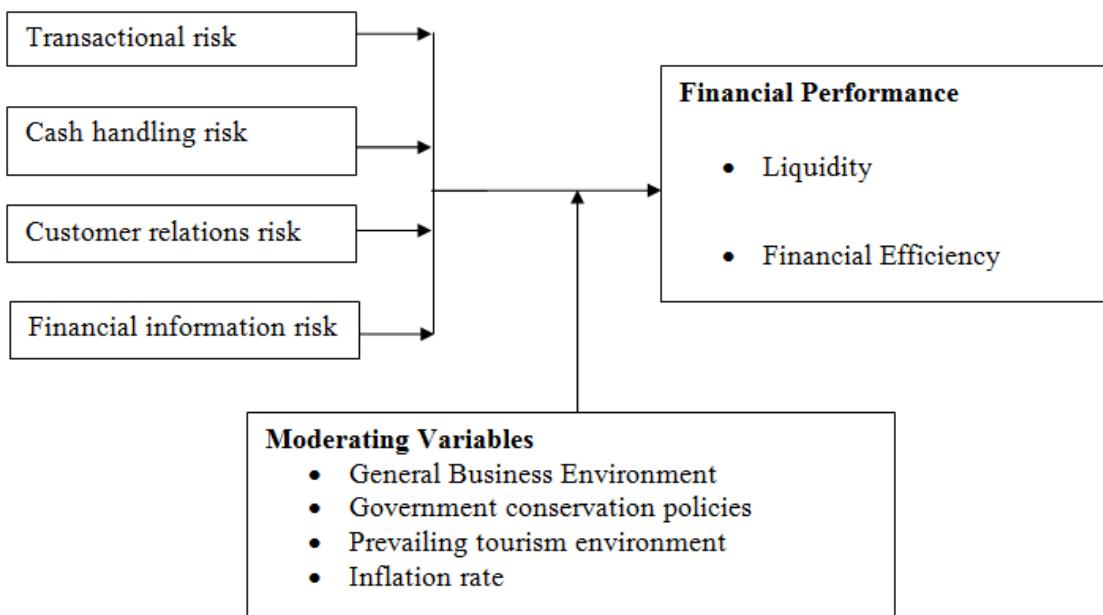


Figure 2.1: Effect of use of Safari Card on Financial Performance

The independent variables of the study are; transactional risk, cash handling risk, customers' relations management risk and financial information management risk. The dependent variable is financial performance measured in terms of; liquidity and financial efficiency (this is because KWS is not for profit organization and therefore other measures like profitability and solvency may not be relevant). The moderating variable are; the general business environment, government conservation policy, prevailing tourism environment and inflation. Effective use of Safiri smart card was meant to reduce transact risks, cash handling risks, customer relations management risks and financial information management risks as requirement towards an increased financial management, keeping the general business environment, government conservation policy, prevailing tourism environment and inflation constant.

3 METHODS

The study used a descriptive survey research design. The target population for the study was 1,286 staff members working in the National Parks where Safaricard system is used as the Parks entry charges system. The study used systematic random sampling techniques on the population of the National Parks using the Safaricard system. We used data entry forms a structured questionnaire to collect both secondary and primary information about the risk management practices and the financial performance of KWS. The relationship between Safari Card as a risk management practice and financial performance was tested using Pearson Correlation.

4 RESULTS

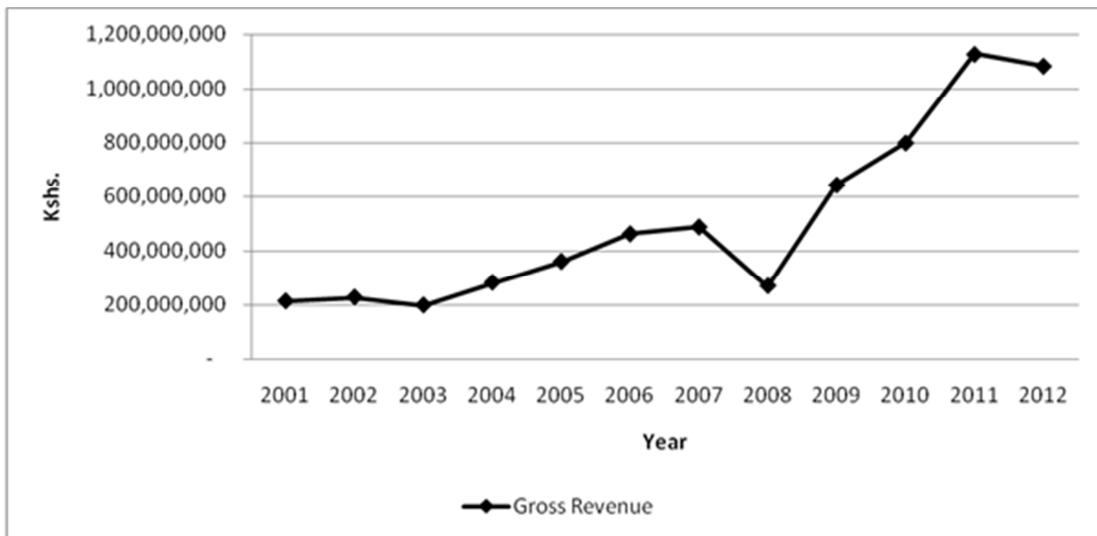
4.1 EFFECT OF SAFARI CARD TRANSACTIONAL RISKS MANAGEMENT ON FINANCIAL PERFORMANCE

Table 1: Safari Card Transactional Risks Management

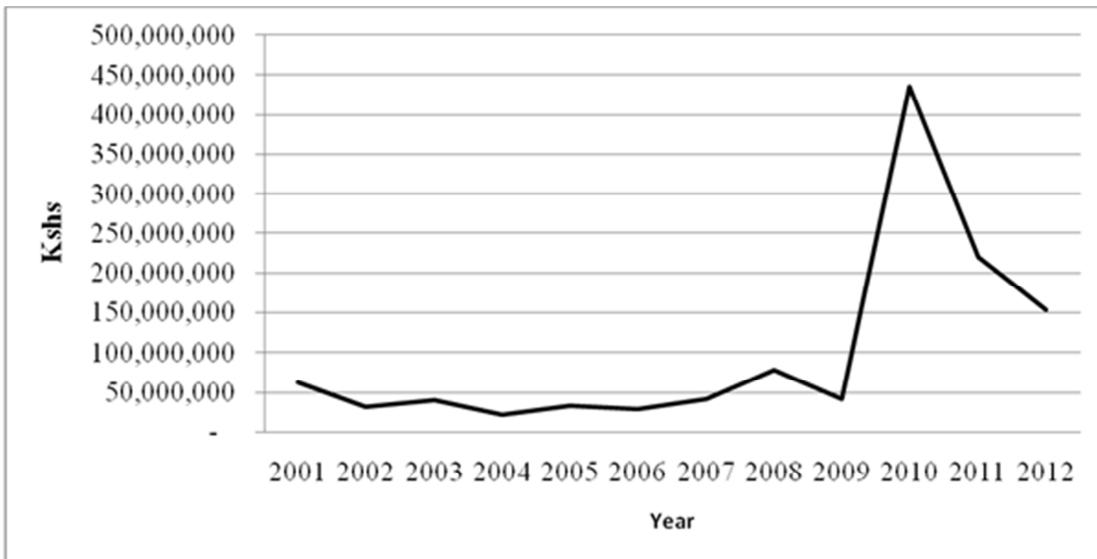
Response	N	Min.	Max.	Mean	Std. Dev.
The system is operationalized	283	2	5	3	0.9
The system captures risk events	283	1	5	3	1.1
The system records transactional risk	283	1	5	3	1.3
The system quantify transactional risks	283	1	5	3	1.3
The system report transactional risk	283	1	5	3	1.3
The system define transactional risks	283	1	5	2	1.4
The system communicate action	283	1	5	2	1.5
The system gives signals of occurrence	283	1	5	3	1.5

The study established that the respondents were not sure about the following features of Safari Card System; that the system was already fully operationalized, that it captures risk occurrence, by keeping records of transactions, quantifying transactional risks, reports transactional risk and automatically gives signal of occurrence of transactional risk. This was evident by the mean of 3 which represented Not Sure in the Likert Scale. The study also established that the respondents disagreed on the existence of the following features of the system; that the system can define all transactional risks and communicate appropriate actions online evident by the mean of 2 which according to Likert Scale represented disagree.

This finding therefore showed that the Safari Card System used by KWS to manage revenue risks was not able to define all transactional risks and communicate appropriate actions online. The employees were also not sure of the ability of the system to; be fully operationalized, captures risk occurrence, by keeping records of transactions, quantify and report transactional risks, reports transactional risk and automatically gives signal of occurrence.

**Figure 2: KWS Revenue Collection Trends (2001-2012)**

Based on the revenue secondary data collected by the study, the revenue collection of KWS was low between 2001 – 2007 and sank further in 2008. This scenario indicated that there was a problem with revenue collection which required an immediate attention. This situation forced the Conservation to come up with a solution which can reverse the poor revenue collection trend. Electronic Payment Smart Card System was introduced in 2000 but did not bear any fruits as far as reduction of revenue risk was concern before 2009 when more risks mitigations of smart card were enhanced. The revenue collection started taking a positive turn by improved gradient shown in figure 2 above. Safari Card System was introduced in 2010 to replace smart card with an aim of increasing revenue collection by sealing all possible revenue leakages which even improved revenue collection further with an indication drop in the year 2012. The study is interested in analyzing the financial statements further to establish whether the changes had an effect in KWS liquidity and efficiency as indicators of financial performance.

**Figure 3: KWS Working Capital (2001-2012)**

Working capital was used to measure KWS ability to meet its short-term obligations. The study established that before the introduction of Safari Card in 2010, working capital was generally below Kshs. 100,000,000 showing that although KWS working capital was positive, its ability to meet its short term obligations was too low, a case which could cause liquidity panic in the organization. When Safari Card was introduced, the working capital was above Kshs 400,000,000 indicating high ability to meet its obligation as per when they were dues but declined to Kshs. 150,000,000 in the year 2012.

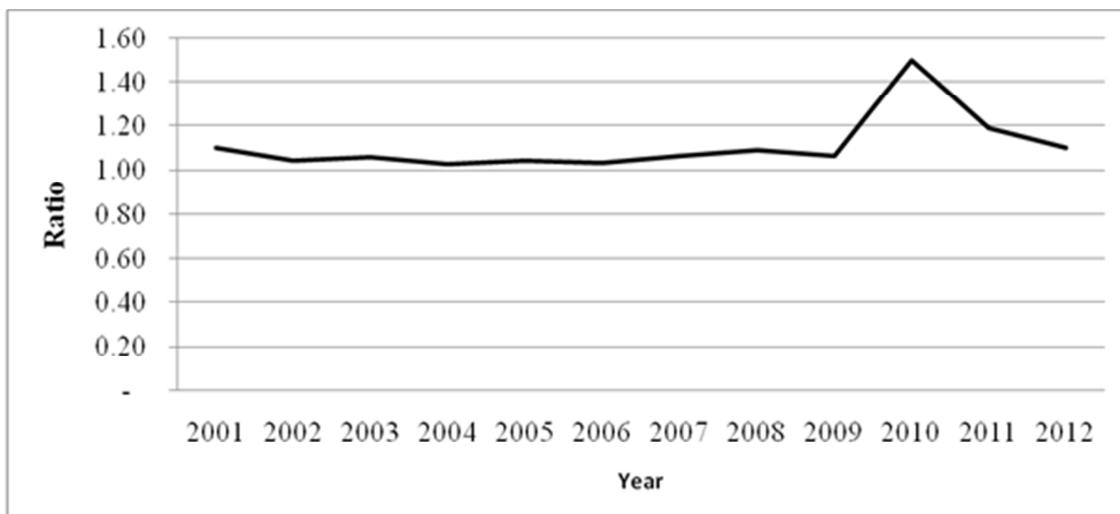


Figure 4: KWS Current Ratio (2001-2012)

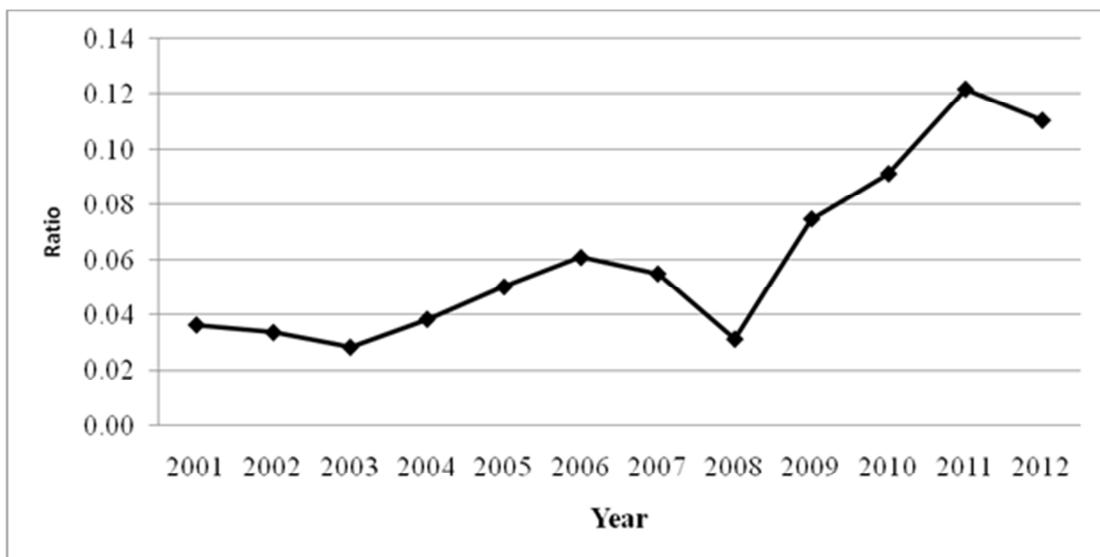


Figure 5: KWS Asset Turnover Ratio

The amount of revenues generated per Kenya Shilling of assets by KWS. The Asset Turnover ratio was used to indicate the efficiency with which KWS was deploying its assets. Generally the ratio was below 1 indicating that however hard KWS employed its Asset, according to the secondary data collected from financial statements, KWS did not generate enough revenue. It is important to note that there was an increase in 2010 and 2011 indicating the effect of Safari Card showing that KWS was putting into use its asset and was generating revenue which would leak due to poor revenue risk management in place (see table 4).

Current ratio was used to ascertain whether KWS short-term assets (cash, cash equivalents, marketable securities, receivables and inventory) were readily available to pay off its short-term liabilities (notes payable, current portion of term debt, payables, accrued expenses and taxes). The study established a positive more than 1 ratio throughout the years indicating that KWS had ability to pay off its short term liabilities as to when they occurred. It is important to note that this ability improved more in 2010 when Safari Card was introduced.

Table 2: Correlation between Safari Card Transactional Risk with Financial Performance

Correlations	Transaction	Current ratio	Working Capital	Asset Turnover
Transaction	1.000	*0.460	-0.412	-0.087
Significance le		0.04	0.07	0.71

The study established a strong positive correlation with $P<0.05$ between Safari Card Risk Management and current ratio, an insignificant negative Correlation of -0.412 with $P=0.07>0.05$ between Safari Card Risk Management and working capital and an insignificance negative correlation of -0.087 with $P=0.71>0.05$.

This finding indicated that the introduction of Safari Card as a transactional risk reduction system made KWS to increase its liquidity as a measure of financial performance, although the system did not improve working capital that is the system did not make the Company obtain different credits from providers as a source of operating liquidity towards its operations. The finding also indicated that the system did not influence the use of the company's asset in generating sales revenue or sales income.

4.2 EFFECT OF SAFARI CARD CASH HANDLING RISK MANAGEMENT ON FINANCIAL PERFORMANCE

Table 3: Safari Card Cash Handling Risk Management

Cash handling	N	Min.	Max.	Mean	Std. Dev.
Reduces cash handling risk	283	1	5	4	1.3
Reduces exposure to cash handling	283	1	5	4	1.3
Reduces collation with customers	283	1	5	3	1.3
Reduces tedious paper work	283	1	5	3	1.4
It ensures safety of cash	283	1	5	3	1.4
Automatically bank	283	1	5	3	1.6

The study established that Safari Card risk management system reduced risk associated with cash handling and also reduced exposures to cash handling risk. This was evident by the respondents who agreed on these two aspects of cash handling expressed in the Likert Scale where the mean of 4 represented Agree. The respondents were not sure whether the system; reduced collation with the customers during cash handling, reduction in the tedious paper work, safety of an equivalent of cash out of transaction and the system's ability to automatically bank the produce out of a transaction. This was evident with the respondents mean choice which was 3 representing not sure.

This finding indicated that Safari Card was able to reduce risk associated with cash handling and also reduced exposures to cash handling risk, although it was not clear in the respondents mind whether it could reduce collation with the customers during cash handling, reduce the tedious paper work associated with cash handling, safety of an equivalent of cash out of transaction and the system's ability to automatically bank the produce out of a transaction.

Table 4: Correlation between Safari Card Cash Handling Risk with Financial Performance

Correlations	Cash	Current ratio	Working Capital	Asset Turnover
Cash	1	0.534	0.515	-0.176
Significance		0.015	0.020	0.459

*Correlation is significant at the 0.05 level (2-tailed).

The study established a strong positive correlation with $P=0.015<0.05$ between Safari Card cash Risk and current ratio, a strong positive correlation with $P=0.02<0.05$ between Safari Card cash Risk and KWS working capital but an insignificant negative Correlation of -0.176 with $P=0.459>0.05$ between Safari Card Risk cash handling and asset turnover.

This finding indicated that the introduction of Safari Card cash handling system positively improved KWS liquidity and also created trust where creditors could extend working capital to the organization although it did not improve efficiency where by KWS assets were optimally used to generate the required liquidity in a short term.

4.3 EFFECT OF CUSTOMERS' RELATIONSHIP MANAGEMENT BROUGHT BY SAFARI CARD SYSTEM ON FINANCIAL PERFORMANCE

Table 5: Safari Card Customer Relations Risk Management

Customer Relation	N	Min.	Max.	Mean	Std. Dev.
Payments can be traced electronically	283	1	5	3	1.5
Reduces customer dissatisfaction	283	1	5	3	1.5
Zero corruption tolerance	283	1	5	4	1.4
Electronically identification of customers	283	1	5	4	1.3
Tariffs automatically updated	283	1	5	4	1.5

The study established that the introduction of Safari Card at KWS helped the organization to achieve zero corruption tolerance in tempering with revenue, the system also improved customers' relations by electronically identifying each customer and automatically updating tariff so that there were no arguments when it comes to tariffs. This was evident by the mean response of 4 on these three aspects of customers' relations which according to Likert Scale was Agree. On the other hand, respondents were not sure whether Safari Card system made customers payments traceable electronically and it did not reduce the already expressed customers' dissatisfaction. This was evident by respondent mean choice of 3 which represented not sure.

The finding showed that the introduction of Safari Card System helped the organization to achieve zero corruption tolerance in tempering with revenue, the system also improved customers' relations by electronically identifying each customer and automatically updating tariff so that there were no arguments when it comes to tariffs but did not expressively make customers payments traceable electronically and it did not reduce the already expressed customers' dissatisfaction.

Table 6: Correlation between Safari Card Customer Relations Risk with Financial Performance

Correlations	Customer Relations	Current ratio	Working Capital	Asset Turnover
Customer Relations	1	-0.283	-0.281	-0.029
Significance		0.227	0.230	0.902

The study established a negative insignificance correlation of -0.283 with P=0.227>0.05, -0.281 with P=0.230>0.05, -0.029 with P=0.902>0.05 between current ratio, working capital, asset turnover and customers relations. This finding indicated that the introduction of Safari Card Customers Relations risk management system did not positively influence KWS liquidity, working capital and use of its assets optimally to generate the required short term liquidity.

4.4 EFFECT OF FINANCIAL INFORMATION MANAGEMENT BROUGHT BY SAFARI CARD SYSTEM ON FINANCIAL EFFICIENCY

Table 7: Safari Card Financial Information Risk Management

Financial Information Risk	N	Min.	Max.	Mean	Std. Dev.
Automatic generation	283	1	5	3	1.4
Information transparently available	283	1	5	4	1.1
No unauthorized changes	283	1	5	4	1.2
Information is shared	283	1	5	3	1.1
access electronically controlled	283	1	5	3	1.2
There is audit controls	281	1	5	3	1.2

The study established that the introduction of Safari Card brought the following benefits as far as financial information risks are concern; financial information were transparently available for decision making and there was also controlled access. This was evident by the respondents choice mean score which was 4 representing Agree in Likert Scale. On the other hand, the respondents were not sure whether Safari Card could; automatically generated financial transactions, share information across the network, electronically control access and enhance audit controls for purposes of improved reliability. This was evident by the respondents' choice of 3 which according to Likert scale meant respondents being not sure.

This finding indicated that the introduction of Safari Card brought the following benefits as far as financial information risks are concerned; financial information were transparently available for decision making and there was also controlled access.

Table 8: Correlation between Safari Card Financial Information Risk with Financial Performance

Correlations	Financial Information	Current ratio	Working Capital	Asset Turnover
Financial Information	1	-0.274	-0.294	-0.045
Significance		0.227	0.230	0.902

The study established a negative insignificance correlation of -0.274 with P=0.227>0.05, -0.294 with P=0.230>0.05, -0.045 with P=0.902>0.05 between current ratio, working capital, asset turnover and customers relations. This finding indicated that the introduction of Safari Card financial information risk management system did not positively influence KWS liquidity, working capital and use of its assets optimally to generate the required short term liquidity.

5 CONCLUSIONS AND RECOMMENDATIONS

The introduction of Safari Card as a transactional risk reduction system made KWS to increase its liquidity as a measure of financial performance, although the system did not improve working capital that is the system did not make the Company obtain different credits from providers as a source of operating liquidity towards its operations. The finding also indicated that the system did not influence the use of the company's asset in generating sales revenue or sales income. Secondly, the introduction of Safari Card cash handling system positively improved KWS liquidity and also created trust where creditors could extend working capital to the organization although it did not improve efficiency where by KWS assets were optimally used to generate the required liquidity in a short term. Thirdly, the introduction of Safari Card Customers Relations risk management system did not positively influence KWS liquidity, working capital and use of its assets optimally to generate the required short term liquidity. Four, the introduction of Safari Card financial information risk management system did not positively influence KWS liquidity, working capital and use of its assets optimally to generate the required short term liquidity.

Based on the findings of this study, the following recommendations were important as far as analysis of Safari Card as a revenue risk management practices on financial performance by Kenya Wildlife Services. First, KWS should increase awareness among employees about revenue leakage and its effect on financial performance as the first step of dealing with challenge. Safari Card system should also be promoted among employees as a matter of awareness and also promoted among the Conservation clients in order to popularize the system. Second, KWS should first popularize the objectives of its revenue risk management practices. This can be done through carrying out participatory revenue risk assessments, designing an effective electronic systems that can reduce exposure to risk, implementing the system effectively and continuously monitoring and evaluating its performance for purposes of improving the system and hence reducing revenue leakages and associated risks. Third, the employees and key customers should be trained on the key elements of Safari Card system as a way of creating awareness of the key features of the system. This will enable the employees and the end users to freely interact with the system in a manner that will enhance its use and hence reduction of revenue risks. Four, KWS should not only use the system as a quick financial tool for sealing revenue leakages and hence enhancing revenue collection but also design it in such a way that it can create creditors confidence to inject more working capital and also incorporate it in efficient use of asset as a means of generating more revenue from the exiting asset. Five, KWS should re-evaluate the system to establish how improved cash handling brought about by Safari Card system could also target the existing assets with a view of operating them optimally so that they can generate the required short term liquidity. Five, KWS should re-evaluate Safari Card system with a view to aligning it with the organization's improvement on liquidity, working capital and proper use of assets to generate the required short term liquidity. Last, KWS should re-evaluate Safari Card financial information risk with a view to aligning it with the organization's improvement on liquidity, working capital and proper use of assets to generate the required short term liquidity.

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Etude de la Qualité d'un dérivé de dattes Marocaines (cas de Tahlaoute)

[Quality Study of a derivative of Moroccan dates (case of Tahlaoute)]

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ABSTRACT: The objective of this work is the study of the quality of a derivative of Moroccan dates: Tahlaoute. It is a vital and essential product oasis whose population exceeds two million. However, this product has been a little or no studies. The study was performed on 220 samples (110 samples of traditional Tahlaoute and 110 samples of industrialized Tahlaoute), the physicochemical characteristics (4 criteria), the microbiological and hygienic (10 criteria) were assessed against the standards. The results showed that the quality of industrialized Tahlaoute is much larger than traditional Tahlaoute and this on all criteria studied whether physico- chemical or microbiological (60% of samples of traditional Tahlaoute are not consistent with international standards). In addition, storage conditions are generally unfavorable, resulting in an alteration of traditional Tahlaoute and its susceptibility to contamination by microorganisms. The control of manufacturing processes and preparation as well as the entire food chain of these products must be improved to ensure the health and safety of consumers.

KEYWORDS: Morocco, Dates, Tahlaoute, quality, microbiological study, physicochemical analysis.

RESUME: L'objectif de ce travail est l'étude de la Qualité d'un dérivé de dattes marocaines : Tahlaoute. Ce dernier constitue un produit vital et de première nécessité des oasis dont la population dépasse les deux millions d'habitants. Néanmoins, ce produit n'a fait l'objet que de peu ou de pas d'études.

L'étude a été réalisée sur 220 échantillons (110 échantillons de Tahlaoute traditionnelle et 110 échantillons de Tahlaoute industrialisée), des caractéristiques physico-chimiques (4 critères), microbiologiques et hygiéniques (10 critères) ont été évaluées par rapport aux normes en vigueur. Les résultats ont montré que la qualité de Tahlaoute industrialisée est beaucoup plus importante que celle de Tahlaoute traditionnelle et ceci sur tous les critères étudiés qu'ils soient physico-chimiques ou microbiologiques (60% des échantillons de Tahlaoute traditionnelle ne sont pas conformes aux normes internationales). En outre, les conditions de stockage sont en général peu favorables, ce qui entraîne une altération de Tahlaoute traditionnelle et sa prédisposition à des contaminations par les microorganismes. La maîtrise des procédés de

fabrication et de préparation ainsi que toute la chaîne alimentaire de ces produits doit être améliorée pour garantir la salubrité et la sécurité des consommateurs.

MOTS-CLEFS: Maroc, Dattes, Tahlaoute, Qualité, Etude microbiologique, Analyse physicochimique.

1 INTRODUCTION

Le palmier dattier (*Phoenix dactylifera L*) constitue une part importante du Sahara, car il joue un rôle important dans la protection des cultures et de système écologique. Les dattes fruits constituent les principales sources de revenus et l'économie pour les personnes vivant dans les oasis marocaines.

La datte fruit est une baie à une seule graine composée d'un mésocarpe charnu couvert par un épicarpe mince, un endocarpe dur entourant la graine [1]. Le Maroc est le sixième pays producteurs de datte avec plus de 4,8 millions de palmiers dattiers, répartis dans les provinces d'Ouarzazate, Errachidia, Tata, Tiznit, Goulmim, Figuig, Marrakech et Agadir [2]. La production cumulative annuelle dans le pays fluctue énormément en fonction des conditions climatiques particulièrement la pluie ou la sécheresse. En année normale, la production totale est supérieure à 100.000 tonnes, dont 25% sont de haute qualité (Mejhoul, Boufeggous, Bouskri, et Aziza Bouzid), 35% de qualité moyenne et 40 % peut être classé comme de faible qualité [2].

D'une manière générale, les dattes présentent des humidités inférieures à 40%. Elles sont classées parmi les aliments à humidité intermédiaire dont la conservation est relativement aisée [3]. Les travaux de Harrak et al. (2005) [4] ont montré que les teneurs en eau varient selon les variétés de dattes. Le pH et l'acidité totale titrable des dattes varient respectivement de 4,9 à 6,7 et de 0,165 à 0,470g d'acide citrique/100 g de dattes. Les variétés aux acidités totales titrables les plus élevées et également à pH les plus faibles sont Bouijjou et Outoukdjm. Les pH les plus élevés sont observés pour Mejhoul (6,7), Bouskri (6,6) et Bouzeggar (6,5). De telles valeurs du pH des dattes pourraient être un indicateur de la qualité commerciale. La majorité des autres variétés ont des valeurs du pH qui se situent entre 5,3 et 6,3 caractérisant des dattes de qualité moyenne. La confrontation des deux paramètres laisse apparaître, d'une façon générale, que le pH et l'acidité varient de manière inverse [4].

Une étude faite par H. HARRAK [5] montre que le jus des dattes (Tassabount) a une très bonne qualité microbiologique, l'acidification du jus et la présence de composés d'arôme et des composés phénoliques à effets antimicrobiens, ont fourni une protection contre l'altération microbienne au cours du stockage.

La présente étude évalue des critères permettant de renseigner sur la qualité d'un principal dérivé des dattes; c'est le cas de Tahlaoute (concentré de dattes) qui est un principal produit vital des oasis. Ce produit soit préparé traditionnellement par les femmes sahariennes à base des dattes molles et de l'eau et qui sont soumis à une cuisson sous un feu doux pendant 6 à 10 heures (Figure N°1), soit préparé dans des coopératives d'une manière plus au moins industrialisée (Figure N°2).

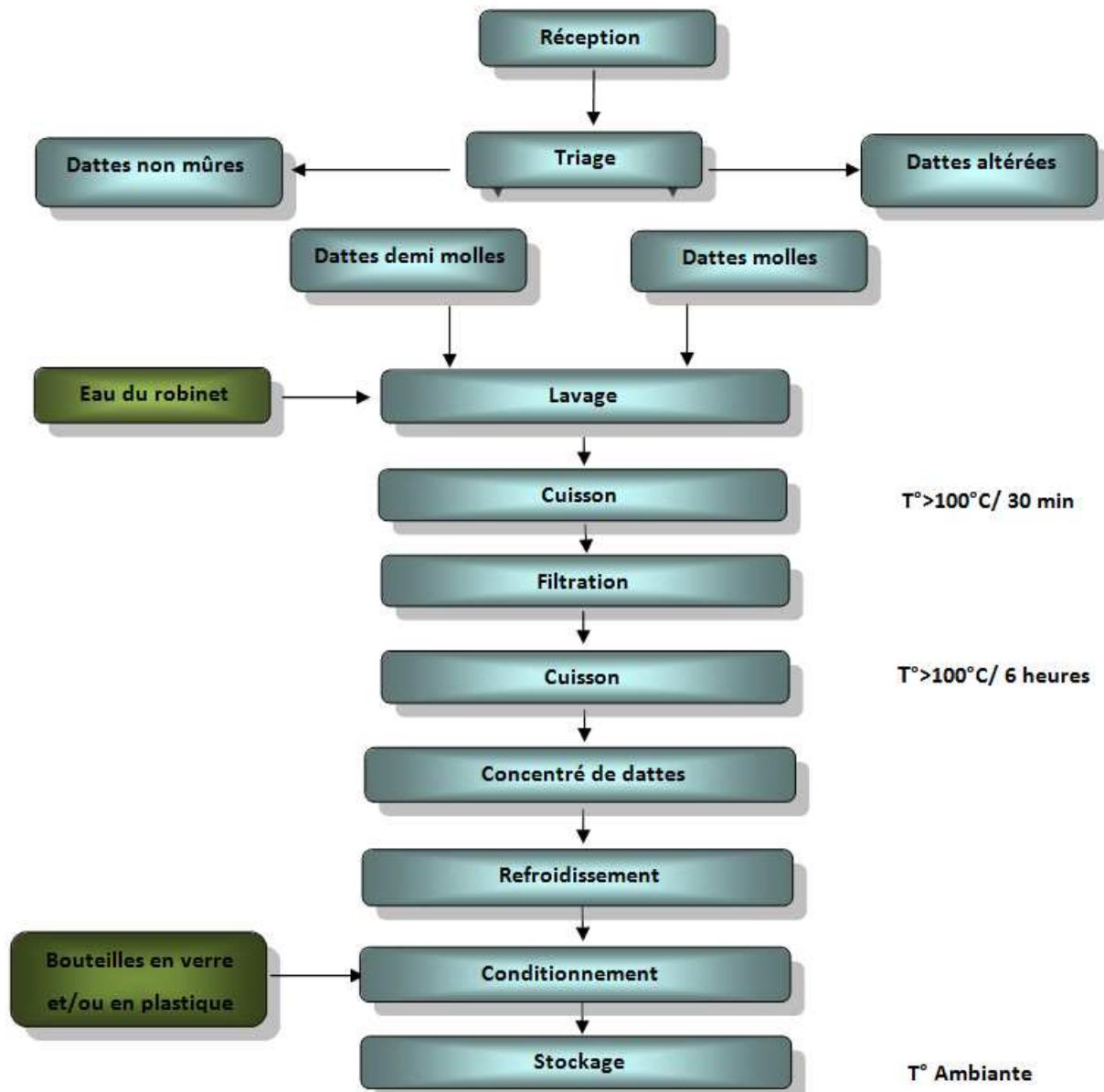


Fig. 1. Processus de préparation de Tahlaoute traditionnelle

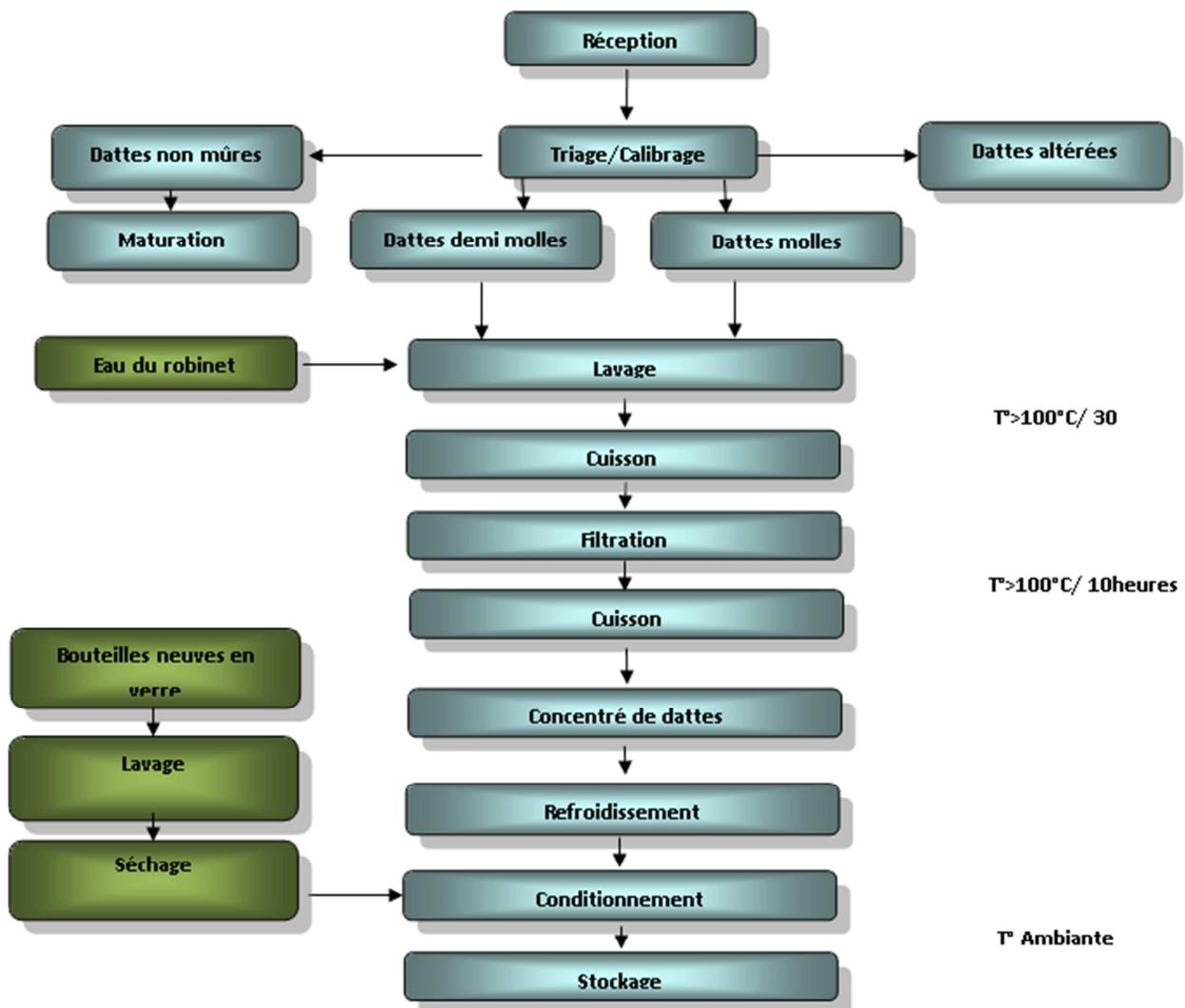


Fig. 2. Processus de préparation de Tahlaoute Industrialisée

D'après les deux figures il apparaît que les deux produits ont presque les même étapes de fabrication sauf au cours de l'étape de deuxième cuisson et au cours de conditionnement ; dont Tahlaoute traditionnelle est cuite pendant moins de dix heures et elle est conditionnée dans des bouteilles non stérilisées en plastique et/ou en verre, alors que Tahlaoute industrialisée est cuite pendant dix heures et elle est conditionnée dans des bouteilles stériles en verre. L'objectif de cette étude est l'étude de la qualité physico-chimique et Microbiologique de Tahlaoute.

2 MATERIEL ET METHODES

2.1 MATÉRIEL

Le matériel utilisé est constitué de 110 échantillons de Tahlaoute industrialisée et 110 échantillons de Tahlaoute traditionnelle ont été sélectionnés aléatoirement à partir de cinq sites à Errachidia.

2.2 MÉTHODE D'ÉCHANTILLONNAGE

L'échantillonnage est fait aléatoirement à partir de cinq sites : le grand marché d'Errachidia, marché d'Arfoud, marché d'Aoufous, marché de Jorf et marché de Bab Lakhmis (Salé). Quatre critères physico-chimiques et biochimiques ont été évalués: matière sèche, conductivité électrique, pH, acidité totale titrable (titrimétrie) ainsi que les analyses microbiologiques (flore mésophile aérobie totale, *Staphylococcus aureus*, Coliformes totaux, Coliformes fécaux, les salmonelles, *Clostridium perfringens*, les bactéries lactiques, les streptocoques, les levures et les moisissures).

2.3 ANALYSES PHYSICO-CHIMIQUES

Les paramètres étudiés sont présentés sur le tableau ci-dessous : (Tabl 1.)

Tableau1. Paramètres physicochimiques déterminés

Caractéristiques étudiées	Référence	Commentaire
Matière sèche	[6]	Dessiccation (jusqu'à une mesure pratique constante) de la matière fraîche à température de $80\pm2^{\circ}\text{C}$ dans une étuve isotherme ventilée à la pression atmosphérique vue que les produits sont thermosensibles
Acidité totale titrable	[7]	La solution liquide du produit a été préparée et analysée par titrimétrie à pH 8.1 avec une solution d'hydroxyde de sodium (NaOH) 0.1N selon les références cités. L'acidité titrable totale est exprimée en grammes d'acide citrique par litre.
pH	[7]	La détermination du pH s'effectue dans nos conditions par une lecture directe à l'aide d'un pH-mètre préalablement étalonné
Conductivité électrique	[7]	Dans une Fiole de 150ml, 10g d'échantillon est dispersé dans l'eau distillée. La solution obtenue sert à déterminer conductivité électrique en utilisant un pH mètre multiparamétrique.

2.4 ANALYSES MICROBIOLOGIQUES

L'analyse de la qualité hygiénique se base sur la connaissance de la flore microbienne existante dans le produit alimentaire. Cette appréciation reste de nos jours la meilleure méthode de la qualité d'un aliment. Au terme de cette étude nous avons adopté le principe de dilution jusqu'à 10^{-5} et les microorganismes recherchés sont présentés sur le tableau ci-après (Tabl.2).

Tableau.2 Microorganismes recherchés

Facteurs/caractéristiques étudiées	Référence	Commentaire
Flore d'intérêt hygiénique		
La Flore mésophile aérobie totale FMAT	[8]	Le dénombrement de la FMAT a été effectué après dilutions appropriées de l'échantillon dans le bouillon d'eau peptone tamponnée et ensemencement sur la gélose Plate Count Agar PCA et incubée à 30°C pendant 72 heures
coliformes totaux CT et coliformes fécaux CF	[9]	Le dénombrement des coliformes totaux a été effectué sur la gélose DLC* (Désoxycholate-Citrate-Lactose) à 37°C et à 45°C pour les coliformes fécaux (colonies rouges). Après 24h.
Staphylococcus aureus	[10]	Cette bactérie est cultivée facilement sur milieu solide (Chapman au mannitol à 10g%) à 37°C pendant 24h. Les colonies développées sont lisses, luisantes et bombées, plus ou moins pigmentées en jaune or.
Streptocoques fécaux	[11]	le dénombrement a été effectué sur le bouillon de Rothe et après incubation à 37°C pendant 24h, les tubes positifs ont été ensemencés sur le bouillon de Litsky après incubation à 37°C pendant 24h
Clostridium perfringens	[12]	le dénombrement du Clostridium a été réalisé sur le milieu SPS (Sulfite de Sodium polymixine-Sulfite de Cystéine). La solution mère est un traitement thermique à 80°C pendant 10min. Ensuite, l'ensemble est incubé à 30°C pendant 24h à 48h. Seules les colonies noires seront comptées.
Flore d'intérêt sanitaire		
Listeria monocytogenes	[13]	Après enrichissement dans un milieu: Faser1/2, puis dans un milieu Fraser*, elle se développe facilement sur un milieu Oxford* où les colonies s'entourent d'une zone de β hémolyse.
Salmonella	[14]	Enrichissement : on utilise deux milieux, le bouillon Muller Kaufman et le tétrathionate (MKTn)-(Merck, Allemagne). L'ensemencement a été fait à partir des cultures sur eau peptone et son incubation ultérieure) 37°C pendant 24h. les colonies de salmonella apparaissent vertes
Flore d'intérêt technologique		
Levures et Moisissures	[15]	La méthode consiste à ensemencer le milieu Potato Dextrose Agar (PDA) fortement acidifié (pH 3-3.5) par l'acide lactique. Le dénombrement a été effectué après 3 jours pour les levures et 4 jours pour les moisissures d'incubation à 30°C
Bactéries Lactiques	[16]	Le dénombrement des bactéries lactiques est réalisé sur un milieu MRS* avec ensemencement en profondeur des boites de pétri et incubation à 30°C pour les espèces mésophiles et à 45°C pour les espèces thermophiles pendant 48h.

3 PRESENTATION DES RESULTATS

3.1 3.1. ANALYSES PHYSICO-CHIMIQUES DE TAHLAOUTE

Sur les 110 d'échantillons de Tahlaoute traditionnelle et les 110 d'échantillons de Tahlaoute industrialisée quatre paramètres ont été étudiés (Cf. Tabl.3).

Tableau.3 Résultats des analyses physico-chimiques de Tahlaoute Traditionnelle et industrialisée

Caractéristiques étudiées	Tahlaoute traditionnelle	Tahlaoute industrialisée
Matière sèche (%)	85,08	76,14
Acidité totale titrable (°D)	21,6	12,11
pH	4,10	4,63
Conductivité électrique (mS/cm)	124	149

Les résultats obtenus montrent que la matière sèche présente une moyenne de 85,08% pour Tahlaoute traditionnelle alors qu'elle est de l'ordre de 76,14% pour Tahlaoute industrialisée.

La valeur moyenne de pH de Tahlaoute Traditionnelle est inférieure à celle de Tahlaoute industrialisée, alors que l'acidité de cette dernière est moins importante par rapport à celle de Tahlaoute traditionnelle.

Les résultats obtenus de la Conductivité électrique (CE) présentent une légère différence entre Tahlaoute traditionnelle qui est de 124 mS/cm et Tahlaoute industrialisée qui est de 149 mS/cm.

3.2 ANALYSES MICROBIOLOGIQUES DE TAHLAOUTE

Au terme de cette étude, les microorganismes identifiés sont présentées sur le tableau ci-dessous (Tabl. 4)

Tableau.4 Résultats des analyses microbiologiques de Tahlaoute traditionnelle et industrialisée

caractéristiques étudiées	Tahlaoute traditionnelle	Tahlaoute Industrialisée	Normes	Référence
Flore d'intérêt hygiénique				
La Flore mésophile aérobiose totale FMAT	$3,4 \cdot 10^5$ UFC/ml	Absente	$<10^6$ UFC/ml	[8]
Coliformes totaux	10^3 UFC/ml	Absente	$<10^3$ UFC/ml	[9]
Staphylococcus aureus	Absente	Absente	-----	-----
Les Streptocoques fécaux	Absente	Absente	-----	-----
Clostridium perfringens	Absente	Absente	-----	-----
Flore d'intérêt sanitaire				
Listeria monocytogenes	Absente	Absente	-----	-----
Salmonella	Absente	Absente	-----	-----
Flore d'intérêt technologique				
Levures	$21 \cdot 10^4$ UFC/ml	Absentes	$<10^3$ UFC/ml	[15]
Moisissures	$1,1 \cdot 10^5$ UFC/ml	Absentes	$<10^3$ UFC/ml	[15]
Bactéries lactiques	$3,4 \cdot 10^4$ UFC/ml	$2 \cdot 10^5$ UFC/ml	-----	-----

Les résultats obtenus montrent une moyenne de FMAT de Tahlaoute traditionnelle $3,4 \cdot 10^5$ UFC/ml, ($<10^6$ UFC/ml selon les normes internationales [8], alors que ces microorganismes sont absents dans les échantillons de Tahlaoute industrialisé.

La charge moyenne en Coliformes totaux (CT) des échantillons de Tahlaoute traditionnelle est de $3,5 \cdot 10^2$ UFC/ml ($<10^3$ UFC/ml selon les normes internationales [9], Par contre les résultats obtenus de CT des échantillons de Tahlaoute industrialisée montre l'absence totale de ces microorganismes.

Staphylococcus aureus, les salmonelles, Clostridium perfringens et les streptocoques sont absentes dans les deux types de Tahlaoute. Pour les Bactéries lactiques L'analyse des résultats de Tahlaoute traditionnelle et Tahlaoute industrialisée montre des moyennes qui sont successivement de $3,4 \cdot 10^4$ UFC/ml et $2 \cdot 10^5$ UFC/ml.

La recherche des levures et moisissures montre une charge moyenne de $21 \cdot 10^4$ UFC/ml de levures ($<10^3$ UFC/ml selon les normes internationales) et de $1,1 \cdot 10^5$ UFC/ml ($<10^3$ UFC/ml selon les normes internationales) de moisissures dans les échantillons de Tahlaoute traditionnelle alors qu'elles sont absentes dans les échantillons de Tahlaoute industrialisée.

Les résultats physico-chimiques et microbiologiques montrent que 60% des échantillons de Tahlaoute traditionnelle ne sont pas conformes aux normes internationales.

4 ANALYSE ET DISCUSSION DES RESULTATS

Dans le cadre de la valorisation de Tahlaoute et l'amélioration de sa qualité, l'ensemble de 110 échantillons de Tahlaoute industrialisé et 110 échantillons de Tahlaoute traditionnelle a été soumis à une analyse physico-chimique (pH, acidité, Conductivité électrique et la matière sèche) et à une analyse microbiologique (recherche de la flore mésophile aérobiose totale, *Staphylococcus aureus*, Coliformes totaux, Coliformes fécaux, les salmonelles, *Clostridium perfringens*, les bactéries lactiques, les streptocoques, les levures et les moisissures) pour améliorer les procédés traditionnels de préparation de Tahlaoute et investir dans la qualité.

L'analyse des résultats obtenus montre une Moyenne de la matière sèche de Tahlaoute traditionnelle qui est très importante par rapport à celle de Tahlaoute industrialisée et à celle des dattes (humidité <40%, [3].

La détermination de pH, d'acidité et de la Conductivité électrique est essentielle pour avoir s'il y a une activité microbienne ou pas : le pH et l'acidité titrable de Tahlaoute traditionnelle sont de l'ordre de (pH =4,10, acidité=21,6°D) et qui sont très importantes par rapport au Tahlaoute industrialisé (pH =4,63, acidité=11,12°D) et qui sont inférieurs à ceux des dattes (pH=4,9 à 6,7 et acidité de 0,165 à 0,470g d'acide citrique/100 g de dattes) [4] ce qui confirme le goût acidulé de Tahlaoute traditionnelle.

Une étude similaire par Heller (1990) [17] a montré que le pH peut varier suivant l'état physiologique du fruit, aussi suivant les conditions climatiques et de stockage. Aussi des travaux faits sur le type «Deglet Nour » montrent qu'au cours des différents stades de l'évolution de cette variété, les acides organiques décelés sont l'acide malique et acétique, ils apparaissent et disparaissent entre le stade «Kimri » et le début de stade «Khalal ». Après ce stade ils se stabilisent en quantité égale. Ces acides ont une influence significative sur le pH [18].

Les résultats obtenus de la Conductivité électrique (CE) présentent une légère différence entre Tahlaoute traditionnelle qui est de 124 mS/cm et Tahlaoute industrialisée qui est de 149 mS/cm. Généralement la forte acidité et l'augmentation de la Conductivité électrique sont souvent associées à une mauvaise qualité des dattes utilisées dans la transformation ce qui est confirmé dans notre étude par la présence de FMAT ($3,4 \cdot 10^5$ UFC/ml), de levures ($21 \cdot 10^4$ UFC/ml) et des moisissures ($1,1 \cdot 10^5$ UFC/ml) dans les échantillons de tahlaoute traditionnelle, alors qu'elles sont absentes dans les échantillons de Tahlaoute industrialisée, une étude microbiologique faite par H. HARRAK [5] sur le jus des dattes « Tassabout » montre une bonne qualité microbiologique. La FMAT est considéré comme le premier index de la qualité des aliments [19].

Les coliformes sont habituellement utilisés comme un indicateur de l'hygiène de préparation d'aliment [20] cette contamination est due principalement à l'utilisation des bouteilles en plastique et en verre non stérilisées, au cours de l'étape de conditionnement (diagramme de fabrication de Tahlaoute traditionnelle) alors que Tahlaoute industrialisée est conditionnée dans des bouteilles neuves et stériles. Aussi présence des levures et des moisissures dans les aliments avec des charges élevées, est un indicateur de qualité infectieuse. Ces moisissures agissent sur la santé humaine et animale par la production des substances toxiques qui sont des métabolites secondaires appelées les mycotoxines.

La différence pourrait être du à la durée de stockage des dattes utilisés dans la transformation (le pH diminue avec l'augmentation de la durée de stockage à T° ambiante) ce qui est traduit par la présence de flore mésophile aérobie totale, Coliformes totaux, les levures et les moisissures dans les échantillons de Tahlaoute traditionnelle alors qu'ils sont absents dans les échantillons de Tahlaoute Industrialisé.

Les mauvaises conditions de transport et de la commercialisation sont autres facteurs qui peuvent contribuer à augmenter la charge microbienne [20]. En outre, l'humidité élevée à l'intérieur des magasins contribue à croître la proportion de la contamination fongique [21].

5 CONCLUSION

De tout ce qui précède, nous pouvons retenir ce qui suit :

Concernant les critères physico-chimiques, Tahlaoute traditionnelle présente une acidité et une conductivité électrique très importante par rapport au Tahlaoute industrialisée ce qui augmente le risque de son altération.

L'analyse microbiologique de Tahlaoute traditionnelle présente une mauvaise qualité hygiénique, ce qui exprime 60% des échantillons de Tahlaoute traditionnelle ne sont pas conformes aux normes internationales.

En ce sens, l'optimisation des paramètres de fabrication de Tahlaoute traditionnelle par l'utilisation des dattes de bonne qualité et des bouteilles stériles en verre est souhaitable pour avoir une bonne qualité de ce produit. Il est à signaler que les bonnes conditions de stockage et de transport de ces produits améliorent leur salubrité et leur rendement et par conséquent leur sécurité vis-à-vis des consommateurs.

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Robustness of Feedforward Notch and Sallen-Key Compensators used with Second-Order Process

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ABSTRACT: Robustness is one of the requirements used in controllers and compensators design. This paper examines the robustness of a Notch and a Sallen-Key compensator when used to control a highly oscillating second-order process. A variation of $\pm 20\%$ in process parameters is considered through simulation to study its effect on the system performance parameters using the tuned compensators. With a feedforward notch compensator, the variation in process damping ratio has small effect on the settling time, maximum percentage overshoot, and phase margin of the control system, while the change in the process damping ratio has a clear effect on the control system performance. For a negative change in the process parameters, the control system is unstable. With the Sallen-Key compensator, the control system is stable for the whole range of the process parameters variation ($\pm 20\%$). The change in the process damping ratio has a minor effect on the control system settling time, maximum percentage overshoot and phase margin. The change in the process natural frequency has a minor effect on the control system settling time and maximum percentage overshoot. The phase margin changes in the range 40-47 degrees corresponding to the $\pm 20\%$ change in process natural frequency.

KEYWORDS: Notch and Sallen-Key compensators, Compensators robustness, Variation in process parameters, Control system performance.

1 INTRODUCTION

Processes are subject to uncertainty in their parameters during operation. Therefore, it is worth to investigate the effectiveness of the used compensators with such process uncertainty. This will investigated for two types of forward compensators suggested by the author to control highly oscillating second-order processes.

Hu, Chang, Yeh and Kwiatny (2000) used the H_∞ approximate I/O linearization formulation and μ -synthesis to design a nonlinear controller for an aircraft longitudinal flight control problem and address tracking, regulation and robustness issues [1]. Gong and Yao (2001) generalized a neural network adaptive robust control design to synthesize performance oriented control laws for a class of nonlinear systems in semi-strict feedback forms through the incorporation of backstepping design techniques [2]. Lee and Na (2002) designed a robust controller for a nuclear power control system. They used the Kharitonov and edge theorem in the determination of the controller which was simpler than that obtained by the H_∞ [3]. Arvanitis, Syrkos, Stellas and Sigrimis (2003) analyzed PDF controllers designed and tuned to control integrator plus dead time processes in terms of robustness. They performed the robustness analysis in terms of structured parametric uncertainty description [4]. Lhommeau, Hardouin, Cottenceau and Laulin (2004) discussed the existence and the computation of a robust controller set for uncertain systems described by parametric models with unknown parameters assumed to vary between known bounds [5]. Dechanupaprittha, Hongesombut, Watanabe, Mitani and Ngammroo (2005) proposed the design of robust superconducting magnetic energy storage controller in a multimachine power system by using hybrid tabu search and

evolutionary programming. The objective function of the optimization problem considered the disturbance attenuation performance and robust stability index [6].

Chin, Lau, Low and Seet (2006) proposed a robust PID controller based on actuated dynamics and an unactuated dynamics shown to be global bounded by the Sordalen lemma giving the necessary sufficient condition to guarantee the global asymptotic stability of the URV system [7]. Vagja and Tzes (2007) designed a robust PID controller coupled into a Feedforward compensator for set point regulation of an electrostatic micromechanical actuator. They tuned the PID controller using the LMI-approach for robustness against the switching nature of the linearized system dynamics [8]. Fiorentini and Bolender (2008) described the design of a nonlinear robust/adaptive controller for an air-breathing hypersonic vehicle model. They adapted a nonlinear sequential loop-closure approach to design a dynamic state-feedback control for stable tracking of velocity and altitude reference trajectories [9]. Labibi, Marquez and Chen (2009) presented a scheme to design decentralized robust PI controllers for uncertain LTI multi-variable systems. They obtained sufficient conditions for closed-loop stability of multi-variable systems and robust performance of the overall system [10]. Matusu, Vanekova, Porkop and Bakosova (2010) presented a possible approach to design simple PI robust controllers and demonstrate their applicability during control of a laboratory model with uncertain parameters through PLC [11].

Kada and Ghazzawi (2011) described the structures and design of a robust PID controller for higher order systems. They presented a design scheme combining deadbeat response, robust control and model reduction techniques to enhance the performance and robustness of the PID controller [12]. Surjan (2012) applied the genetic algorithm for the design of the structure specified optimal robust controllers. The parameters of the chosen controller were obtained by solving the nonlinear constrained optimization problem using IAE, ISE, ITAE and ITSE performance indices. He used constraints on the frequency domain performances with robust stability and disturbance rejection [13]. Jiao, Jin and Wang (2013) analyzed the robustness of a double PID controller for a missile system by changing the aerodynamic coefficients. They viewed the dynamic characteristics as a two-loop system and designed an adaptive PID control strategy for the pitch channel linear model of supersonic missile [14]. Hassaan (2014) published a series of papers aiming at studying the robustness of some controllers and compensators when used with difficult processes [15-17].

2 ANALYSIS

Process:

The process considered in this analysis has the transfer function, $G_p(s)$:

$$G_p(s) = \omega_n^2 / (s^2 + 2\zeta\omega_n s + \omega_n^2) \quad (1)$$

Where the process parameters are carefully selected to represent one of the difficult industrial processes having high maximum percentage overshoot and large settling time. The process parameters are:

ω_n = process natural frequency = 10 rad/s.

ζ = process damping ratio = 0.05

Feedforward Notch Compensator Tuning:

This compensator was tuned to control this difficult second order process by Hassaan [18]. The compensator has 3 parameters:

- The compensator gain: K.
- The compensator constants: a_1 and b_1 .

The compensator was tuned manually for a satisfactory performance of the closed-loop control system incorporating the compensator and the second order highly oscillating process. The tuning parameters and the control system performance measures are [18]:

$K = 150$

$a_1 = 200$

$b_1 = 100$

$OS_{max} = 0.549 \%$

$T_s = 0.0287 \text{ s}$

$GM = \infty \text{ dB}$

$PM = 67.5 \text{ degrees}$

Process Uncertainty:

Due to the change in the operating conditions during operation, the process is subjected to parametric changes. It is assumed that this change can be as large as $\pm 20\%$ of the assigned process parameters.

Compensator Robustness:

The control system is robust when it has acceptable changes in its performance due to model changes or inaccuracy [19]. On the other hand Lee and Na added the stability requirement to the robustness definition besides the plants having uncertainty [3]. Toscano added that the controller has to be able to stabilize the control system for all the operating conditions [20].

In this work, the robustness of the controller and hence of the whole control system is assessed as follows:

- A nominal process parameters are identified.
- The compensator is tuned for those process parameters.
- A variation of the process parameters is assumed within a certain range.
- Using the same compensator parameters, the step response of the system using the new process parameters is drawn and the control system performance is evaluated through the maximum percentage overshoot and settling time.
- The frequency based relative stability parameters are also evaluated using the open-loop transfer function of the control system.
- The variation in process parameters is increased and the procedure is repeated.

Application of the above procedure results in the fact that with the feedforward Notch compensator almost all the performance parameters change with changing the process natural frequency.

- The control system is unstable for a change in the process natural frequency in the range:
- $20\% \leq \delta\omega_n \leq -2.5\%$
- The control system is stable for a change in the process natural frequency in the range: $0\% \leq \delta\omega_n \leq 20\%$
- The control system is stable for a change in the process damping ratio in the range:
- $20\% \leq \delta\zeta \leq 20\%$
- Fig.1 shows the variation of the settling time against the variation in the process parameters.

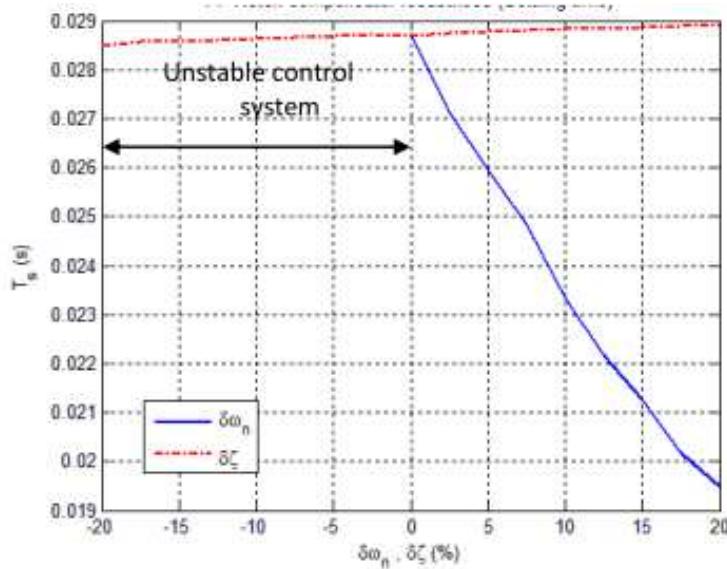


Fig.1 Effect of process parameters change on system settling time (Feedforward Notch compensator).

- Fig.2 shows the variation of the maximum percentage overshoot against the variation in the process parameters.

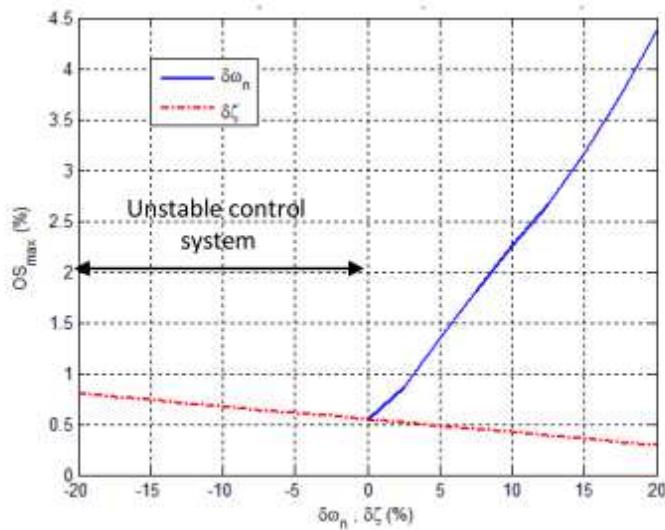


Fig.2 Effect of process parameters change on system maximum overshoot (Feedforward Notch compensator).

- Fig.3 shows the variation of the phase margin against the variation in the process parameters.

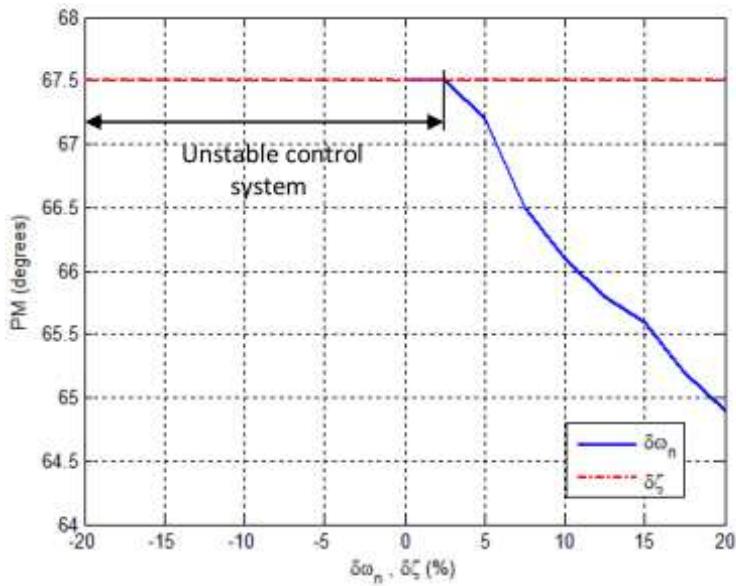


Fig.3 Effect of process parameters change on system phase margin (Feedforward Notch compensator).

Feedforward Sallen-Key Compensator Controlling a Highly Oscillating Second Order Process:

Hassaan used a manual tuning approach to tune a feedforward Sallen-Key compensator when used with a highly oscillating second-order process [21].

The compensator parameters and the system performance measures are:

$$K_c = 99$$

$$\omega_{nf} = 0.04$$

$$\zeta_f = 10$$

Maximum percentage overshoot: 0 %

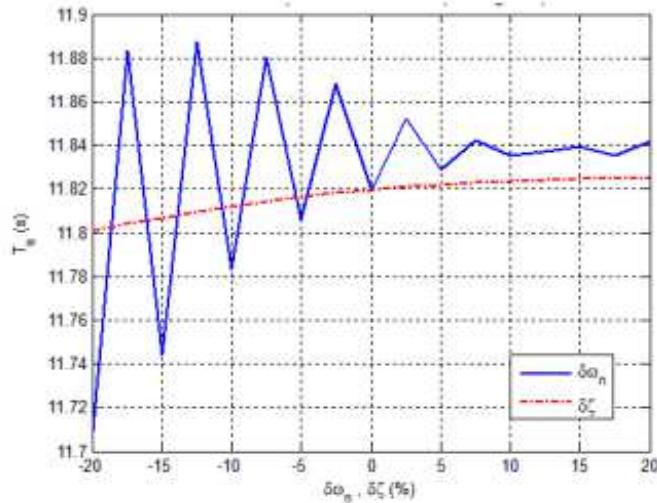
Settling time: 11.819 s

Gain margin: 43.8 dB

Phase margin: 76.9 degrees

The robustness investigation procedure is applied on the resulting control system for process variation in the range $\pm 20\%$ from the nominal values. The results are as follows:

- The change in settling time , maximum percentage overshoot and phase margin with natural frequency variation is negligible.
- The minimum and maximum change in the gain margin with natural frequency change is -8.4 % and 6.8 % respectively.
- The change in damping ratio almost has no effect on all the performance parameters of the control system.
- Fig.4 shows the effect of the natural frequency change on the system settling time.



**Fig.4 Effect of process parameters change of system settling time.
(Sallen-Key compensator).**

- Fig.5 shows the variation of the maximum percentage overshoot against the variation in the process parameters.

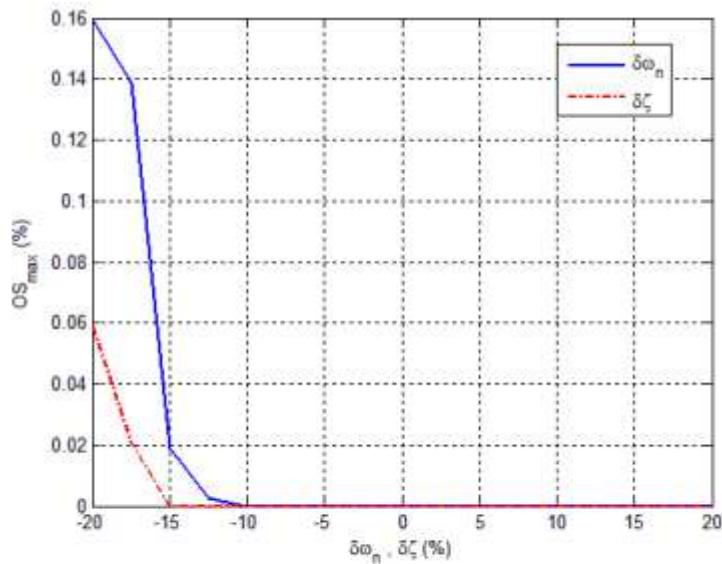


Fig.5 Effect of process parameters change on system maximum overshoot.
(Sallen-Key compensator).

- Fig.6 shows the variation of the phase margin against the variation in the process parameters.

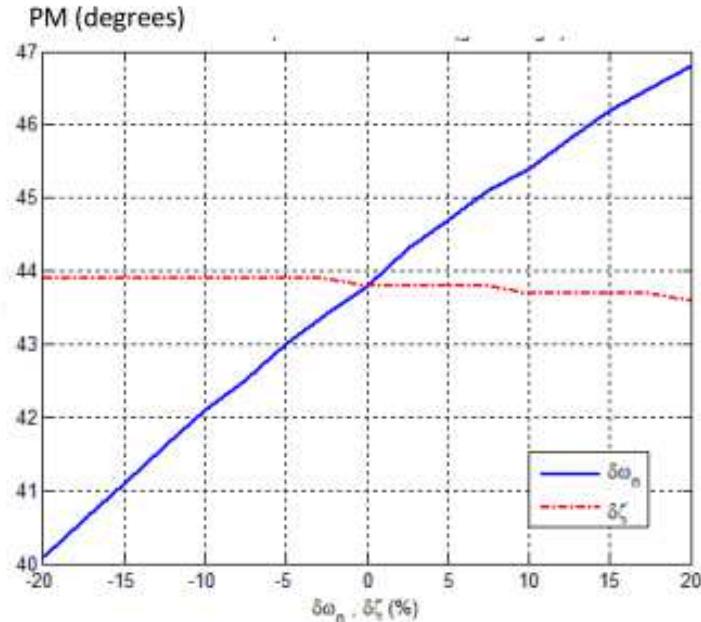


Fig.6 Effect of process parameters change on system phase margin.
(Sallen-Key compensator).

3 CONCLUSION

- Variation in second-order process parameters within $\pm 20\%$ was considered.
- The judgment on the robustness condition of a controller is based on an accepted range of both gain margin and phase margin of the closed-loop control system.
- According to Ogata [22], a recommended range is: $GM \geq 6 \text{ dB}$ and $30 \leq PM \leq 60 \text{ degrees}$.
- According to Lei and Man [23], the phase margin range can be widened to be:
 $30 \leq PM \leq 90 \text{ degrees}$.
- The notch compensator suffered from instability condition associated with negative changes in process natural frequency and damping ratio.
- The Sallen-Key compensator has a robust design since it generated a stable control system for the variation range of $\pm 20\%$ of process parameters.
- With Sallen-Key compensator, the variation in process parameters almost did not change the settling time, maximum overshoot and phase margin.
- The maximum change in gain margin with Sallen-Key compensator was only 8.4 %.
- The notch compensator is not robust when used with the highly oscillating second-order process.
- The Sallen-Key compensator is robust when used with the highly oscillating second-order process.

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Impact of Global Media on the Culture of Pakistan: A Case Study of Youth of Layyah City

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ABSTRACT: Pakistan is an under developing country and it is facing the problems of globalization which are created due to global media. The present study is conducted to dig out the impact of global media of Pakistani culture with particular focus on the role of cable television in the promotion of foreign cultural trends in Pakistan. In this study it is documented that the young generation of Layyah city is extremely influenced due to cable network. To understand that what type of cultural impact have been imposed on our society by foreign TV entertainment channels. By using survey and content analysis data was collected from the target respondents. The results of the study strongly supported that foreign entertainment channels are extremely influencing the Pakistani young generation.

KEYWORDS: Global Media, Cultural Trends, Cable television, entertainment, Foreign Culture

INTRODUCTION

Globalisation is the interconnectivity between different in which the whole world looks like a village. Globalisation is the product of mass media and mass media has promoted the concept of global village. Mass media has created new phenomenon in the society and one of them is cultural globalisation. This issue was initiated with cultural globalisation because now the audiences are global no universal. Now the media contents are produced by keeping in mind the needs and demands of global audience. As global media is under the control of west and west is promoting their own culture at the behalf of free flow of information. This free flow information has created cultural homogeneity and it has replaced the particular cultural identity of under developing nation such as Pakistan. It is a universal reality that Hollywood is extreme advance film industry of the world and is also under the control of west which is promoting the western life among the viewers of under developing nations.

In this way protection of cultural identity has become key factor since 1970s due to cultural globalisation of global media. This trend is a great threat to the local cultural identity of different under developing countries. Culture is a way of life of the individuals of any society which includes attitude, belief, and way of interaction etc. In short culture is a complete code of conduct that how to live in a given society.

Cultural globalisation is the product global and free global media because media has power to make and break the mind of individuals. As west is technology rich and it use the media as an instrument to promote their cultural ideology. Fast food culture and Pizza culture is not the culture of under developing nation but it most popular among under developing nations because western media is promoting these new trends of west. As cable and satellite TV channels has global access and west is getting benefits from the global access by promoting their own cultural values. Globalisation of media is promoting Americanization, most of the researcher stated that it is not globalisation, it is just Americanization of western culture because west is the owner of huge fashion industry and media industry, by these industries it is promoting their own cultural values in the developing nations. Due to globalisation the dependency of different nations has increased on west.

PROBLEM STATEMENT

The contents of global media have power to bring the cultural homogeneity among the different societies of the globe. Media globalisation and cultural imperialism is started when main stream media is under the control of other countries and it is clearly defined that main stream media will promote the culture of their own country. Cable and satellite television is a key factor and best example in the promotion global or western culture among the under developing nations. Exposure to TV creates the perception of outer world in the mind of viewers. Cable and satellite television has extremely influenced our particular cultural ideology and it is a great threat to local and nation culture of Pakistan. Mass media has promoted the cultural globalisation but it has finished cultural identity of individuals. Extensive growth of Cable network in Pakistan is alarming to replace the Islamic culture of Pakistan. So this study will investigate that how the global media (Cable network) is imposing the western cultural trends on the youth of Layyah city (Punjab, Pakistan) with special focus on the on changing attitude, behavior, way of thinking, belief system, and other cultural values.

SIGNIFICANCE OF STUDY

Cultural globalisation is the result of modern invention in the field of communications. Cable television and satellite television has replaced all the communication boundaries and has created new society which is called information society. Global entertainment media has huge access in the world and global media is creating new perceptions in the mind of viewers and it is affecting their social life. As globalisation is the interconnectivity among the different societies of globe and this connectivity due to global media is also influencing the language and culture of different societies. The global trade system is also impacting on our traditional norms and way of thinking for long time period. McLuhan idea of global village has totally changed the entire world.

In the current research effort it will be investigated that how the local and national media groups are influenced due to cable and satellite televisions and how the local media is following the contents of global media. It is reality, when the local media will play the contents of global media then viewers will also adopt the global trends. In each society the culture is stated its representative because culture give the identity to the societies. Youth is also the cultural representative of any society and it is mostly influenced by new cultural trends so, that youth of Layyah city is selected for this case study.

OBJECTIVES

- To explore the key characteristics of media globalisation
- To dig out the youth viewing pattern of cable network
- To indicate the impacts of cable network on youth.

LITERATURE REVIEW

Cultural domination and threat to cultural identity were firstly highlighted by MacBride Commission during 1980. According to Barret (1997) stated that global media is promoting the new cultural trends and it is creating homogeneity of culture in the world which replacing the local cultural identity of different nations. As Ogan (1988) explained that the media of third world countries is widely influenced due global media and third world media is also following the contents of global media. The world is injecting western values by presenting the contents of western media. Thussu (2000) stated that global media is supported by the western advertisers and these are promoting their products by using the global media and global media is also protecting the interests of global advertisers.

Tomlinson (1991) argued that due to global media the west is creating its dominancy over under developing nations. This global is also introducing the new western cultural trends among the viewers of third world countries. Hamelink (1983) stated that west has dominant media groups and it is universal truth that a culture is promoted when the media of one country is influenced by the media of independent country. So the media of third world countries is under the influence of developed nation and they are promoting their own cultural values. According to different critical school of thoughts, cable network and satellite television is the major player to promote the western cultural ideology among the youth. Now youth is the target of mass media and is trying hard to capture the mind of youth. Najia (2003) stated that cable television is promoting the foreign cultural trends among the youth and foreign cultural trends are most popular among the young generation of Pakistan. Quraat (1998) indicated that PTV dramas which are considered the family dramas are also following foreign media contents and are also promoting the foreign cultural trends. Afira (2000) indicated that satellite television channels are introducing new cultural trends and social interaction among the youth is also decreasing because they prefer

to spend their extra time on watch TV instead of to interact with their family members and with the others members of society.

HYPOTHESES

- The greater the exposure to the satellite/cable TV Entertainment programmes, the greater the effects of foreign culture on our youth & cultural identity.
- The greater the exposure to foreign channels, the greater the effects on modern orientation of youth.

RESEARCH METHODOLOGY

Qualitative content analysis method is used to investigate that how the global media is influencing the cultural products by the entertainment programmes. To analysis the influence of global media on local media, comparative research between Pakistani channels and foreign channel with particular focus on Indian entertainment channels was conducted. To dig out the media to media effects, it was investigated that how the entertainment channels are influencing the youth in term of culture. In this way different categories were selected.

SELECTED PROGRAMS

For this study different TV programmes are categorized into Film, Drama, Music, Fashion and Film Award Show.

FINDINGS OF CONTENT ANALYSIS

The content analysis findings in term of films, dramas and music indicated that Pakistani media is highly influenced by foreign media because to compete the foreign media, Pakistani media is following the contents of foreign media. Such as television dramas and music shows of Pakistani television channels totally depict Indian culture. Pakistani media is playing the foreign dramas and films without any restrictions and this freedom is imposing negative impact on Pakistani youth and also on Pakistani Islamic culture. Pakistani dramas are projecting the Indian culture and this projection is great danger to national culture of Pakistan. Our Pakistani media industry is promoting new fashion trends of foreign countries. Pakistani entertainment channels are making and playing the music and dance culture of Indian society. Pakistani media groups are promoting the foreign customs and traditions which are replacing our national and local traditions and cultural identities.

SURVEY RESEARCH

Survey research technique is also used to document the responses of respondents. The population present study consists of educated community of 18-24 years age group from Layyah city which has access to cable television. Stratified random sampling method was use to select the target respondents. During survey research a sample of two hundred people (50% males and 50% females) was chosen.

FINDINGS OF SURVEY RESEARCH

Findings indicated that the target people are the regular viewer of cable television. As cultivation analysis which is based on perception by exposure to TV contents. This study indicated that target viewers are the medium viewers (table.1).

Table No.1

Total Respondents	Up to 1 Hour	2-3 hours	4 -5 hours	More than 5 hours
Male(100)	30	46	8	16
Female(100)	34	48	7	11
200	64	94	15	27
Percentage%	32	47	7.5	13.5

Findings further indicated that respondents are exposed to cable television for entertainment and to kill the time. 20% respondents express their views that they watch the cable television to gain the knowledge about different social and political issues (table. 2).

Table No.2

Total Respondents	Entertainment	Information	Knowledge	Pass Time
Male(100)	53	16	9	22
Female(100)	48	8	7	37
200	101	24	16	59
Percentage%	50.5	12	8	29.5

The results of the study further indicated dramas of Indian channels such as star plus are most popular among the Pakistani female viewers. In star plus dramas the language which is used is same to the Pakistani national language Urdu and it is another plus point for the likelihood of star plus dramas among Pakistani viewers. As star plus dramas has huge viewership and these are promoting Indian fashion industry among Pakistani viewers. Most of the respondents showed their interest in viewing the English TV channels because their basic objective is to improve their English speaking and to get awareness about foreign culture. 49 % of the overall respondents documented that they like to watch the cable television alone, 27 % indicated that they prefer to watch the cable television with their friends and 5% stated that they watch cable TV with their family members. It is further observed that a huge majority of the entire respondents like music, movies and dramas. While majority of male viewers are interested in news, sports and others infotainment channels (table.3).

Table No. 3

Total Respondents	Films	Dramas	Music	News	Sports	Any Other
Male(100)	25	16	30	10	12	7
Female(100)	24	26	38	4	4	4
200	49	42	68	14	16	11
Percentage%	24.5%	21	34	7	8	5.5

Findings further documented their views that majority of the target respondents are gain the information about new cultural trends presented in entertainment channels. They further stated that also practice these new cultural trends in their daily life to show up to datedness (table.4).

Table No.4

Total Respondents	To look modern	To attract others	Social Pressure	Any Other reason
Male(100)	29	37	20	14
Female(100)	33	16	20	31
200	62	53	40	45
Percentage%	31	26.5	20	22.5

According to the documented views of 60 % viewers in the survey, they stated that our females prefer to western dressing style and they also practice these western type dresses during the celebration of different festivals (Table.5).

Table No.5

Total Respondents	Yes	To Some Extent	No
Male(100)	71	24	4
Female(100)	47	22	31
200	118	46	36
Percentage %	60	23	17

Most of the respondents stated that they are ready and agree to follow the modernization projected by cable television and they never feel that our culture replacing due to the adoption of foreign culture. 77% respondents indicated that Pakistani entertainment channels are equal partner to promote the foreign cultural trends in Pakistani society (table 6).

Table No.6

Total Respondents	Agree	Disagree	To Some extent
Male(100)	80	8	12
Female(100)	73	13	14
200	152	20	21
Percentage %	77	10	13

The results show that western TV channels are promoting obsession among youth. It is analyzed that 61 % of overall respondents expressed their views that they mentally puzzled due to English obsession and it is also creating different social evils among youngsters (table.7).

Table No.7

Total Respondents	Strongly Agree	Agree	To Some Extent	Disagree	Strongly Disagreed
Male(100)	29	36	23	12	0
Female(100)	17	36	19	28	0
200	46	72	42	40	0
Percentage%	23	36	21	20	0

Most of the viewers documented their views that modern way of living projected in the foreign television channel is creating problems in their life and it is promoting the materialistic approach among the viewers. Research further shows that reading culture in the youth is decreasing among the youth with the passage of time. It is all due to extreme exposure to foreign TV channels. It is further documented that cable television is promoting anti Islamic ideology in the mind of viewers and it is also threat to our Islamic belief system. Majority of the respondents stated that cable television is promoting fast food culture and now the people prefer to western food instead of their traditional food. Viewers also stated that western food culture is also creating different health problems (table.8).

Table No.8

Total Respondents	Yes	To Some Extent	No
Male(100)	47	26	27
Female(100)	20	23	57
200	67	49	84
Percentage %	33.5	24.5	42

Survey study indicated that foreign television channels are promoting anti Islamic festivals such as valentine day. According to findings a difference is creating between modern and traditional nations (table.9).

Table No.9

Total Respondents	Yes	To Some extent	No
Male(100)	52	16	32
Female(100)	38	33	29
200	91	48	61
Percentage %	46	23.5	30.5

Most of the respondents indicated that media is violating our traditional and National culture by projecting the new cultural trends. 71 % of the overall respondents documented their views they are different from their insisters because they were brave and have rational mind to adopt the innovations. We have no rational mind and we blindly adopt all those trends which are presented on the media, never think about their negative impacts.

DISCUSSION

Globalisation is a process of unification of worldwide relations in which the whole world looks like a village. It has affected the each aspect of human life, globalisation in the field of information and communication has created new cultural trends among the different communities of the world. As globalisation is the product of invention of modern technologies of communication and information and it has created new cultural phenomenon which are adopted by the different nations of the globe. The adoption of new cultural trends by the under developing nations has created different problems to protect their cultural identity.

Global media is the result of wide spread of cable and television network in the world. Global media is under the control of west and by using global media west is promoting its cultural ideology at the name of free flow of information. Globalisation of media has created the homogeneity of culture among the different societies of entire globe. So researcher has investigated the impact of global media with particular focus on Indian on the Pakistani youth by using triangulation research paradigm. Content analysis method was used to investigate the impact of foreign media on Pakistani local media by comparing foreign entertainment channels and Pakistani entertainment channels. This comparison has indicated that entertainment channels of Pakistan are following the contents of foreign media and this situation is providing opportunities to the Pakistani viewers to adopt the foreign cultural trends.

Global media has direct impact on the Pakistani media. This impact deals with distinct classification of programmes. Cable network in our homeland country is projection the foreign culture especially the anti Islamic cultural trends of India. Pakistani entertainment channels are playing the Indian dramas and also following the Indian dramas to produce their own dramas and they represent all those trends which are presented in the star plus dramas. Entertainment media of Pakistan is also following the Indian music shows in which elite class fashion is presented and that presented fashion is blindly followed by the young generation of Pakistan.

As researcher conducted the survey research to document the responses of viewers and it was conducted with the youth of Layyah city to measure the cultural changes among the youth and in the Pakistani society. Investigating the viewing parameters of youth it was indicated that 33 % respondents are light viewers and 48% are medium viewers of cable network while remaining respondents fall in the class of heavy viewers. Most of the responded documented that they prefer to entertainment which they enjoy by cable network. Females are in the favor of star plus dramas and the male casted their vote in the favor of films and news.

Findings show that respondents adopt the new cultural trends by exposure to cable television as 32 % stated that they practice these cultural trends to show up to dated while 27% said that they adopt it to impress the others. It is the point of view of 77 % respondents western dressing tendency among females is increasing due to exposure to star plus dramas and jeans culture is promoting among the girls.

The traditional way of life of Pakistani viewers is hugely influenced due to global media contents. Cable network has become opinion leader for the youth to adopt the new cultural trends. Due to Indian media our national and local languages are badly affected and new world of Hindi and English are injected in our language. Modern way of life has become the all in all desire of viewers and fast food culture is being promoted among the youth .Cable network is forcing the youth to celebrate the anti Islamic festivals which are creating different economic and social problems in the society. The overall debate on the impact of global media on Pakistani culture indicates that all these problems are created due to freedom of media. Pakistani media should provide the healthy entertainment to the viewers by projecting the Islamic culture of our mother land Pakistan at global and national level. The study indicated that entertainment channels are manipulating the mind of youth by projecting anti Islamic ideology, customs and cultural values of west.

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ENHANCING KNOWLEDGE SHARING: CASE OF NILE BASIN INITIATIVE (NBI)

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ABSTRACT: Knowledge sharing has been identified as the key enabler of knowledge management. To leverage knowledge resources and to support knowledge sharing, organizations are employing knowledge management systems. While knowledge management systems are important, practical implementations have found that technology alone cannot guarantee that knowledge will be shared.

The objective of this research study was to examine the determinant factors that promote or discourage knowledge sharing behaviors of individuals with in NBI context and propose a technical and non-technical solution. Drawing from multiple streams of research including social psychology, organizational learning, knowledge management, information systems and so forth, this research developed an integrated theoretical model and unveiled three sets of critical factors: psychological, organizational and technological that are believed to affect the knowledge sharing behaviors.

The posited theoretical model was validated using a field survey of individuals from NBI, the case study area of this research study. The results of the study provide empirical support for the overall structure theorized in the research model. 9 of the 11 hypothesized relationships were supported. Knowledge sharing behavior was predicted by individual's intention towards knowledge sharing and perceived behavioral control. Knowledge sharing intention in turn was predicted by knowledge workers attitude towards knowledge sharing, subjective norm and perceived behavioral control. The strength of Social network and trust exerted positive effect towards favorable attitude towards knowledge sharing and subjective norms towards knowledge sharing. Perceived organizational incentives and benefits exerted a positive effect towards favorable attitude towards knowledge sharing. The perceptions of loss of knowledge power exerted a negative effect on the attitude. Organizational climate positively influenced knowledge workers subjective norm. Additionally, facilitating tools and technology was positively associated with high levels of perceived behavioral control towards knowledge sharing.

Based on the findings, the study discussed implications for theory and practice. Overall, the results of the study advance prior research in the area of knowledge sharing by shedding light on the determinants of knowledge sharing behaviors of individuals. In addition to contributing to theory, the findings of the study also yield insights for practice. These insights could be used by organizations in developing realistic environments that are conducive to knowledge sharing. Furthermore in the final section the study proposed a prototype knowledge portal that can be used as a common tool to minimize the effects of those factors identified during study through providing an easy means for collaboration, Community of practices, access to valuable knowledge, team building, knowledge sharing, to narrow the physical gap between individuals in organization like NBI and so forth.

KEYWORDS: knowledge Management, knowledge sharing, Knowledge, knowledge portals, Nile, Determinants and solutions, knowledge sharing factors.

1 INTRODUCTION

An organizations survival in today's world is highly dependent on its intelligent use of the knowledge resources it has due to the emergence of a new economy where knowledge has become a valuable resource and asset. "The dynamism of the new economy requires us to not only quickly create knowledge, but also to acquire and apply knowledge quickly."(Ming-Yu Cheng 1, Jessica Sze-Yin Ho1 and Pei Mey Lau2,2003). One possible way to do so is to share our knowledge effectively.

However, most organizations tend to over-emphasize on systems and tools, rather than on the core component that is knowledge sharing within the organization.

knowledge management (KM) is "a systemic and organizationally specified process for acquiring, organizing, and communicating both tacit and explicit knowledge of employees so that employees may make use of it to be more effective and productive in their work", Alavi and Leidner (1999).Therefore having an efficient KM initiative is important to understand and utilize organizational knowledge resources, tacit vs. explicit, as well as to implement the appropriate mechanisms to generate and share existing and new knowledge. Furthermore the analysis of the broad environment where the knowledge resources exit and knowledge sharing occurs is essential to identify and overcome barriers to the success of KM/KS efforts.

For organizations like NBI, where the management and development of trans-boundary knowledge resources takes place, knowledge sharing is important in order to effectively disseminate knowledge generated and Integration of the knowledge resources which might be captured in different systems developed with specific needs and scope of the projects and center specific events and activities. On the other hand, knowledge is the "power", holding knowledge is similar to holding the competitive power of the new economy. This dilemma of knowledge sharing and hoarding happened all the time between staffs, centers, stakeholders and academic Institutions conducting different studies and scientific analysis on those trans-boundary resources.

This research explored the knowledge sharing practices of organizations by taking the case of Nile Basin Initiative (NBI). It examined the behavior and intensity of knowledge sharing behavior of individuals using the theory of planned behavior (TPB) of Ajzen 2001, *Social-psychological model for explaining and predicting human behavior in specific contexts* to clearly identify and study those determinant factors of KS behavior. Furthermore the study explores common practices between staffs, stakeholders and NBI centers with the intention of providing useful insights ,best practices and opportunities useful for policy makers and management that can be used to set strategic direction to promote knowledge sharing, finally the study proposed a technical solution, web portal, which is intended to provide individuals with an efficient media for knowledge sharing, strengthen social network (collaboration and team work) and dissemination and/or integration of the vast volume of information/knowledge scattered throughout the wider riparian countries of the NBI.

1.1 BACKGROUND

The Nile Basin Initiative is a regional intergovernmental partnership that seeks to develop the River Nile in a cooperative manner, share substantial socio-economic benefits and promote regional peace and security. The partnership continues to be led by 10 Member States namely Burundi, DR Congo, Egypt, Ethiopia, Kenya, Rwanda, South Sudan, The Sudan, Tanzania, and Uganda and Eritrea participates as an observer. NBI was conceived as a transitional institution until the cooperative framework agreement (CFA) negotiations were finalized and a permanent institution created. The NBI has three centers (Nile SEC, ENTRO, and NELSAP-CU) governed by a Council of 10 Ministers (Nile-COM) in charge of water affairs in the NBI member states, which meets once a year. Nile-COM is the highest decision-making body and provides policy guidance. A Nile technical advisory committee (Nile-TAC), of 20 senior government officials from the partner states meets at least twice a year and oversees the work of NBI as well as offers technical support and advice to the Nile-COM on matters related to the management and development of the common Nile Basin water resources. In each country, the national NBI office headed by the respective Nile-TAC member serves as the focal point for all NBI-related activities.

The partnership is guided by a shared vision: 'To achieve sustainable socio-economic development through equitable utilization of, and benefit from, the common Nile Basin Water resources'. The shared belief is that countries can achieve better outcomes for all the peoples of the basin through cooperation rather than competition. At the heart of this challenge is the imperative to eradicate poverty. A *Shared Vision Program (SVP)* comprising a series of inter-related projects spread across the basin aimed at building cooperation and capacity for what we know these days as integrated water resource management (IWRM), all in trans-boundary context. A *Subsidiary Action Program (SAP)* aimed at early concrete investments 'on the ground'. This operates in two distinct sub-regions - the eastern Nile sub-region and the Nile Equatorial Lakes sub-region - though connected by the common thread of the Nile River.

To guide NBI, Nile-COM formulated a set of objectives for the SAP to enable all actions to be directed to the common cause in a common manner.

The objectives are:

- To develop the water resources of the basin in a sustainable and equitable way to ensure prosperity, security and peace for all its peoples.
- To ensure efficient water management and the optimal use of the resources.
- To ensure cooperation and joint action between the riparian countries seeking win-win gains.
- To target poverty eradication and promote economic integration.
- To ensure that the program results in a move from planning to action.

NBI, with an objectives that seeks to develop the river Nile in a cooperative manner, share substantial socio-economic benefits and promote regional peace and security, has taken numerous steps to improve its information systems, strengthen internally and externally focused knowledge-sharing activities, and foster region wide knowledge-sharing initiatives, all in support of enhancing the cooperation of the riparian countries towards realizing their shared vision.

1.2 STATEMENT OF PROBLEM

Most of the efforts, researches and practices in knowledge management seem to focus on the development of knowledge management systems, overlooking how knowledge is presented or communicated. Managing knowledge occurs within a complex structured social context. There are social and human factors in the creation and exchange of knowledge which is constituted in the organizational culture and nature. "Given the role of technology in transferring and disseminating knowledge, a true picture of knowledge is one where people voluntarily explore, use and adopt knowledge in the best interest of their organization."(Awad, Elias M. Awa, 2004).

Intergovernmental partnership organizations like NBI, are characterized by such a complex political, social and human factors which significantly determine the way knowledge is generated and shared. Within NBI, there is a vast volume of knowledge captured in different systems and used or accessed in limited manner or only within NBI centers in which they are developed. There is also quite a lot of knowledge not captured and shared but available in different format in the hand of staffs, centers and stakeholders.

In addition several studies have been conducted with respect to the common water resource (NILE) even if the outputs of those studies is not fully utilized or shared throughout the region due to identified and unidentified barriers. Furthermore NBI has taken various steps to advance its information systems and reinforce internally and externally focused knowledge-sharing activities such as the development of decision support system (DSS), knowledge web portals and websites. Again this technological solutions are not fully employed for their intended purpose, except being used with specific needs and scope of the projects/centers in which they are developed.

This visible gaps of knowledge sharing mentioned above needs to be clearly identified and studied for the success of KM/KS efforts, through exploring and examining individual's behavior towards knowledge sharing as well as identifying external factors of individuals knowledge sharing behavior which significantly determine the way knowledge generated and shared.

Motivated by the above mentioned significant factors these study developed a conceptual model based on theory of planned behavior (TPB) to clearly identify and study determinants of individual's behavior towards the actual knowledge sharing behavior to provide useful insights that could help strategists and management in tackling barriers in knowledge sharing and fostering relationships between centers, stakeholders and riparian countries of the NBI .Furthermore based on findings the study attempted to explore possible technical solutions and suggestions for practice that might contribute in maximizing the contribution of KM/KS efforts in achieving organizational objectives. .

Accordingly, the study is expected to answer the following two major research questions depicted below:

Q1: What are the major determinants of individual's knowledge sharing behavior within NBI?

Q2: What solution measures, technical and non-technical, can be proposed to address knowledge sharing challenges of NBI?

1.3 OBJECTIVES

1.3.1 GENERAL OBJECTIVE

The general objective of this research is to identify the significant determinant factors of Knowledge Sharing within NBI, with the intention to provide useful insights and an appropriate technical solution.

1.3.2 SPECIFIC OBJECTIVES

In responding to the above general objective, the research will address the following specific objectives;

- Assessing and identifying barriers in knowledge sharing behavior of individuals, & between related centers with in the riparian countries of the NBI.
- Pointing out the opportunities that are already existing but not fully utilized to promote knowledge sharing.
- Review of different literatures related to knowledge, knowledge sharing and knowledge management with the intent of providing useful perceptions and best practices.
- Design and develop knowledge portal to facilitate KS or to let sharing comes first.
- To evaluate and communicate the result.

1.4 SIGNIFICANCE OF THE STUDY

This study will be significant in order to effectively share the wealth of knowledge generated within NBI from different projects and programs by giving insights on those gaps and barriers in knowledge sharing behavior of individuals together with proposed solution measures which helps in making the vast volume of knowledge available in the hand of centers (Nile SEC, ENTRO, and NELSAP-CU), key stakeholders and staffs accessible for wider public throughout the region. In addition it will also help in improving the contribution of knowledge Management in the process of realizing NBI's shared vision, "*achieving sustainable socioeconomic development through the equitable utilization of, and benefit from, the common Nile Basin water resources*".in addition the findings of the study could be used as an input in the formulation of knowledge sharing policy and guidelines by providing useful insight for policy makers to take appropriate measures to improve knowledge sharing practices with in the NBI.

By and large, the findings of this research are expected to make a significant contribution to enhance knowledge sharing efforts of NBI in particular and other knowledge based organizations in general.

1.5 SCOPE AND LIMITATION OF THE STUDY

1.5.1 SCOPE OF THE STUDY

The scope of this research study was strictly on identifying major determinants or barriers of individual's knowledge sharing behavior within NBI together with proposed solutions and pointing out existing opportunities and best practices of knowledge sharing in organizations by taking the case of Nile basin initiative, NBI.

1.5.2 LIMITATIONS OF THE STUDY

The following major limitations are identified for this study:

- Though PLS-graph handles small sample size, the statistical power of the study is limited with sample size of 103.
- The findings are not based on longitudinal examination. Which is important for organizations like NBI, where the organizational environment and activities are highly subjected to change based on different factors like political situations, countries economic interests etc.
- The study didn't consider all important determinant factors for organizations work environment context such as political factors, perceived ownership of knowledge, self-efficacy etc.
- The proposed prototype knowledge portal was not validated and tested with users due to time and development environment limitations.

1.6 ORGANIZATION OF THE STUDY

This paper is organized into six chapters. The first chapter is about the background of the study, statement of the problem, objectives, scope and limitation of the study. The second chapter presents review of related literatures to knowledge sharing and discuss related works in that area. The third chapter discusses the methodologies and procedures followed for the data collection, analysis and interpretations. The fourth chapter presented the study findings, and presentation of the data and the fifth chapter followed with presentation of a proposed technical solution, prototype of knowledge portal that could contribute significantly in improving KM / KS efforts of NBI as well as other organizations. The

final chapter, chapter sixth, brings to an end of this survey research with the summary of findings, conclusion and recommendation.

2 LITERATURE REVIEW

2.1 OVERVIEW

Since establishment, with an objectives that seeks to develop the river Nile in a cooperative manner, share substantial socio-economic benefits and promote regional peace and security, NBI has taken numerous steps to improve its information systems, strengthen internally and externally focused knowledge-sharing activities, and foster region wide knowledge-sharing initiatives, all in support of enhancing the cooperation of the riparian countries towards realizing their shared vision ,“Achieving sustainable socioeconomic development through the equitable utilization of, and benefit from, the common Nile basin water resources ”(NBI-vision statement).As background to an assessment and identification of determinant factors of knowledge sharing (KS) organizations by taking the case of NBI, this paper presents an exploration of the literature on the factors that can affect organizational knowledge sharing success.

Knowledge has been viewed as a competitive advantage and a source of power for those who possess it at the right place and at the right time (Van Der Bij et al., 2003, Yang and Wu, 2008).In the new era, knowledge is regarded as a factor of production together with land, labor, and capital. Knowledge is recognized as the most important resource in the organization (Nahapiet and Ghoshal, 1998; Spender and Grant, 1996). From the point-of-view of an organization, performance can be improved by providing useful and relevant knowledge to employees (Alavi and Leidner, 2001; Hansen et al., 1999). It is considered as the primary source of competitive advantage (Stewart, 1997) and critical to the long term sustainability and success of the organization (Nonaka and Takeuchi, 1995). On the other hand effective knowledge management is considered to play an increasingly important role in creating competitive advantage. While defined in many different ways, knowledge management generally refers to how organizations create, retain, and share knowledge (Argote, 1999; Huber 1991).

Knowledge sharing, which is the means by which an organization obtains access to its own and other organizations' knowledge, is the most important element to the overall success of organizational KM activates. Despite the fact there are a range of determinant factors that limits the KS practices from accomplishing their objectives, which is mainly due to the large diversity of potential sharing barriers.

The literature identifies four primary Frameworks that can affect successful knowledge-sharing implementations, including

- Knowledge sharing behaviors of knowledge workers
- Organizational culture and strength of relationships
- Nature of knowledge,
- The environment in which the sharing occurs.

The literature begins with providing different view of knowledge and knowledge sharing with the intention of identifying the nature and importance of the two terms, following this section it provides definitions on measures of knowledge sharing success and overview of researches on determinants of knowledge sharing.

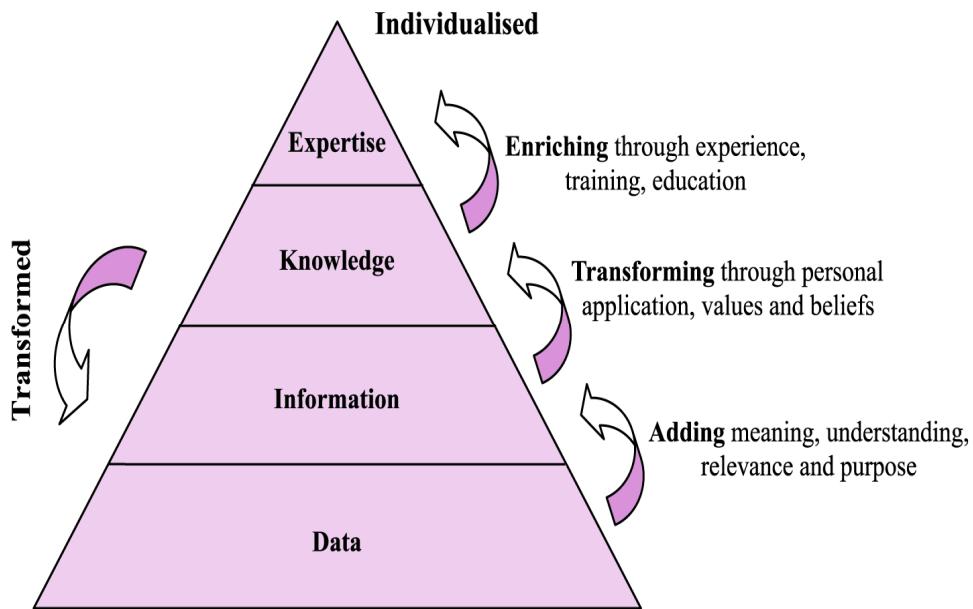
2.2 THE NOTION OF KNOWLEDGE

2.2.1 DEFINITIONS OF KNOWLEDGE

A review of the literature in strategic management, organizational theory, knowledge management and information systems disciplines indicate the existence of several definitions and viewpoints of knowledge. To begin with the definition adopted by much of the published research to date , knowledge is defined as a “fluid mix of framed experience, values, contextual information and expert insight that provides a framework for evaluating and incorporating new experiences and information” ,Davenport and Prusak (1998).

On the other hand there is a commonly held view, mostly in information science literature, uses a hierarchy of data, information and knowledge to describe the characteristics of knowledge (Alavi and Leidner, 2001)[Fig:2.1].This hierarchical approach distinguishes data, information and knowledge incorporating additional elements at each level of the hierarchy (Vance, 1997; Davenport and Prusak, 1998; Tuomi, 1999).In this hierarchy Knowledge is validated and authenticated

information (Alavi and Liedner, 2001) that is ready to apply to decisions and actions, which includes a collection of skills, principles, insights, instincts, ideas, rules and procedures that aid in decision making behavior and actions.



[Fig: 2.1 Hierarchy of data, information and knowledge

Source: Bender and fish (2000)

Building on the above perspectives of knowledge hierarchy, Alavi and Leidner (2001) observe that the distinguishing factor between information and knowledge is not found in the content, structure, accuracy or utility of the information or knowledge. Rather, knowledge is simply information that exists in the individual's mind. It is personalized information associated to facts, procedures, concepts, interpretations, ideas, observations, and judgments. Researchers assert that this knowledge need not be new, unique, useful or accurate. They argue that information becomes knowledge, when it is processed by the individuals and knowledge becomes information when it is articulated and structured in the form of texts, graphics, words and other symbolic forms.

Other definitions of knowledge also exist. Zack (1999) define knowledge as "that which we come to believe and value on the basis of the meaningful organized accumulation of information through experience, communication, or inference".

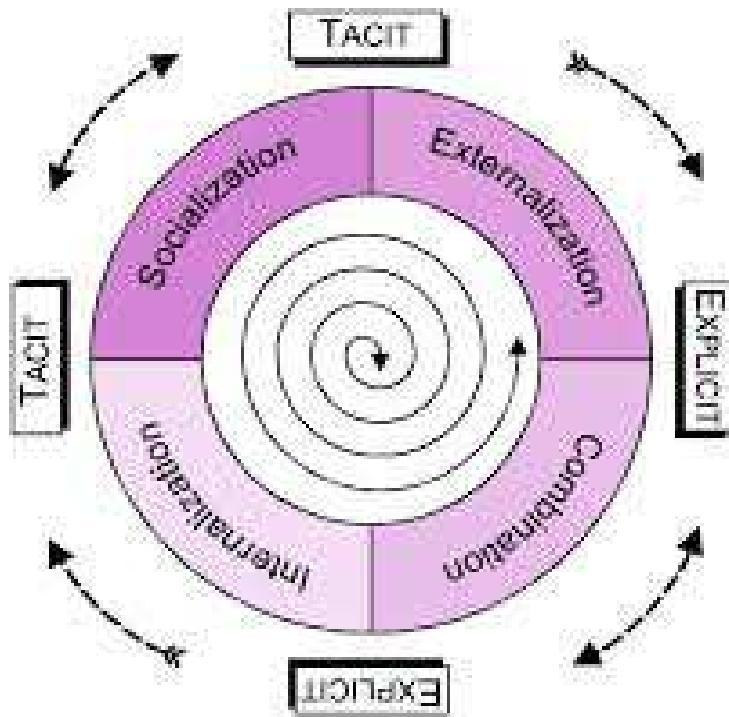
2.2.2 CLASSIFICATIONS OF KNOWLEDGE

There are different forms or categorizations of knowledge. For instance, Nonaka (1994), categorizes knowledge into two forms: explicit and tacit. Explicit knowledge, according to the researcher, is knowledge that can be formalized, documented, archived, codified, and can easily be communicated or transferred between individuals. This includes theoretical approaches, manuals, databases, plans, business documents, guidelines, process models etc. Tacit knowledge, in contrast, is deeply rooted in individual's actions, experiences, ideals, values and is far more difficult to write down or articulate.[Table 2.1]. Polanyi (1966) summarizes the fundamental nature of tacit knowledge in the phrase "We know more than we can tell". He exemplifies tacit knowledge by providing everyday example such as the ability to recognize the face of an acquaintance. Nonaka (1994) observes that tacit knowledge comprises two components: technical and cognitive. The technical component refers to "know-how" or informal personal skills of crafts and the cognitive component refers to individual's deeply ingrained beliefs, ideals, values and mental models. The researcher notes that the cognitive component, while difficult to articulate and formalize, shapes the way we see the world.

Table 2.1 Explicit vs. Tacit knowledge

	Explicit Knowledge	Tacit knowledge
Nature	<ul style="list-style-type: none"> • Easily Identifiable • Relatively easy to share • Lacks context • Requires interpretation 	<ul style="list-style-type: none"> • Within-person knowledge • Difficult to articulate • Hard to share • Can be shared only indirectly
Mechanisms to generate and sharing	<ul style="list-style-type: none"> • Codification • Documentation • Database and search engine • Blogs,wikis, and internet 	<ul style="list-style-type: none"> • Practice • Personal and team reflection • Drawing mental maps • Apparent ships • Social interaction and mentoring • Story-telling and metaphors • New codification systems can make some tacit knowledge easier to share, through converting some elements of it in to explicit knowledge
Typical examples	<ul style="list-style-type: none"> • Information • Know-that • Theoretical knowledge 	<ul style="list-style-type: none"> • Intuition and insights • Practical intelligence,skills and practice • Know-how and heuristics • Rules of thumb. • Mental models and beliefs.

Knowledge can also be viewed as individual or collective (Nonaka, 1994). Individual knowledge exists in the heads of individuals, while collective knowledge exists in the collective actions of the groups and organizations. Nonaka (1994) regards organizational knowledge creation as “knowledge spiral” in which there is a continuous interaction among individuals and continuous conversion of explicit knowledge to tacit knowledge and vice versa. This continual interaction and conversion in turn results in joint creation of knowledge by individuals and organizations. Organizations play an important role in activating the explicit and tacit dimensions of knowledge and in providing a forum for the knowledge spiral through four modes of knowledge creation: socialization, externalization, combination and internalization [Fig: 2.2]. Socialization refers to the exchange of tacit knowledge among members through the social interactions and shared experiences. Externalization refers to the translation of tacit knowledge into explicit knowledge through models, concepts, metaphors, analogies, stories etc. Combination refers to the generation of new explicit knowledge by combining and bundling together different bodies of explicit knowledge and internalization refers to the creation of new tacit knowledge from explicit knowledge. All of these conversion modes are highly interdependent and tangled.

*Fig: 2.2 Modes of knowledge Creation*

Source: Theorized by Nonaka and Takeuchi (2005)

Although explicit-tacit dichotomy of knowledge is widely cited, other classifications of knowledge have also been presented. For instance, Zack (1999) categorized knowledge into declarative (know-what), procedural (know-how) and causal (know-why). Another classification from a purely practical perspective includes knowledge about customers, knowledge about products, knowledge about processes, knowledge about competitors, and knowledge about business frameworks (Alavi and Leidner, 2001).

2.2.3 PERSPECTIVES OF KNOWLEDGE

Knowledge can be looked at from several perspectives. For instance, knowledge can be considered as a process, an object, a state of mind, a condition of having access to information and a capability (Alavi and Leidner, 2001; Wasko and Faraj, 2000).

- **Knowledge as process:** this perspective of knowledge as a process depends on applying expertise. It hypothesizes that knowledge does not exist independent of human action. Instead, it builds through social construction of meaning.
- **Knowledge as an object:** this perspective regards knowledge as a thing or object; free of human action.” Knowledge can be stored, retrieved and manipulated.” (Wasko and Faraj, 2000).
- **Knowledge as state of mind:** this viewpoint centers on enhancing individual’s personal knowledge so they can effectively apply it to the organization’s requirements.
- **Knowledge as a condition of access to information:** is an extension to the object view, contends that organizational knowledge must be organized in a way that it is easy to access and retrieve.
- **Knowledge as a capability:** this standpoint builds on capability view and asserts that knowledge has a potential to influence future action. It speculates that knowledge has the capability to build intangible assets and intellectual capital.

Alavi and Leidner (2001) underlines each of the above knowledge perspectives require different strategies and different type of tools and technologies to manage knowledge. For instance, view of knowledge as object requires KM initiatives to highlight the significant of building knowledge management system in the organization, like wise view of knowledge as process entails strong focus on the flow of knowledge as in the processes of knowledge creation, knowledge sharing and knowledge distribution.

2.3 KNOWLEDGE MANAGEMENT

Review of the prior research on knowledge management (KM) indicates the existence of multiple definitions of KM. For instance, Alavi and Leidner (1999) define knowledge management (KM) as "*a systemic and organizationally specified process for acquiring, organizing, and communicating both tacit and explicit knowledge of employees so that other employees may make use of it to be more effective and productive in their work*". Beckman (1999) define KM as "the formalization of and access to experience, knowledge and expertise that create new capabilities, enable superior performance, encourage innovation and enhance customer value." O'Dell et al., (1998) define KM as "a conscious strategy of getting the right knowledge to the right people at the right time and helping people share and put information into action in ways that strive to improve organizational performance." Malhotra (1998), also explains KM as "Knowledge Management caters to the critical issues of organizational adaptation, survival, and competence in face of increasingly discontinuous environmental change. Essentially, it embodies organizational processes that seek synergistic combination of data and information processing capacity of information technologies, and the creative and innovative capacity of human beings."

As the above definitions illustrate, KM is a set of things involving various activities. It encompasses theories, models, processes and technologies that support the protection, development and exploitation of knowledge assets. By managing intellectual capital that exists in both explicit and tacit forms, KM enhances an organization's ability to learn from its environment and to incorporate knowledge into business processes. It creates a new value for the organization by improving its efficiency, effectiveness and competitiveness. Davenport, De Long and Beers (1998) regard most KM projects as having one of the following objectives:

- Making knowledge visible through KMS such as maps, yellow pages and hypertext tools.
- Promoting knowledge intensive culture that encourage knowledge sharing, particularly the proactive acquisition and contribution of knowledge.
- Developing knowledge infrastructure which includes a web of people and technologies with the objective of promoting interaction and collaboration among employees.

2.4 DEFINITIONS OF KNOWLEDGE SHARING (KS).

Review of the extant literature on knowledge sharing indicates that there is no all-inclusive definition of knowledge sharing. Many researchers have defined knowledge sharing from their own point of view. Some researchers even considered knowledge sharing, knowledge flows and knowledge transfer as exchangeable terms and defined them as such. For instance, Alavi and Leidner (2001) relate knowledge sharing to knowledge transfer and define it as the process of disseminating knowledge throughout the organization. The dissemination can happen between individuals, groups or organizations using any type or number of communication channels. Similarly, Gupta and Govindarajan (2000), equating knowledge sharing to knowledge flows theorize that knowledge flows comprise of five elements: value of the source knowledge, willingness of the source to share knowledge, media richness of the communication channel, willingness of the recipient to acquire knowledge and the absorptive capacity of the recipient.

Davenport and Prusak (1998) define knowledge sharing as process that involve exchanging knowledge between individuals and groups. Connelly and Kelloway (2003) define knowledge sharing as "a set of behaviors that involve the exchange of information or assistance to other". It is separate from information sharing, which typically involves management making information on the organization available to employees. Whereas knowledge sharing contains an element of mutuality, information sharing can be unidirectional and unrequested".

The general concept of knowledge sharing is the processes through which knowledge is routed between a source and a recipient, in other words regardless organizational role the objective of any knowledge-sharing process is to transfer source knowledge successfully to a recipient. In addition KS is key in the spiral through four modes of knowledge creation: socialization, externalization, combination and internalization.

Table 2.2: knowledge sharing and knowledge creation process

	Knowledge sharing	Process
1	Knowledge sharing happens when an individual try to communicate his/her tacit knowledge with others through for example writing ideas and through in the form of theory.	Tacit to explicit (Externalization)
2	Knowledge is shared during social interaction such as story telling that enable transfer of complex tacit knowledge from the source to the recipient.	Tacit to tacit. (Socialization)
3	Human can get knowledge when rational behind a document is informed by other individuals. When Knowledge is put into action by ‘learning by doing.’	Explicit to tacit. (Internalization)
4	When knowledge is written in a form of document and shared with other people. If individuals combine their knowledge, it will create new ideas that is written on paper.	Explicit to explicit. (Combination)

2.5 KNOWLEDGE SHARING SUCCESS

After understanding the general concept of knowledge sharing, which is transferring source knowledge successfully to a recipient, one approach to defining knowledge-sharing success focuses on the degree to which the knowledge is re-created in the recipient. Consistent with the innovation literature knowledge can be seen as knowledge packages embedded in different structural elements of an organization, such as in the people and their skills, the technical tools, and the routines and systems used by the organization, as well as in the networks formed between and among these elements (Argote & Ingram, 2000; Leonard-Barton, 1992). From this perspective, knowledge transfer involves the re-creation of a source’s knowledge-related elements – its knowledge package – in the recipient (winter, 1995). Thus, knowledge-transfer success is defined as the degree to which the underlying knowledge elements have been re-created in the recipient to conform to those of the source.

In addition to the fact that it is often difficult to know what aspects of knowledge are important (Sowell, 1980), there is significant evidence that effective re-creation also requires that the knowledge package is made accessible to the recipient so that ‘the local doers of development’ can convert it, adapt it or reconfigure it to their localized needs (Dixon, 1994; Nonaka, 1994; Epple, Argote & Murphy, 1996). Thus, even if the elements of the knowledge package can be clearly identified, they may be hard to determine in their adapted forms within the recipient. As a result, rather than using some notion of knowledge re-creation to gauge sharing success, Kostova (1999) argues that a recipient’s internalization of knowledge is more appropriate.

Knowledge internalization can be characterized by three different aspects, which are the degree of recipient’s ownership, commitment and satisfaction with the transferred knowledge. Control of an object look like to be a key characteristic of the sensations of ownership, which relates to the degree that an individual invests energy, time, effort, and attention in the knowledge; as such investments tend to cause individuals to develop ownership of the knowledge (Csikszentmihalyi & Rochberg-Halton, 1981).The second aspect of knowledge internalization is Commitment, since the relative strength of an individual’s identification and constant involvement with the knowledge can also affect the degree to which the recipient puts the knowledge into use (Mowday, Steers & Porter, 1979), Individuals develop knowledge commitment to the extent that they see the value of the knowledge, develop competence in using the knowledge (Leonard-Barton, 1990), maintain a working relationship or interaction with the knowledge, and are willing to put in extra effort to work with the knowledge (Mowday, et al., 1979). The last aspect of knowledge internalization is satisfaction. Recipient satisfaction with the knowledge is important because it can reduce resistance levels in adapting and using the knowledge (Leonard-Barton & Deschamps, 1988) as well as reduce the likelihood of the not-invented-here syndrome (Katz & Allen, 1982) occurring.

In order to foster knowledge internalization, research suggest that an organization needs to adopt an active learning perspective through which it fosters situations where the knowledge sharing parties catalyze the recipient’s learning experiences and such a process requires the clients to have the discretion to localize the knowledge, see the value in doing so, invest in doing so, etc.

2.6 THE STUDY OF DETERMINANTS OF KNOWLEDGE SHARING

Knowledge sharing has emerged as a key research area from a broad and deep field of study on technology transfer and innovation, and more recently from the field of strategic management. Increasingly, knowledge-sharing research has moved to an organizational learning perspective. Different research’s suggest that successful knowledge sharing involves extended

learning processes rather than simple communication processes, as ideas related to development and innovation need to be made locally applicable with the adaptation being done by the 'incumbent firms' (Nelson & Rosenberg, 1993).

Early research's found that greater knowledge-sharing experience was associated with lower transfer costs (Mansfield, Romeo & Wagner, 1979; Teece, 1976, 1977). Other studies have focused on how organizations can best accomplish international technology transfers. Another topic was concerned with the speed through which organizations are able to transfer innovations to subsidiaries (Mansfield & Romeo, 1980; Davidson, 1980; 1983). Other researchers examined the influences of the mode of association between the parties (Mason, 1980; Balasubramanyam, 1973), the level of technological development of the host country (Baranson, 1970), and the appropriateness of the technology with respect to its capital- or labor-intensiveness (Schumacher, 1973). Gupta and Govindarajan (1991). They suggested that the key variables affecting organizational knowledge flows were the broad task environments in which the flows occur, organizational structural characteristics that can affect the relationship between the parties, and organizational cultural norms with respect to a willingness to keep knowledge proprietary or accept outside knowledge.

This study categorized previous studies on determinants of KS in to three as;

- Organizational and Individual Factors
- Technological factors
- Knowledge management and business strategy factors

2.6.1 ORGANIZATIONAL AND INDIVIDUAL FACTORS

Researches identify several key knowledge sharing determinants related to organizational as well as individual factors, Connelly and Kelloway (2003) investigated a number of factors that impact employee's perceptions of a knowledge sharing culture. The identified factors can be broadly categorized into groups: organizational factors and individual factors. Organizational factors include individuals' perceptions regarding management support for knowledge sharing, their perceptions about a positive social interaction culture, organization's size, and the presence of technology that can facilitate knowledge sharing. Individual factors include age, gender and organizational tenure. The research findings suggest perceptions about management's support for knowledge sharing, and perceptions of a positive social interaction culture to be significant predictors of a positive knowledge sharing culture. Organizational size was negatively related to positive knowledge sharing culture such that smaller organizations were linked more with positive knowledge sharing culture.

Chow, Deng and Ho (2000) studied how individual's openness in knowledge sharing is affected by the interaction between national culture and the two contextual factors: the nature of the available knowledge for sharing and the knowledge sharer's relationship to the potential recipient. The study investigated the impact of individualism/collectivism, concern for face, Confucian dynamism, in-group / out-group attributes that researchers hypothesized would affect knowledge sharing. The research employed quantitative and open-ended questionnaires to two scenarios and collected data from 104 managers from United States (US) and 38 managers from People's Republic of China (PRC). The findings of the study indicate that when there is no conflict between self and collective interests, both the managers in the individualistic (US) and collectivistic (PRC) cultures were equally willing to share knowledge. However, when there is a conflict, managers in the collectivistic culture (PRC) exhibited a higher tendency to share, thereby placing collective interests ahead of their own. On the other hand, individualistic cultures do not give much importance to group enhancing behavior. They noted that certain organizational forms, where there is no conflict between self and collective interest, have the capacity to crowd out essential motivation and therefore are detrimental to the effective transfer of knowledge.

Wing S. Chow, Lai Sheung Chan, (2008) in there exploratory study of Social network, social trust and shared goals significance in organizational knowledge sharing success using Survey, measurement tool, theoretical framework (TRA) which is the early version of TPB and relationship confirmatory factoring analysis techniques identified that Social network and shared goals significantly contributing towards individuals desire to share knowledge, and directly contributed to the perceived social pressure of the organization. The social trust has however showed no direct effect on the attitude and subjective norm of individuals towards knowledge sharing behavior.

See Kwong Goh and Manjit Singh Sandhu (2013), using a research model which includes TPB and the two affective components examined knowledge sharing Among Malaysian Academics to identify Influence of Affective Commitment & Trust and examine whether the perception of knowledge sharing in public universities differs from private universities. a survey was conducted with a total respondent of 545 academics from 30 universities in Malaysia. Multiple linear regression was used to examine the research model. On the other hand, t-test was used to examine the differences between public and private universities. Their finding pointed out emotional influence (affective commitment and affective trust) is crucial for knowledge sharing behavior. Accordingly they addressed the need to implement policies and activities to strengthen

emotional bonding between universities. In addition their t-test analysis showed a significant differences between public and private universities.

Bock, Zmud, Kim and Lee (2005) examined factors that are believed to influence individuals' knowledge-sharing intentions. Researchers drew upon the Theory of Reasoned Action (TRA) (Ajzen and Fishbein 1980) for the study's theoretical framework. To this framework, they have added extrinsic motivators, social psychological forces and organizational climate factors. Using field survey of 154 managers from 27 Korean organizations, the researchers found that the attitude towards knowledge sharing along with the subjective norms and organizational climate influence individual's intention to engage in knowledge sharing behavior. Other findings of the study indicate that anticipated reciprocal relationships positively influence attitudes towards knowledge sharing while sense of self-worth and organizational climate influence subjective norms. A surprising finding of the study is that anticipated extrinsic rewards negatively influence the knowledge sharing behavior.

Using theories of collective action, Wasko and Faraj (2005) examined why individuals in wider environment, such as NBI, share their knowledge through electronic networks of practice to others. The study defined electronic networks of practice as computer-mediated discussion forums where individuals exchange ideas on problems with others based on common interests. Researchers employed archival, network, survey and content analysis data to examine the knowledge sharing activities of members in an electronic network supporting a professional legal association. The results of their study indicate that individuals contribute their knowledge when they believe that participation enhances the professional reputation, when they have necessary expertise to share and when they become part of the structural network. An interesting finding of this study is that individuals contribute regardless of expectations of mutuality or high levels of commitment to the network.

The importance of culture for effective knowledge management is also highlighted by Janz et al's (2003) theoretical model which explains the relationships between knowledge related activities and organizational or individual characteristics that promote the creation and dissemination of knowledge throughout organization. Researchers note that knowledge flow in an organization depends on the trust in the organization as a whole as well as the specific individuals and suggest that organizations provide a climate of trust built on culture that encourages and provides incentives for sharing knowledge in all its manifestations such as learning, mentoring, collaboration, sharing ideas and stories etc.

2.6.2 TECHNOLOGICAL FACTORS

The applications of technology to KM are manifold. As such, a new class of information systems applications called knowledge management systems (KMS) have emerged. Alavi and Leidner (2001) define knowledge management systems (KMS) as "*a class of information systems applied to managing organizational knowledge. That is, they are IT-based systems developed to support and enhance the organizational processes of knowledge creation, storage/retrieval, transfer and application*". Some of the examples of KMS include knowledge repositories, knowledge networks, directories of subject matter expertise, intranets including corporate portals, group ware and collaboration tools, desktop computer conferencing and so forth.

Research has identified different determinants of knowledge sharing related the technology or the information system in use. Jarvenpaa and Staples (2000) studied the factors affecting the use of collaborative technologies such as electronic mail, World Wide Web, list serves, and other collaborative systems for sharing information in an organization. Their Findings suggest that the significant predictors of individual's use of collaborative technology for information sharing to be task characteristics, perceived information usefulness and the user's computer comfort.

Markus (2001) emphasizes the role knowledge management systems and knowledge repositories play in increasing organizational effectiveness. The researcher developed a theory of knowledge reusability by synthesizing a wide variety of sources and identified four distinct knowledge reuse situations involving different types of reusers and reuse. The four types of knowledge reusers are: shared work producers, shared work practitioners, expertise seeking novices and secondary knowledge miners. Markus asserts that each type of knowledge reuser has different needs from knowledge repositories and therefore the successful reuse of knowledge is dependent upon the quality and content of repositories.

Constant, Keisler and Sproull (1994) studied the factors that support or constrain information sharing in technologically advanced organizations. The factors they looked into are work experience, computer experience, year of training and perceptions about organizational ownership of information. The results of their laboratory studies indicate that attitudes about information sharing depend on the form of information. While sharing tangible information depend on pro-social attitudes and norms of organizational ownership, sharing expertise depends on people's own identity and self-expressive needs.

Kankanhalli, Tan and Wei (2005) investigated factors affecting electronic knowledge repositories (EKR) usage from the perspective of knowledge contributors. An interesting result of this study is that contextual factors (generalized trust, pro-sharing norms, and identification) moderate the impact of extrinsic benefits (mutuality and organizational reward) on EKR usage by contributors but not the intrinsic benefits (knowledge self-efficacy and enjoyment in helping others). Another finding of this study is that loss of knowledge power and image does not impact EKR usage by knowledge contributors.

Raafat George Saadé, Weiwei Tan, & Dennis Kira (2008), empirically examine the validity of behavioral intention's prediction on actual system usage by construction and using an integrated model which uses constructs of the two closely related theoretical paradigm namely theory of acceptance model and theory of planned behavior. (TAM and TPB) to explain user's technology acceptance. They used questionnaire to gather the system usage perceptions of students who took an online management information system (MIS) and partial least square (PLS) approach. Their finding using the data collected from 105 students showed a very good fit of the model with 60% explanation of the variances in behavioral intention. However the relationship between the intention and actual system use was found to be insignificant and weak. The finding of their study questions the validity of using self-reported intention to represent system usage and provides insight into future research directions on technology acceptance behavior.

2.6.3 KNOWLEDGE MANAGEMENT AND BUSINESS STRATEGY FACTORS

Knowledge management is a dazzling, multi-faceted, and controversially discussed concept. (Nonaka and Takeuchi, 1995). Knowledge management can be defined as all the activities that utilize knowledge to accomplish the organizational objectives in order to face the environmental challenges and stay competitive in the market place. The attention and importance given to the acquisition of knowledge increased in the past years (Alavi and Leidner, 2001). Knowledge management promises to help organizations to be faster, more efficient, or more innovative than the competition. Also, the term "management" implies that knowledge management deals with the interactions between the organization and the environment and the ability of the organization to react and act (Maharini, 1999).

On the other Organizations aware of their knowledge resources possess a valuable, unique resource that is difficult to imitate and can be exploited to achieve a sustainable competitive advantage (Alavi and Leidner, 2001). An organization's strategy of knowledge management is not arbitrary but depends of the "way the company serves its clients, the economics of its business, and the people it hires" (Hansen et al., 1999), means KM depends on organizational business activities.

Accordingly, different studies suggest the need to align KM with business strategies .And IT to continuously capture, maintain, and reuse the key information, and arbitrates the strategic knowledge assets that improve business performance (Cedar, 2003). *In addition KM should not be implemented because it is just "nice-to-have" Thus, it should be tightly related to objectives and business strategies of the organization or subunit of the organization* (Davenport et al., 1998; Zack, 1999).

Vera (2001) views learning as the core of a knowledge strategy. However, argues that it is not sufficient to learn something new and suggests that learning has to be aligned with the core business activities to ensure that new products, systems, procedures, and structures, are developed in line with the firm's business strategy. In her study she investigates ideal matches between business strategy and knowledge strategy and argues the greater the alignment between both strategies the better the firm's performance. Vera identifies four ideal matches, which she terms "innovative prospector," the "lone defender," the "exploring prospector," and the "exploiting analyzer".

- **Innovative Prospects:** Prospects have the ability to proactively find and exploit new product and market opportunities and to quickly change strategies to outperform competitors.
- **Exploring Prospects:** These types of prospects have limited resources and pursue more focused approaches to business strategy by offering fewer but very innovative products and services.
- **Lone Defenders:** Defenders emphasize a limited number of products and services at a more narrowly defined market, and offer higher product and service quality or lower prices to defend their current market position against competitors.
- **Exploiting Analyzers:** Analyzers combine elements of both prospects and defenders. They pursue an advanced differentiation or cost leadership business strategies. Analyzers focus on a defined scope of products and services offered to customers.

According to Jones (2002), technology-focused knowledge management solutions offer little more than the implementation of groupware and documentation management. In his study, he recommends that knowledge strategies have to focus on knowledge resource development to support the firm's business strategy. Firms need to identify, which knowledge supports best strategic business goals. Jones (2002) argues that knowledge strategy follows business strategy and technology follows both. Furthermore, Jones identifies three strategic domains firms typically engage a) growth and value b) operational effectiveness and c) customer intimacy. Within these strategic domains, firms pursue a number of strategic

relevant core business and knowledge activities to achieve defined corporate goals. The possible relationships of these activities are graphically represented in table 2.3.

Table 2.3: Domains of Knowledge Strategy and Business Strategy

	Growth & Value	Operational Effectiveness	Customer Intimacy
Knowledge Strategy	<ul style="list-style-type: none"> • Product Innovation • Process Innovation • Intellectual Capital 	<ul style="list-style-type: none"> • Process innovation • Knowledge sharing • Developing knowledge Culture 	<ul style="list-style-type: none"> • Product Innovation • Customer knowledge • Integration • Branding Knowledge
Business Strategy	<ul style="list-style-type: none"> • Product sales • Time to money • Distribution networks • Pricing strategy • Patent and product leverage 	<ul style="list-style-type: none"> • Process Streaming • Supply chain management • Accounting and finance 	<ul style="list-style-type: none"> • Customer relation • Customer product needs • Revenue growth • Partnering /Alliance

Source: jones (2002)

Zack (1999) recommends firms to align knowledge management with firm strategy. He argues firms have to map their organizational knowledge base relative to their competitors. He classifies the organizational knowledge base into core, advanced, and innovative knowledge. Zack (1999, p. 136) suggests firms to perform a gap analysis using the SWOT framework to identify opportunities and threats, which refers to 'What the firm must know' and strength and weaknesses "what the firm can do. See [Fig: 2.3]. According to Zack, the K-SWOT analysis helps managers to identify critical knowledge resources that can be exploited and knowledge that needs to be developed to maintain or grow its competitive market position.

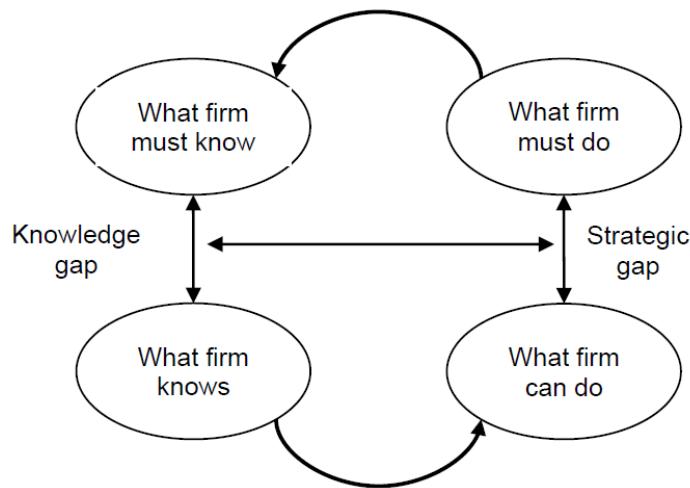


Fig: 2.3: Approach to perform gap analysis

Source: zack (1999, p. 136)

Consequently, the literature like to underline the need to evaluate and understand determinant factors that create gap or the lack of matching between business and KM strategies to succeed in knowledge management as well as knowledge sharing initiatives of organizations. Furthermore implementing the appropriate KM strategy through careful analysis and understanding of the business needs and its relation to knowledge management helps in improving business performance. In addition organizations must be aware of their knowledge resources since it is essential to achieve efficient product development or innovation excellence.

2.7 SUMMARY

After reviewing different research's related to this study general objective which is identifying major determinant factors of individuals knowledge sharing behavior for NBI .The study like to underline that the focus for the successful knowledge-sharing effort is beyond simply transferring a specific knowledge from the source to the recipient. Instead, related factors such as individuals, organizational, technological and KM – Business strategic needs to be given strong emphasis.

Accordingly, any evaluations of the knowledge-sharing efforts need to incorporate assessments individuals' behavior, evaluation of organizational environment for establishing and managing appropriate administrative structures and exploration of technological factors. In addition facilitating the transfer of the knowledge and understanding the strategic gaps that may exist between the organization business and KM strategies. Moreover special attention need to be given to organizational learning, since it are a preeminent tool to improve the capability of individuals to efficiently involve in a given KS activity and learn about essential knowledge resources of the organization. Furthermore organizations need to develop extensive, deep, friendly relationships between the parties so as to bridge any relational distances through creating socialization means like staff retrets,knowledge transfer meetings and workshop's. Furthermore having the appropriate KM system or information system in place is important, because it provides the platform to capture, codify and share knowledge efficiently.

2.8 SUMMARY OF RELATED WORKS

The study also reviewed different studies related to individuals, organizational, and technological factors of the actual knowledge sharing behavior of individuals. Table 2.4 below summarize some of the related studies reviewed.

Table 2.4: Related works

Title	Author	Method used	Objective	Key Findings
Determinants of Knowledge Sharing Behavior,	Elham Aliakbar, Rosman Bin Md Yusoff and Nik Hasnaa Nik Mahmoud. (2012).	<ul style="list-style-type: none"> • Review the previous researches and Theories used to understand individuals KS behavior. 	<ul style="list-style-type: none"> • To find out the most important factors which influence KS behavior. • Identify how various examined factors influence knowledge sharing behavior. • Point out how different perspectives could correctly formulate the knowledge sharing behavior. 	<p>The need of more profound studies related to social capital theory since it is a significant issue affecting KS behavior.</p> <p>Considering different cultural characteristics and economical situations, recommends the need to conduct more investigations in areas like middle East and African countries.</p> <p>Identifying important theories and conceptual models which are vastly used and critical to understand human behavior, such as SET, TRA, TPB and TAM.</p>
Knowledge Management in a Research organization: International Livestock Research Institute (ILRI)	Ezra ondari-Okemwa (2006)	<ul style="list-style-type: none"> • Intensive face-to-face interviews, • literature review and a critical analysis and synthesis of the available KM/KS/knowledg e creation and transfer materials and • Observation. 	<ul style="list-style-type: none"> • To identify how a non-profit research organization may build its internal knowledge base; • To dispel the view that knowledge management is only possible in knowledge-based economies of the developed regions; • To demonstrate that good knowledge management practices are possible in a non-profit research organization and to establish the nature of the critical challenges of establishing and running a successful knowledge management programme in a non-profit research organization environment. 	<p>Proves that :</p> <ul style="list-style-type: none"> • ILRI KM programme stands out as a good example of the best practices that may be emulated in sub-Saharan Africa. • KM challenges of ILRI are adaptive, flexible and minimized by adjusting to the environments in which it operates. • ILRI demonstrates that IT is only one of the tools which support efficient knowledge management. • Having suitable environment for knowledge Management initiatives is important for its success. Such as socialization mean's like group training, internal / external collaborative relationships,

Inter- and Intra-Organizational Barriers to Sharing Knowledge in the Extended Supply-Chain	Richard J Barson, Gillian Foster, Thomas Struck, Svetan Ratchev, Kulwant Pawar, Frithjof Weber, and Michael Wunram. (2000)	<ul style="list-style-type: none"> • literature review • Case studies done in industrial companies. 	The major objective was to outline barriers to knowledge sharing.	<ul style="list-style-type: none"> • Majority of KS barriers are concerned with people issues. • More emphasis should be given to on how to best enable people to participate in knowledge sharing than on technological solutions. • More emphasis should be given to • How can people be encouraged to share? • How can trust be established between collaborating organizations? • How can cultural barriers be overcome? • How can fear be replaced by enthusiasm?
Three-dozen knowledge-sharing barriers managers must consider	Andreas Riege,(2005)	Detailed review of current KM and related literatures	To Offer a more comprehensive and structured starting-point for senior managers when auditing their organization's current knowledge base and knowledge-sharing requirements.	The finding of this study is extensive list of potential individual, organizational and technological knowledge sharing barriers.
Motivations and barriers to participate in virtual KS community of practice.(in multi-national organization)	Alexander Ardichvili; Vaughn Page; Tim Wentling (2003).	<ul style="list-style-type: none"> • Interview • Document analysis • Observation. • Selection of CoP using purposive sampling approach. (qualitative Case Study design) 	To identify motivations and barriers to employee participation in Virtual CoP.	<p>The study indicates that when employees enable to view knowledge as a public good belonging to the whole organization, knowledge sharing will be a success or knowledge will flow easily.</p> <p>An organization trying to create a network of efficient virtual Community of knowledge sharing would need to create a supportive environment such as</p> <ul style="list-style-type: none"> • Norms promoting institution based trust, • Multiple Face-to-face CoP, which provides a foundation for knowledge based trust. • A set of clearly communicated norms and standards for knowledge sharing.
Why Share Knowledge? The Influence of ICT on the Motivation for Knowledge Sharing	Paul Hendriks (1999)	<ul style="list-style-type: none"> • Survey questionnaire. • Research conceptual model 	To answer the question : How do information systems, and more particularly information and communication technology (ICT), relate to the motivation for knowledge sharing?	<p>Points out improving knowledge sharing is not the same as stimulating knowledge-sharing behavior .Understanding the motivation factors of knowledge sharing is a first, essential step towards understanding how knowledge sharing can be managed and ICT can be an important instrument in this respect.</p> <p>Suggests ,” ICT can make a difference for KS and Understanding what this difference will be cannot be learned by looking at the technology only”</p> <p>Identifies three points that relates ICT and KS or KS management.</p> <ol style="list-style-type: none"> 1. The role of ICT for knowledge sharing can only be fully understood if it is related to the KS, and not just to maintenance factors. 2. The role of ICT and its role as motivation to KS should be identified and studied since it may vary under different concepts. 3. Other factors, such as personal preferences and a knowledge sharing culture should be considered explicitly.

3 METHODOLOGY

3.1 OVERVIEW

The research method is the heart of a research because it helps researchers to decide how they are going to achieve their stated objectives, what new data they need in order to shed light on the problem they are going to address and how they are going to collect data and process the data. Therefore, it needs much attention on choosing the appropriate methods which can provide the desired or expected outputs.

Mixed and action research methodologies are the most popular forms of research methods where both the quantitative and qualitative research methods are integrated in order to get a bigger and better picture (Christ, Thomas 2013). Accordingly the study selected mixed research method to capture the most relevant information through applying both qualitative and quantitative research methods.

3.2 STUDY AREA

The general objectives of NBI are targeted to poverty eradication and economic integration of the riparian countries by developing the common water resources of the basin through efficient water management, cooperation between member states seeking win-win gains and maintaining prosperity, security and peace for all its peoples.

Nile basin initiative (NBI) is selected for the research because there is a huge volume of important knowledge or information available within the wide region of NBI which needs to be efficiently captured, codified and shared for the realization of the shared Vision of those riparian countries. In addition proficient identification of the determinants of knowledge sharing is important to the success of significant effort that NBI has taken to advance its information systems, reinforce internally and externally focused knowledge-sharing activities realizing the importance of proper understanding and management of knowledge resources. The other reason NBI is selected for this research is due to the broad environment it covers, there are potential KS barriers related to social, cultural, economic, organizational and political that needs to be clearly identified and studied to the success of knowledge sharing (KS) as well as knowledge management (KM) efforts as a whole.

3.3 STUDY DESIGN

Researchers can use different types of design depending on the type of problem, the knowledge already available about the problem and the resources available for the study. Accordingly, the study used a mixed research approach where both quantitative and qualitative research designs are applied. Mixed methodology was selected basically to gather all the relevant insights that might support each other which is important in maximizing the reliability of findings. Furthermore to increases the validity or accuracy of findings by examining the same study area in different ways and gain better /greater understanding of findings.

For the quantitative method web based self-administered questionnaires are used whereas for the qualitative data collection methods including interview, observation and document analysis were used.

3.4 STUDY POPULATION

In NBI there are a total of 139 employees working for the three centers, namely Nile SEC, ENTRO, and NELSAP-CU as permanent staff which includes support staff and regional/national consultants and professionals.

The population of the study consists all of the permanent employees in order to get detailed and relevant information about the knowledge sharing behavior at the individual as well as organizational level. In addition 41 NBI stake holders like national focal points at the ministry of water and those professional who closely work with NBI such as senior staffs at the water resource ministries, water resource specialists/professors at different universities throughout the NBI region and different consultants/interns are included.

3.4.1 SAMPLE SELECTION

The sample population for quantitative study was determined from the categories of office workers like water resources study unit, project planning and monitoring and development, Human resource management, finance and ICT workers who are permanent workers with minimum educational qualification of diploma as an inclusion criteria ,since this individuals are

the one who involved in the creation ,development and exchange of knowledge , they could provide us with the more reliable informations.Inadditions for those individuals or stakeholders of NBI who are not direct employees, more than one year close work relation with NBI is used as an inclusion criteria because the reliability of information is in question for those with less than one year experience with NBI.

3.5 SAMPLE SIZE

The study used sampling to select those respondents who satisfy the inclusion criteria set to maximize the reliability of information provided by respondents. The URL to the web where the questionnaires designed was sent through email. A total of 180 surveys were distributed which includes the 139 permanent employees of NBI and 41 reachable NBI stakeholders. A total of 120 questionnaires were returned; of which 17 incompletes and not complied with the inclusion criteria of the sampling were discarded. The final numbers of usable questionnaires were 103 .The overall response rate of the survey was 66.67 %.Which is greater than the acceptable good (60%) response rate for online administered surveys according to instructional assessment resource (IAR) of the University of Texas at Austin (2007).

Furthermore 15 senior employees, who are at the management level and highly involved in decision making as well as knowledge management issues, were selected for an interview. In addition KM related activities and documents with in the three centers were observed and analyzed as part of the qualitative research method employed.

3.6 DATA COLLECTION PROCEDURE

3.6.1 QUANTITATIVE DATA

Data collection for this study began on second week of February, 2014, and ended in the last week of March 2014.The primary data for the research was gathered by using a web based self-administered survey questionnaire. The questionnaire was divided into two parts namely part 1 and part 2.

- **Part 1:** comprised 60 questions organized in to 11 constructs are designed to ascertain the views of the employees and stakeholders of NBI on the significance of knowledge sharing, strategies to encourage knowledge sharing, identify the barriers in knowledge sharing, use and challenges related to information technology infrastructures, to identify knowledge sharing behaviors and intentions of individuals and identify individuals view of their social network, trust and common goal.
- **Part2:** comprised questions eliciting demographic characteristics of respondents.

A five point Likert scale was used and the respondents were required to state the extent to which they agreed or disagreed with the statements in the questionnaire part 1. (Refer Annex- I).

3.6.2 QUALITATIVE DATA

Qualitative data were also collected using unstructured interview to 15 professionals such as Regional project coordinators, water resource specialists,Monitring and evaluation experts ,IT/GIS specialists,etc.The interview questions were designed to capture the views of those individuals according to the constructs identified which are important for the context of the study(Refer Annex-II). In addition review of KM strategic and other related documents is also used to gather secondary qualitative data important for the research context.

3.7 VALIDITY AND RELIABILITY OF DATA

Validity is concerned with the extent that a scale accurately represents the construct of interest. Where possible this should be supported by past research and consideration given to the practical things that affect the research (Hair et al., 1998). Accordingly the research adopted categories of constructs of the research questions from Wing S. Chow *, Lai SheungChan (2008) with some modification and addition to address research objectives. [See: Table 3.2].Wing S. Chow *, Lai SheungChan (2008) by using Confirmatory factor analysis model and theory of reasoned action (TRA) concepts to test their hypotheses about the relationships between the adopted categories of constructs, provides an empirical evidence about the influence of a social network, social trust, and shared goals on employees' intention to share knowledge. Their study offers insights to practitioners on the value of social capital and reasons why people are or are not willing to engage in knowledge sharing within an organization.

Furthermore to provide with a conceptual model for explaining, predating and studding the knowledge sharing behavior of individuals theory of planned behavior (TPB) of Ajzen (1991) was adopted.TPB is a popular social-psychological model for explaining and predicting human behavior in a specific context. Accordingly a new construct named perceived behavioral control is incorporated which is based on the validated scales developed by Taylor and Todd (1995).In addition the survey uses other constructs [See Table :3.2] which model behavioral ,normative and control beliefs and major determinants to individuals attitude, subjective norm and perceived behavioral control. Which includes:

- **Perceived loss of knowledge power**, adopted from Kankanhalliet al. (2005) study.
- **Perceived Organizational Incentives and benefits of knowledge sharing**, adapted from Kankanhalli et al. (2005) study.
- **Usage of tools/technology**, adopted from Teng and Song's scale for tools and technology, which was derived from DeLone and McLean's (2003) study.
- **Perceived organizational climate**, adapted from the validated instrument developed by Bock et al., (2005).

Table 3.2: Research Constructs together with their definition and number of items

Construct	Definition	Items
Social Network And Trust	The degree of contact, accessibility and willingness to vulnerable to the actions of other people.	6
Shared goal	The degree to which one has collective goals, missions and visions with other people	3
Attitude toward knowledge sharing	The degree of one's favorable or positive feeling about sharing one's knowledge	5
Subjective norm about knowledge sharing	The degree of one's perceived social pressure from important others to share or not to share one's knowledge	3
Intention to share knowledge	The degree of one's belief that one will engage in knowledge-sharing behavior	5
Perceived Loss of Knowledge Power	The degree of one's belief that one will lose his power of knowledge if engaged in knowledge sharing	4
Perceived organizational Incentives and benefits of knowledge sharing	The degree of one's expectation of organizational incentives and benefits related to sharing his knowledge	4
Perceived Behavioral Control	The degree of one's belief that it is easy or difficult to engage in the knowledge sharing behavior.	6
Usage of tools and technology	The Degree of individual's usage of, access to and availability of essential tools and technologies to knowledge sharing.	10
Perceived organizational climate.	The Degree of affiliation (perception of togetherness), innovativeness (perception that change and creativity are encouraged) and fairness (perception that organizational practices are equitable and non-arbitrary) in the organization. (Adopted from :Bock et al., (2005)	8
Knowledge sharing behavior	The Degree of individual's knowledge sharing behavior.	7

Furthermore the validity of each constructs against the research objective and NBI context was discussed with 10 participants. The feedback also led to minor modifications aimed at increasing the questionnaires validity and clarity. See, for the complete presentation of the survey instruments used.

3.7.1 CONSTRUCT MEASURES

The measures used to operationalize constructs were generated based upon previously validated instruments (Ajzen, 1991; Bock et al, 2005; Taylor and Todd, 1995; Kankanhalli et al., 2005; DeLone and McLean's, 2003; and Wing S. Chow *, Lai SheungChan, 2008).

The scale used to measure each construct had a number of items and a five point Likert scale was used to measure the degree to which they agreed or disagreed with the statement in the items. [See Table 3.3] and See (Appendix I), for the complete presentation of the survey instruments used.

Table 3.3: Research constructs and associated measurement items

N o	Construct	Items
1	Social Network And Trust(SN)	SN-1. In general, I have a very good relationship with my organizational members and related NBI stake holders
		SN-2. In general, I am very close to my organizational members and related NBI stake holders.
		SN-3. I always hold a lengthy discussion with my organizational members and related NBI stake holders.
		SN-4. I know my organizational members will always try and help me out if I get into difficulties
		SN-5. I can always trust my organizational members to lend me a hand if I need it
		SN-6. I can always rely on my organizational members to make my job easier
2	Shared Goals(SG)	SG-1. My organizational members and I always agree on what is important at work,
		SG-2. My organizational members and I always share the same ambitions and vision at work.
		SG-3. My organizational members and I are always enthusiastic about pursuing the collective goals and missions of the whole organization.
3	Attitude toward knowledge sharing(ATT)	AT-1. Sharing of my knowledge with organizational members is always good
		AT-2. Sharing of my knowledge with organizational members is always beneficial
		AT-3. Sharing of my knowledge with organizational members is always an enjoyable experience
		AT-4. Sharing of my knowledge with organizational members is always valuable to me
		AT-5. Sharing of my knowledge with organizational members is always a wise move
4	Subjective norm about knowledge sharing(SNK)	SU-1. My chief executive officer (CEO) always thinks that I should share my knowledge with other members in the organization.
		SU-2. My boss always thinks that I should share my knowledge with other members in the organization.
		SU-3. My colleagues always think that I should share my knowledge with other members in the organization.
5	Intention towards sharing knowledge(INS)	IN-1. I will share my work reports and official documents with my organizational members more frequently in the future.
		IN-2. I will always share my manuals, methodologies and models with my organizational members in the future.
		IN-3. I will always share my experience or know-how from work with my organizational members in the future.
		IN-4. I will always share my know-where or know-whom at the request of my organizational members.
		IN-5. I will always try to share my expertise obtained from education and training with my organizational members in a more effective way.
6	Usage of tools and technology(UTT)	UT-1. Whenever I want to share knowledge, I can easily access tools and technology in our organization
		UT-2. I am satisfied with the overall quality of tools and technology for sharing knowledge in our organization
		UT-3. I hesitate to use tools and technology to share knowledge for fear of making mistakes
		UT-4. Tools and technology for sharing knowledge can be customized to fit individual needs
		UT-5. I use e-mail to share knowledge with my co-workers
		UT-6. I use discussion forum (using tools like electronic bulletin board, chat room etc.) to share knowledge with my co-workers
		UT-7. I share knowledge by inputting it into knowledge repository/company databases (containing existing expertise, lessons learned, best practices etc.)
		UT-8. I use intranet (including corporate portal) to share knowledge with my co-workers
		UT-9. I use video and teleconferencing to share knowledge with my co-workers.
		UTT-10. I share knowledge through face-to-face discussions with my coworkers

7	Perceived Loss of Knowledge Power(LK)	<p>LK-1.Sharing knowledge with my co-workers makes me lose my unique value in the organization.</p> <p>LK-2.Sharing knowledge with my co-workers makes me lose my power base in the organization.</p> <p>LK-3.When I share knowledge with my co-workers, I believe I will lose my knowledge that no one else has.</p> <p>LK-4.Sharing knowledge with my co-workers makes me lose my knowledge that makes me stand out with respect to others.</p>
8	Perceived Organizational Incentives and benefits of knowledge sharing(IB)	<p>IB-1. Sharing knowledge with my co-workers improves the likelihood of getting a better work assignment or promotion for me.</p> <p>IB-2. Sharing knowledge with my co-workers improves the likelihood of getting a higher salary or bonus for me.</p> <p>IB-3. I expect to get more job security when I share knowledge with my co-workers.</p> <p>IB-4. When I share knowledge with my co-workers, I believe that my queries for knowledge will be answered in the future.</p>
9	Perceived Behavioral Control(PBC)	<p>PBC-1. I have enough time available to share knowledge with my co-workers</p> <p>PBC-2. I have the necessary tools to share knowledge with my co-workers.</p> <p>PBC-3. I have the ability to share knowledge with my co-workers.</p> <p>PBC-4. Sharing knowledge with my co-workers is within my control.</p> <p>PBC-5. I am able to share knowledge with my co-workers easily.</p> <p>PBC-6. Even if I wanted to share, I do not have the means to share knowledge.</p>
10	Perceived organizational climate(OC)	<p>POC-1. Members in our department keep close ties with each other.</p> <p>POC-2. Members in our department consider other members standpoint highly.</p> <p>POC-3. Our department encourages suggesting ideas for new opportunities.</p> <p>POC-4. Our department puts much value on taking risks even if that turns out to be a failure.</p> <p>POC-5. Our department encourages finding new methods to perform a task</p> <p>POC-6. In our department, objectives which are given to us are reasonable.</p> <p>POC-7. In our department, our boss doesn't show favoritism to anyone</p> <p>POC-8. Members in our department can trust department head's judgment to be good.</p>
11	Knowledge sharing behavior(KSB)	<p>KS-1. I shared factual knowledge (know-what) from work with my coworkers.</p> <p>KS-2. I shared business knowledge about the customers, products, suppliers and new technology with my co-workers.</p> <p>KS-3. I shared internal reports and other official documents with my coworkers</p> <p>KS-4. I shared work experiences with my co-workers.</p> <p>KS-5. I shared know-how or tricks of the trade from work with my coworkers.</p> <p>KS-6. I shared expertise from education or training with my co-workers.</p> <p>KS-7. I shared know-why knowledge from work with my co-workers</p>

A comprehensive survey instrument was constructed using the adopted constructs and measurement Items to test the research conceptual model. The questionnaire is well designed, clear and applicable. Though the questions are adapted from Wing S. Chow *, Lai Sheung Chan (2008), Bock, Zmud, Kim and Lee (2005), Kankanhalliet al. (2005), DeLone and McLean's (2003) and Taylor and Todd (1995) some modifications and contextualization are made in order to meet research context. A five point Likert scale was used and the respondents were required to state the extent to which they agreed or disagreed with the statements in the questionnaire. The questionnaire was also circulated and pre-tested by 5 senior permanent employees of NBI to determine the understandability of the items included in the questionnaire (See Appendix-I). Thus improvement and modification including rephrasing and rewording were done based on the feedback obtained since limitations can lead to wrong interpretation of the results of the survey.

3.8 RESEARCH CONCEPTUAL MODEL AND HYPOTHESIS

The focus of this section is to develop a conceptual research measurement model and the hypothesis for examining the factors influencing knowledge sharing behaviors in knowledge based organization context such as NBI. This study adopts the theory of planned behavior (TPB) as theoretical framework to model knowledge sharing behaviors.

3.8.1 THEORY OF PLANNED BEHAVIOR (TPB)

TPB of Ajzen (1991) is the most influential and popular social-psychological model for explaining and predicting human behavior in specific contexts (Ajzen, 2001) and it is an extension of the researcher's earlier work Theory of Reasoned Action (TRA) (Ajzen and Fishbein, 1980).

The extension was a result of a finding that behavior appeared to be not 100% voluntary and under control and resulted in the introduction of a new determinant, perceived behavioral control. With this introduction, the theory was named theory of planned behavior. According to TPB, the primary determinants of an individual's behavioral action are intention and perceived behavioral control (PBC). Intention in turn is a function of individual's attitude towards a behavior, subjective norm and perceived behavioral control (PBC) with each determinant weighted for its significance in relation to the behavior and population in question.

According to TPB, Attitude is based on behavioral beliefs, which are beliefs about the expected consequences of a specified behavior and the favorable or unfavorable evaluation of these consequences. Subjective Norm is based on normative beliefs about the perceived social pressure from important referent group to perform or not to perform a specified behavior. In addition Perceived Behavioral Control (PBC) is based on control beliefs about the perceived presence or absence of factors that may facilitate or impede the performance of behavior in interest. Control beliefs together with the perceived power of each factor determine perceived behavioral control (PBC). PBC boosts intention because individuals are not motivated to undertake tasks at which they fail. Additionally, PBC is also expected to influence actual behavior. Fig: 3.1 presents the components of the theory of planned behavior.

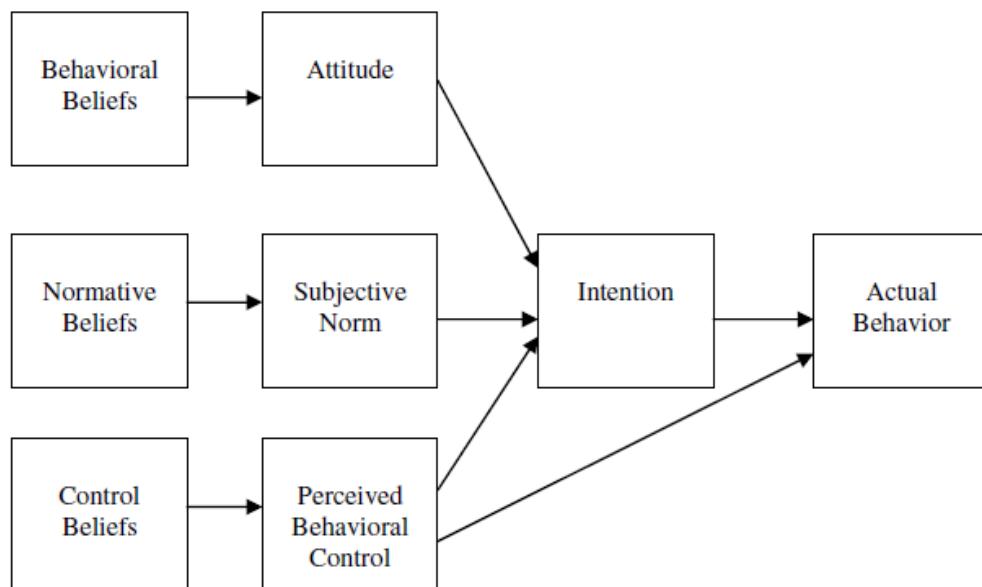


Fig 3.1 Components of the theory of planned behavior, Source: Ajzen (1991)

3.8.2 RESEARCH MODEL

The research model uses theory of planned behavior (TPB) as theoretical framework and supplements it with the constructs from Wing S. Chow *, Lai Sheung Chan (2008) theory and adopting other important constructs from literature to meet research objectives as well as to analyze the motivational factors that influence knowledge sharing behaviors of individuals. [Fig: 3.2] presents the conceptual research model of this study.

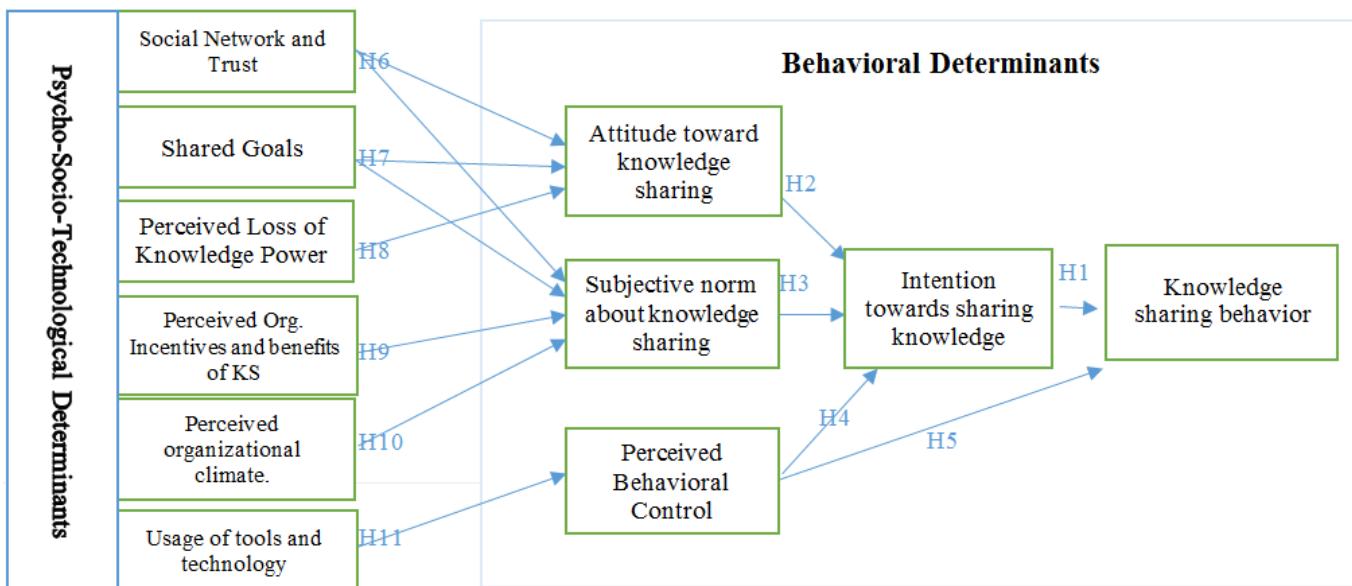


Fig 3.2: Research conceptual model based on TPB of Ajzen (1991)

As presented on the above graphical description, the conceptual model contains 11 constructs integrated with reflexive indicators, where changes in the construct are expected to be manifested in changes in all of its indicators. In other words indicators depends on the latent variable and should be highly/positively correlated. The conceptual model has got two major components. The first one, models external factors to the actual human behavior namely behavioral beliefs, normative beliefs and control beliefs modeled on the original TPB of Ajzen (see fig: 3.1). The study uses six latent constructs for explaining and predicting external psychological, social and technological dimensions towards the actual knowledge sharing behavior of individuals.

The second part models the actual knowledge sharing behavior of individuals based on TPB. In addition the conceptual model represents the relationship between behavioral determinants and other external factors depicted as psych-socio-technological determinants. The values H1 – H11 represented the hypothesized relationships in the following section (3.8.3).

3.8.3 RESEARCH HYPOTHESIS

To examine the research model, the following 11 hypothesis are proposed which demonstrates the relationships between the identified constructs as well as their impacts towards the overall knowledge sharing behavior of individuals.

- **H1:** A higher level of intention towards knowledge sharing will lead to greater sharing of knowledge.
- **H2:** A more favorable attitude toward knowledge sharing will lead to greater intention to share knowledge.
- **H3:** A higher level of subjective norm supportive of knowledge sharing will lead to greater intention to share knowledge.
- **H4:** A higher level of behavioral control towards knowledge sharing will lead to greater intention to share knowledge.
- **H5:** A higher level of behavioral control towards knowledge sharing will lead to greater sharing of knowledge.
- **H6:** The greater the social network and trust among organizational members, the more favorable will be the attitude and subjective norm toward knowledge sharing.
- **H7:** The greater the shared goals among organizational members, the more favorable will be the attitude and subjective norm toward knowledge sharing.
- **H8:** Perceived loss of knowledge power has a negative effect on the knowledge worker's attitude towards knowledge sharing.
- **H9:** Perceived Organizational Incentives and benefits have positive effect on the knowledge worker's attitude towards knowledge sharing.
- **H10:** Tools and Technology have a positive effect on knowledge worker's perceived behavioral control towards knowledge sharing.
- **H11:** A higher level of perceived organizational climate characterized by fairness, innovativeness and affiliation will lead to greater subjective norm to share knowledge.

3.9 DATA ANALYSIS PROCEDURE

As recommended by Hair et al., (1998), the current study used two-stage model building process for analyzing data. *Assessment of the measurement model* was conducted in the first stage of the analysis followed by the *examination of structural relationships* of research constructs proposed on the research hypothesis. The study also used *line-by-line open coding* techniques for the analysis of qualitative data gathered to explore findings relevant to support the proposed conceptual model.

This research study chose Partial Least Squares (PLS) as the primary data analysis technique.(PLS) is a *latent structural equation modeling technique that assesses the psychometric properties of the scales used to measure the theoretical constructs and estimates the hypothesized relationships among the constructs.*(Barclay et al., 1995). The main reason for this study to choose PLS over alternative structural equation modeling techniques such as LISREL, AMOS, EQS is the fact that it is prediction oriented and handles reflective type of indicators which is directly related to objective and the type of indicators (reflective indicators) of this exploratory research study, to develop an integrated model of factors that predict knowledge sharing behaviors. The other reason was the fact that PLS places minimal demands in terms of sample size. As rule of thumb for testing the research model in PLS is equal to the larger of the following two possibilities: (1) 10 times the number of indicators on the most complex formative construct (2) 10 times the largest number of independent constructs leading to an endogenous construct (Chin, 1998; Chin & Newsted, 1999).The final usable number of cases were tested against this rule of thumb and complied. Accordingly PLS Graph 3.00, academic version software was used for both model building process of the study.

The raw data (quantitative) was extracted from web platform, SurveyMonkey, and prepared in *.raw format that PLS graph require for the input data, which is Plain ASCII file with the names of the variables first followed by each data case in the same order as the variables listed .PLS-Graph also requires for missing data points to be imputed a-priori or given a code such as -99,-1 etc. Otherwise an error message will occur if the number of numeric data points counted is not an even multiple of the variables listed. Accordingly missing data was replaced with -1, and finally the *.raw file was imported to modeling software for processing and analysis .In addition Bootstrap Resampling procedure with size of 200 was configured which samples with replacement from the original sample set until it reaches the maximum. As per the guidelines given in the PLS-Graph-v3 bootstrap procedure utilizes a confidence estimation procedure and resamples size of 200 tend to provide reasonable standard error estimates.

The following section discussed in detail the data analysis procedures used for both quantitative and qualitative data, respectively.

3.9.1 ASSESSMENT OF THE MEASUREMENT MODEL (QUANTITATIVE)

The measurement model specifies the relationship between the indicators and the latent construct they are intended to measure. Assessment of the measurement model requires examining two type of validities: convergent validity, and discriminant validity (Chin, 1998). Convergent validity indicates the degree to which theoretically similar constructs are highly correlated with each other. Alternatively, discriminant validity indicates the degree to which a given construct is different from other constructs. Collectively, these two validities provide some evidence regarding the goodness of fit of the measurement model.

3.9.1.1 CONVERGENT VALIDITY

Convergent validity was assessed in two ways: First by evaluating the t-values of the Outer Model Loadings and second by extracting the composite reliabilities. According to (David Geffen, 2005) Convergent validity is shown when the t-values of the Outer Model Loadings are above 1.96.The t-values of the loadings are, in essence, equivalent to t-values in least-squares regressions. Which implies that more than 50% of the variance is shared between the measurement item and its theorized construct (Barclay et al., 1995).

55 of the original 61 items had t-values of the outer model loadings greater than the recommended value of 1.96 (David Geffen, 2005).the 6 measurement items namely SG1,IB1,IB2,POC4,UT3 and UT9 are trimmed from the model since they presented t-values below the recommended. The trimmed constructs together with their weight, mean, standard error and t-statistics value are extracted from the PLS-Graph and presented on table 3.4 below.

Table 3.4: Extracted relationships between constructs and their indicators,(Outer Model Loadings)

		Weights	Mean	Standard Error	T-Statistic
SN : Social Network and Trust					
	SN1	0.2203	0.2158	0.0294	7.4826
	SN2	0.2634	0.2631	0.0328	8.0335
	SN3	0.2139	0.2157	0.0313	6.8396
	SN4	0.2793	0.2755	0.0347	8.0537
	SN5	0.1453	0.1428	0.0422	3.4421
	SN6	0.1840	0.1841	0.0488	3.7731
SG : Shared Goals					
**	SG2	0.3706	0.39	0.0716	5.175
	SG3	0.4419	0.4718	0.1138	3.8845
LK : Perceived Loss of Knowledge Power					
	LK1	0.2418	0.2457	0.0312	7.7595
	LK2	0.2825	0.2782	0.0288	9.7933
	LK3	0.2771	0.2738	0.0341	8.1309
	LK4	0.2934	0.302	0.0546	5.3768
IB :Perceived Organizational Incentives and Benefits					
**	IB1	0.6734	0.7387	0.1384	4.865
	IB4	0.5198	0.4295	0.2149	2.4187
UT :Usage of tools and technology					
**	UT1	0.2157	0.2161	0.0428	5.0453
	UT2	0.185	0.1868	0.0469	3.9459
	UT4	0.1133	0.1072	0.0544	2.0845
	UT5	0.2389	0.2441	0.0459	5.2025
	UT6	0.1953	0.185	0.0556	3.5103
	UT7	0.2335	0.2205	0.0455	5.1363
	UT8	0.1602	0.1516	0.0509	3.149
	UT10	0.3708	0.3643	0.0912	4.0663
OC : Perceived Organizational climate					
**	POC1	0.2129	0.2058	0.0487	4.3732
	POC2	0.1345	0.1237	0.0575	2.3382
	POC3	0.2879	0.2848	0.0475	6.06
	POC5	0.2159	0.2212	0.0547	3.9445
	POC6	0.188	0.1869	0.0788	2.3862
	POC7	0.1465	0.1428	0.0742	1.9745
	POC8	0.276	0.28	0.049	5.6375
ATT : Attitude Towards Knowledge sharing					
	AT1	0.2146	0.2181	0.0453	4.7379
	AT2	0.2832	0.284	0.0305	9.2901
	AT3	0.2034	0.2089	0.0399	5.0926
	AT4	0.2866	0.2841	0.0375	7.6449
	AT5	0.2427	0.2327	0.0386	6.2866
SNK : Subjective norms Towards Knowledge Sharing					
	SU1	0.4412	0.4372	0.0397	11.1225
	SU2	0.3828	0.3785	0.0407	9.395
	SU3	0.3258	0.3263	0.0658	4.9487
PBC : Perceived Behavioral Control					
	PBC1	0.1685	0.1632	0.0463	3.636
	PBC2	0.2962	0.2983	0.0291	10.1933
	PBC3	0.3177	0.3122	0.0325	9.7881
	PBC4	0.2494	0.2486	0.0458	5.4488

	PBC5	0.26	0.2532	0.0357	7.2846
	PBC6	-0.1537	-0.1577	0.0658	2.3368
INS : Intentions Toward knowledge Sharing					
	IN1	0.2114	0.2078	0.0234	9.0238
	IN2	0.2428	0.2433	0.0159	15.2835
	IN3	0.2495	0.2553	0.0217	11.5112
	IN4	0.2525	0.2534	0.0182	13.9012
	IN5	0.2651	0.2671	0.0197	13.4485
KSB : Knowledge sharing Behavior					
	KS1	0.1665	0.1648	0.0186	8.9638
	KS2	0.171	0.1727	0.0195	8.7911
	KS3	0.133	0.1292	0.0225	5.9092
	KS4	0.1887	0.1883	0.0221	8.5569
	KS5	0.1564	0.1546	0.0149	10.5221
	KS6	0.2202	0.2218	0.0268	8.2209
	KS7	0.1979	0.1971	0.0141	14.0778
Constructs where insignificant indicators are trimmed**					

The second step taken to evaluate the convergent validity of measurement items was extracting the composite reliabilities. According to Nunnally et al. (1994) composite reliability values greater than 0.80 indicate good internal consistency. Consequently composite reliabilities and average variance together with number of items in each constructs of the trimmed model from the first step was extracted. [See table 3.5]. As is evident from Table 3.5, the composite reliabilities range from 0.808 to 0.954 exceeding the recommended value of 0.80.

Table 3.5: Extracted composite reliabilities and average variance

	Composite Reliability	Average Variance
SN	0.891	0.578
SG	0.917	0.787
LK	0.954	0.839
IB	0.954	0.839
UT	0.808	0.313
OC	0.855	0.438
ATT	0.905	0.656
SNK	0.898	0.749
PBC	0.823	0.453
INS	0.913	0.680
KS1	0.935	0.674

3.9.1.2 DISCRIMINANT VALIDITY

Two procedures were used to assess discriminant validity (Chin, 1998; Geffen and Straub, 2005), which is the extent of one construct is different from all other constructs in the research model. The first procedure is the Analysis of the correlations of the latent variable scores with the measurement items. To establish discriminant validity, measures of a construct should be distinct and the measures should load more strongly on their theorized construct than on the other constructs in the research model. The second one is the Examination of the average variance extracted (AVE) to ensure that each construct shares larger variance with its measures than with the other latent constructs in the research model. Partial Least Squares (PLS Graph, academic version 3.0) was used to evaluate the discriminant validity.

As a rule of thumb, the square root of the AVE for an individual construct should be greater than 0.5 recommended value (Fornell and Larcker, 1981) and should be much larger than the variance shared between the construct and other constructs in the model (Chin, 1998). AVE loading greater than 0.5 implies that the construct accounts for at least 50% of measurement variance.

Table 3.6 presents the loadings and cross loadings. Examination of the loadings and cross-loadings points out that all the measurement items load highly on their own latent construct than on other constructs.

Table 3.6: Measurement Indicator to Construct Correlation

	SN	SG	LK	IB	UT	OC	ATT	SNK	PBC	INS	KSB
SN1	.847**	.286**	-.122	-.028	.136	.091	.353**	.395**	.440**	.366**	.369**
SN2	.816**	.245*	-.242*	-.049	.078	.114	.411**	.496**	.419**	.402**	.314**
SN3	.737**	.300**	-.085	.001	.157	.103	.401**	.426**	.338**	.375**	.176
SN4	.834**	.403**	-.084	.074	.304**	.106	.419**	.548**	.549**	.339**	.340**
SN5	.644**	.413**	-.171	-.005	.214*	-.020	.295**	.226*	.376**	.268**	.256**
SN6	.685**	.291**	-.166	-.003	.260**	.014	.328**	.325**	.277**	.356**	.291**
SG1	.294**	.738**	-.061	.051	.197*	.109	.200*	.185	.314**	.256**	.165
SG2	.259**	.902**	.052	.105	.268**	.107	.185	.199*	.181	.142	.032
SG3	.270**	.921**	-.115	.094	.134	.106	.227*	.231*	.228*	.217*	.089
LK1	-.203*	.011	.733**	.062	.282*	.207*	-.284**	-.177	-.142	-.303*	-.198*
LK2	-.173	.013	.716**	.064	.306**	.195*	-.277**	-.188	-.140	-.350**	-.208*
LK3	-.166	-.049	.760**	.077	-.005	.196*	-.298**	-.183	-.194*	-.407**	-.217*
LK4	-.147	-.090	.701**	.131	.176	.168	-.319**	-.126	-.068	-.357**	-.175
IB1	.067	.094	.340**	.826**	.158	.335**	.186	.264**	.004	.174	.111
IB2	-.023	.148	.302**	.646**	.238*	.370**	.032	.057	.002	-.009	.008
IB3	.021	.057	.188	.658**	.153	.390**	.071	.246*	.021	.074	-.015
IB4	.073	.200*	.209*	.864**	.046	.459**	.140	.203*	.042	.132	.037
UT1	.191	.127	.034	.064	.659**	.104	.315**	.205*	.301**	.394**	.357**
UT2	.154	.203*	.032	.037	.714**	.115	.096	.064	.262**	.143	.189
UT4	.095	.166	.236*	.161	.619**	.350**	.095	-.039	.130	.084	.070
UT5	.124	.210*	.240*	.308**	.712**	.282**	.045	-.018	.233*	.131	.224*
UT6	.155	.533**	.196*	.178	.619**	.163	.126	.171	.340**	.169	.148
UT7	.079	.066	.265**	.066	.567**	.234*	.078	-.038	.242*	.032	.132
UT8	-.020	-.053	.312**	.060	.540**	.270**	.061	-.055	.116	.035	.080
UT9	.036	.105	.202*	.052	.474**	.319**	.100	.091	-.008	.141	.144
UT10	.088	.138	.198*	.154	.588**	.193	.257**	.185	.392**	.273**	.319**
POC1	.075	.282**	.292**	.324**	.010	.838**	.173	.160	.006	.246*	.114
POC2	.113	.291**	.217*	.416**	.105	.791**	.131	.035	.137	.210*	.060
POC3	.188	.044	.295**	.488	.073	.837**	.120	.146	.134	.158	.137
POC4	.004	.113	.360**	.379**	.137	.540**	-.068	-.101	.006	.090	.086
POC5	.137	.135	.428**	.480**	.239*	.682**	.006	.108	.132	.027	.111
POC6	.065	-.006	.373**	.436**	.270**	.632**	.015	.058	.178	.079	.147
POC7	.181	.262**	.338**	.312**	.027	.542**	.041	.089	-.096	.005	-.176
POC8	.099	.215*	.331**	.329**	.213*	.664**	.157	.128	.045	.250*	.090
AT1	.521**	.043	-.180	-.162	.119	.035	.572**	.227*	.391**	.381**	.391**
AT2	.286**	.250*	-.212*	.000	.162	.133	.857**	.377**	.368**	.678**	.352**
AT3	.090	-.086	-.087	-.014	.116	.074	.435**	.140	.262**	.173	.177
AT4	.233*	.124	-.255*	.127	.139	.069	.756**	.420**	.270**	.594**	.265**
AT5	.109	.096	.082	.297*	.072	.300**	.640**	.226	.157	.374**	.075
SU1	.428**	.243*	-.173	.097	.081	.325**	.402**	.840**	.249*	.348**	.165
SU2	.362**	.245*	-.083	.119	.200*	.070	.408**	.917**	.158	.318**	.161
SU3	.212*	.063	-.081	.105	.092	.093	.357**	.651**	.200*	.186	.304**
PBC1	.194*	.106	-.134	.086	.066	.114	.108	.145	.388**	.187	.277**
PBC2	.379**	.250*	-.137	.074	.212*	.086	.377**	.193	.745**	.330**	.383**
PBC3	.301**	.285**	-.191	-.020	.231*	-.001	.405**	.159	.714**	.315**	.403**
PBC4	.400**	.299**	-.119	-.038	.454**	.111	.231*	.211*	.703**	.242*	.325**
PBC5	.196*	.284**	-.061	-.053	.116	.024	.067	.160	.467**	.098	.237*
PBC6	.012	.131	.115	.215*	-.293	.093	-.113	.039	.392**	-.167	-.293**

IN1	.262 **	.056	-.291 *	.019	.015	.121	.587 **	.447 **	.257 **	.695 **	.355 **
IN2	.264 **	.005	-.275 *	-.028	.094	.275 **	.503 **	.428 **	.378 **	.656 **	.384 **
IN3	.344 **	.046	-.292 *	.073	.116	.150	.628 **	.526 **	.402 **	.741 **	.390 **
IN4	.234 *	.022	-.041	.212 *	.056	.327 **	.457 **	.406 **	.322 **	.552 **	.382 **
IN5	.229 *	-.021	-.042	.187	.086	.315 **	.605 **	.502 **	.253 **	.651 **	.362 **
KSB1	.226 *	.015	-.249 *	-.075	.077	.003	.304 **	.252 *	.413 **	.346 **	.783 **
KSB2	.115	.047	-.054	-.127	.137	.259 **	.153	.140	.374 **	.197 *	.597 **
KSB3	.080	-.038	-.134	-.075	.068	-.053	.237 *	.163	.236 *	.330 **	.648 **
KSB4	.255 **	.090	-.098	.032	.313 **	.091	.390 **	.211 *	.425 **	.536 **	.842 **
KSB5	.018	-.007	.035	-.074	.192	.210 *	.147	.017	.241 *	.246 *	.594 **
KSB6	.269 **	.030	-.236 *	-.026	.199 *	.072	.458 **	.179	.492 **	.629 **	.803 **
KSB7	.230 *	.019	.165	.229 *	.251 *	.253 **	.295 **	.209 *	.326 **	.450 **	.763 **

Table 3.7 presents the analysis of average variance extracted (AVE). As can be seen, the square root of AVE values range from 0.559 to 0.916 exceeding 0.5 recommended value. (Fornell and Larcker, 1981) That is all constructs share greater variance with their own measures than with other constructs in the model, thus establishing discriminant validity.

Table 3.7: The analysis of average variance extracted

	Average Variance(AVE)	SQRT :AVE
SN	0.578	0.760
SG	0.787	0.887
LK	0.839	0.916
IB	0.839	0.916
UT	0.313	0.559
OC	0.438	0.662
ATT	0.656	0.810
SNK	0.749	0.865
PBC	0.453	0.673
INS	0.680	0.825
KSB	0.674	0.821

3.9.2 ASSESSMENT OF THE CONCEPTUAL MODEL

After weighing and identifying the adequacy of measurement model the next step will be the Assessment of the Conceptual Model .The conceptual/structural model indicates the causal relationships among the latent constructs in the research model. Assessment of structural model was done first by determining the predictive power of the model and second by analyzing the hypothesized relationships among the latent constructs proposed in the research model. The R-square value of the dependent variables determine the predictive power of the research model and the path coefficients evaluate the strength of the hypothesized relationships.

Validation of structural model was accomplished with academic version of PLS-Graph 3.0.The model was setup in PLS as per the guidelines given in the PLS-Graph Users Guide (Chin, 2001). See [Fig: 3.3]

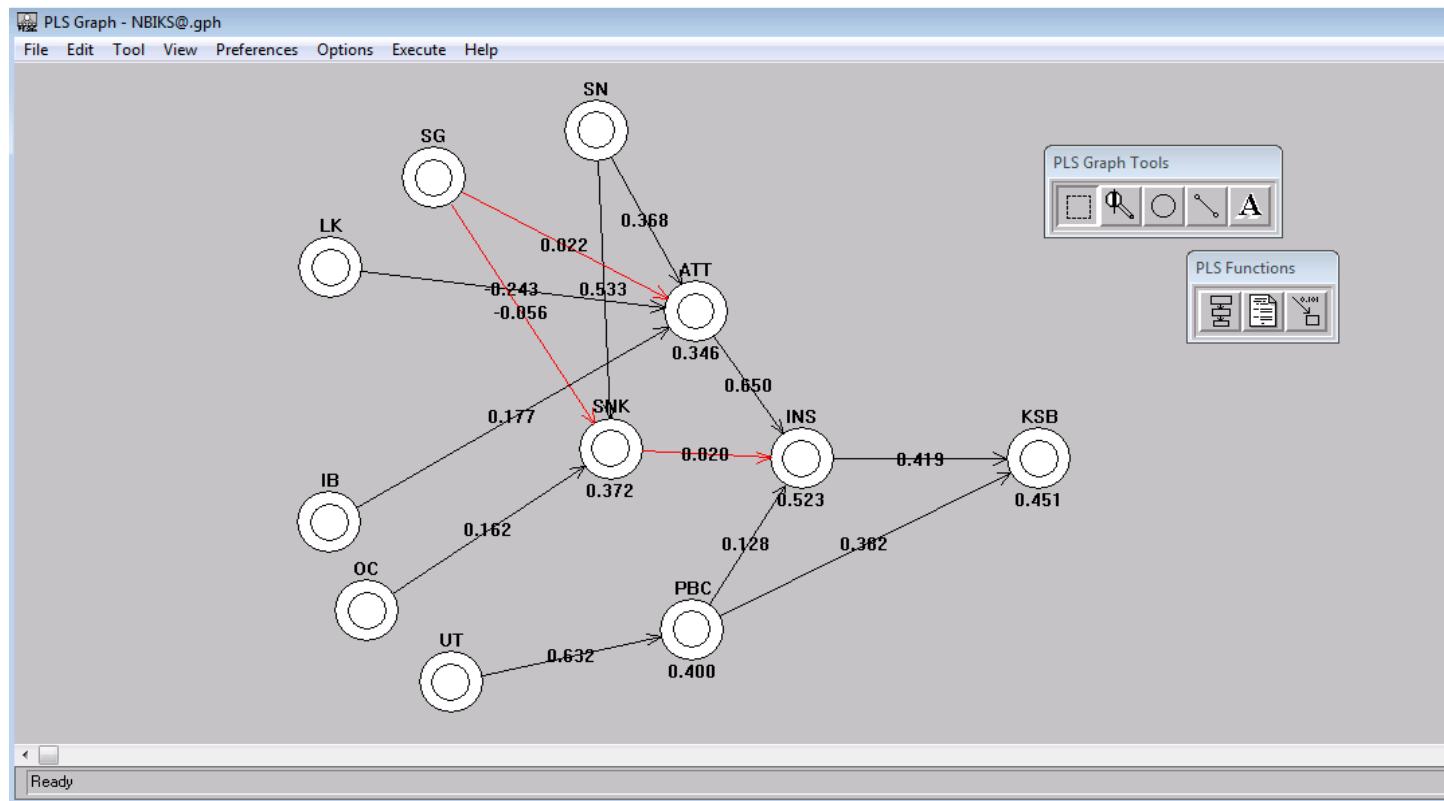


Fig 3.3: Displaying the conceptual research model constructed on PLS-Graph.

Path in red shows non-significant/Weak paths

The results of PLS-Graph and statistical analysis using SPSS and Excel (to calculate the P-value) of the conceptual model is summarized on the table 3.8 below.

Table 3.8: Summary of R-Square, Path Coefficients and Significance Levels.

Construct	R-Square	Beta Coefficient	t-Value	P-value
KS B	0.45			
I N S		0.42	5.24	< 0.01
P B C		0.38	5.07	< 0.01
I N S	0.52			
A T T		0.65	9.66	< 0.01
***S N K		0.12	0.22	> 0.50
P B C		0.13	1.86	< 0.05
A T T	0.35			
S N		0.37	4.08	< 0.01
***S G		0.02	0.24	> 0.10
L K		-0.24	2.23	< 0.05
I B		0.18	2.03	< 0.05
S N K	0.34			
***S G		-0.06	0.41	> 0.10
O C		0.16	2.25	< 0.05
S N		0.53	5.67	< 0.01
P B C	0.4			
U T		0.63	11.56	< 0.01

*** Non-significant Path

As is evident from table 3.8, the model has high predictive power. It explains approximately 45% of the variance in the actual knowledge sharing (KS_B) and 52% of the variance in the intention to share knowledge (INS). The attitude towards knowledge sharing (ATT), subjective norm (SNK) and perceived behavioral Control (PBC) respectively account for 35%, 34% and 40% of the variance. Additionally, 9 of the 12 paths were found to be statistically significant. The standardized path coefficients ranged from 0.02 to 0.65. The overall fit of the model was good.

3.9.2.1 TESTS OF HYPOTHESIS

The results of the hypothesis tests which support 9 of the 11 posited relationships presented below.

- **H1:** *A higher level of intention towards knowledge sharing will lead to greater sharing of knowledge.*
Supported, $\beta= 0.42$, $t > 5.24$, $p < 0.01$.
- **H2:** *A more favorable attitude toward knowledge sharing will lead to greater intention to share knowledge.*
Supported, $\beta= 0.65$, $t > 9.66$, $p < 0.01$.
- **H3:** *A higher level of subjective norm supportive of knowledge sharing will lead to greater intention to share knowledge.*
Not-Supported, $\beta= 0.12$, $t < 0.22$, $p > 0.50$.
- **H4:** *A higher level of behavioral control towards knowledge sharing will lead to greater intention to share knowledge.*
Supported, $\beta= 0.13$, $t > 1.86$, $p < 0.05$.
- **H5:** *A higher level of behavioral control towards knowledge sharing will lead to greater sharing of knowledge.* Supported, $\beta= 0.38$, $t > 5.07$, $p < 0.01$.
- **H6:** *The greater the social network and trust among organizational members, the more favorable will be the attitude and subjective norm toward knowledge sharing.* : Supported.
Towards ATT: $\beta= 0.37$, $t > 4.81$, $p < 0.01$
Towards SNK: $\beta= 0.53$, $t > 5.67$, $p < 0.01$
- **H7:** *The greater the shared goals among organizational members, the more favorable will be the attitude and subjective norm toward knowledge sharing.* Not-Supported.
Towards ATT: $\beta= 0.02$, $t < 0.25$, $p > 0.1$
Towards SNK: $\beta= -0.06$, $t < 0.42$, $p > 0.1$
- **H8:** *Perceived loss of knowledge power has a negative effect on the knowledge worker's attitude towards knowledge sharing.* Supported, $\beta= 0.38$, $t > 5.07$, $p < 0.01$
- **H9:** *Perceived Organizational Incentives and benefits have positive effect on the knowledge worker's attitude towards knowledge sharing.*
Supported, $\beta= 0.18$, $t > 2.03$, $p < 0.05$
- **H10:** *Tools and Technology have a positive effect on knowledge worker's perceived behavioral control towards knowledge sharing.*
Supported, $\beta= 0.63$, $t > 11.5$, $p < 0.01$
- **H11:** *A higher level of perceived organizational climate characterized by fairness, innovativeness and affiliation will lead to greater subjective norm to share knowledge.*
Supported, $\beta= 0.16$, $t > 2.25$, $p < 0.05$

Table 3.9 summarizes the results of the hypothesis testing.

Table 3.9: Summary of hypothesis testing results.

	Hypothesis	Result
H1	A higher level of intention towards knowledge sharing will lead to greater sharing of knowledge	Supported
H2	A more favorable attitude toward knowledge sharing will lead to greater intention to share knowledge	Supported
H3	A higher level of subjective norm supportive of knowledge sharing will lead to greater intention to share knowledge	Not-Supported
H4	A higher level of behavioral control towards knowledge sharing will lead to greater intention to share knowledge	Supported
H5	A higher level of behavioral control towards knowledge sharing will lead to greater sharing of knowledge.	Supported
H6	The greater the social network and trust among organizational members, the more favorable will be the attitude and subjective norm toward knowledge sharing	Supported
H7	The greater the shared goals among organizational members, the more favorable will be the attitude and subjective norm toward knowledge sharing. Not-Supported	Not-Supported
H8	Perceived loss of knowledge power has a negative effect on the knowledge worker's attitude towards knowledge sharing	Supported
H9	Perceived Organizational Incentives and benefits have positive effect on the knowledge worker's attitude towards knowledge sharing	Supported
H10	Tools and Technology have a positive effect on knowledge worker's perceived behavioral control towards knowledge sharing	Supported
H11	A higher level of perceived organizational climate characterized by fairness, innovativeness and affiliation will lead to greater subjective norm to share knowledge	Supported

3.9.3 ANALYSIS PROCEDURE OF QUALITATIVE DATA

The study employed a line-by-line open coding technique for the analysis of qualitative data, which was gathered to find some valuable information's to support findings from the quantitative data analysis or the proposed conceptual research model of the study. According to Bulmer H (1969); Denise F. Polit, Cheryl, Tatano Beck (2004) open coding technique consists of three parts: noticing, collecting and thinking about interesting things. Noticing refers to taking notes based on observation, recording events or interviews, gathering documents etc., In the analysis phase, when you are going through the data you often mark important sections and add descriptive name or 'code' to it and it is called open coding. And finally the coded data is gathered or collected and used to reach in to some kind of conclusion. Even though line-by-line coding is a very time consuming, recursive and tedious work it helped to build structured conceptual data that supported findings during this explorative research study. Figure 3.4 presented workflow of qualitative data analysis technique used.

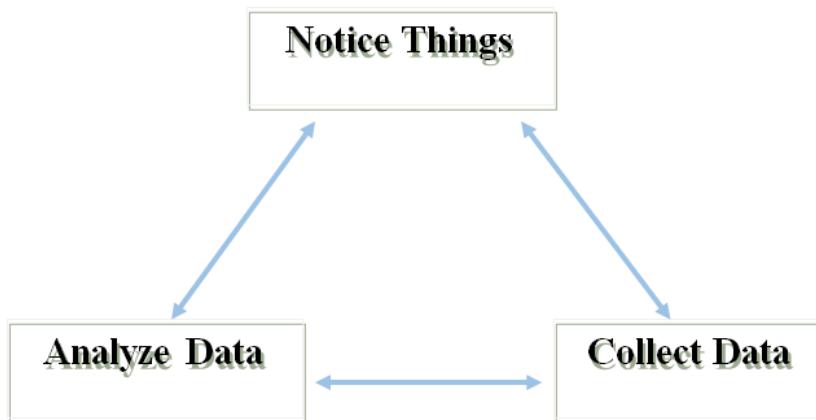


Figure 3.4: Workflow of Qualitative Data Analysis Technique used.

4 FINDINGS AND DISCUSSION OF RESULTS

This chapter discusses the results from the data analysis. First, the demographic characteristics of the survey respondents is presented. Second, the findings related to usage of tools and technology to share knowledge is reported. And finally, the results from the assessment of structural model and tests of hypothesis are analyzed and discussed.

4.1 DEMOGRAPHIC DISTRIBUTIONS OF RESPONDENTS

During the field study using survey methodology, the researcher observes from the title of the respondents that most of the respondents were knowledge worker. As Kelloway and Barling (2000) noted that knowledge work primarily “comprise the creation of knowledge, the application of knowledge, the transmission of knowledge and the acquisition of knowledge.in other words knowledge workers are those individuals who primarily deals with information or require developing and using knowledge to solve problems. Thus the researcher considers this observation as one of the strength of the study.

The respondents reported a wide range of position titles. Some of these include Regional Project Coordinator, Water Resources Engineer, Professor, Assistant Professor, national Focal Point, power engineer, Environmental Management specialist, Teaching Assistant, Monitoring & Evaluation expert, Senior Water Resources Specialist, Expert , Senior Water Resources Specialist , Professor of Hydraulics faculty , D/D for water resources management , Independent GIS Consultant, soil and water conservation zonal expert , M&E Officer , Program Manager, information systems specialist, Accountant, extension agent ,Head internal audit , Bi-lingual Secretary , NBI National Desk officer, director, national Focal Point, Program Manager, Accountant, support staff, hardware and network engineer, IT expert , Dean of College of Environmental Studies, hydrologist, Project and Programme coordinator, Intern, Senior Hydraulic Engineer, Ass.administration head ,and so on. In total, more than 40 unique position titles were reported.

The details of demographic findings, which includes gender distribution, Age distribution, educational categories and respondents organizational tenure is presented as follows.

4.1.1 GENDER DISTRIBUTION

Out of the 103 valid respondents, 87 (84%) were males and 16 (16%) were females. the gender distribution of the respondents is presented on the following fig: 4.1

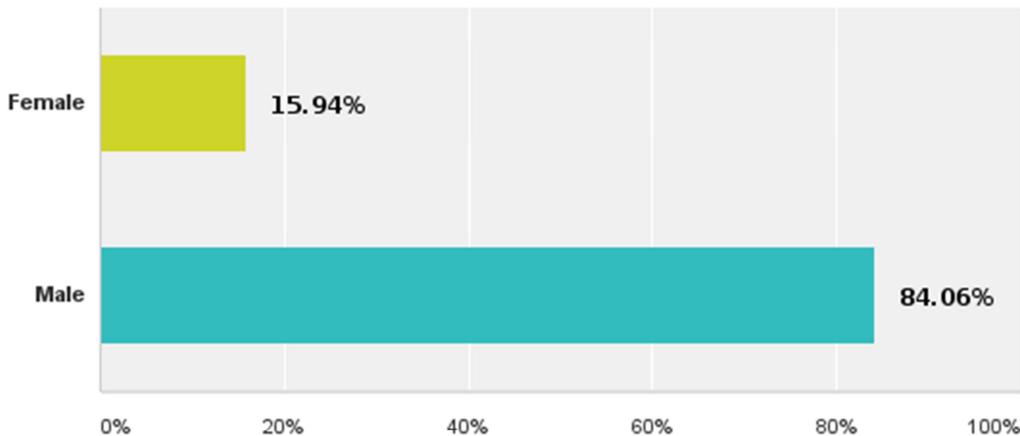


Fig: 4.1 Gender distribution of Respondents

4.1.2 AGE DISTRIBUTION

The respondent ages ranged from approximately 24 years to 65 years. 40 % were between the ages of 25 and 34; 34.85% were between ages of 35 and 44; 16.67% were between ages of 45-54 and 7.58% were between ages of 55-64. Examination

of age category indicates that the sample has slightly younger respondents. Figure 4.2 below shows a graphical depiction of the respondent age category distribution.

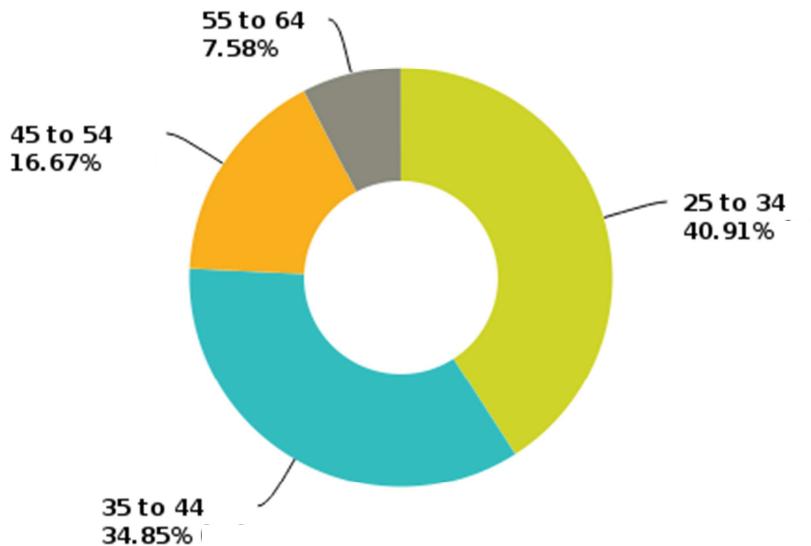


Fig: 4.2 Age distribution of respondents

4.1.3 RESPONDENTS EDUCATION LEVEL:

The majority of the respondents are well-educated .more than 60 % of respondents have Masters or doctoral degree. 38 (39 %) individuals had a bachelor's degree, 50 (45.45%) had a master's degree, 15(15.15%) had doctoral degree .Figure 4.3 below provides a graphical representation of the distribution of respondents education category.

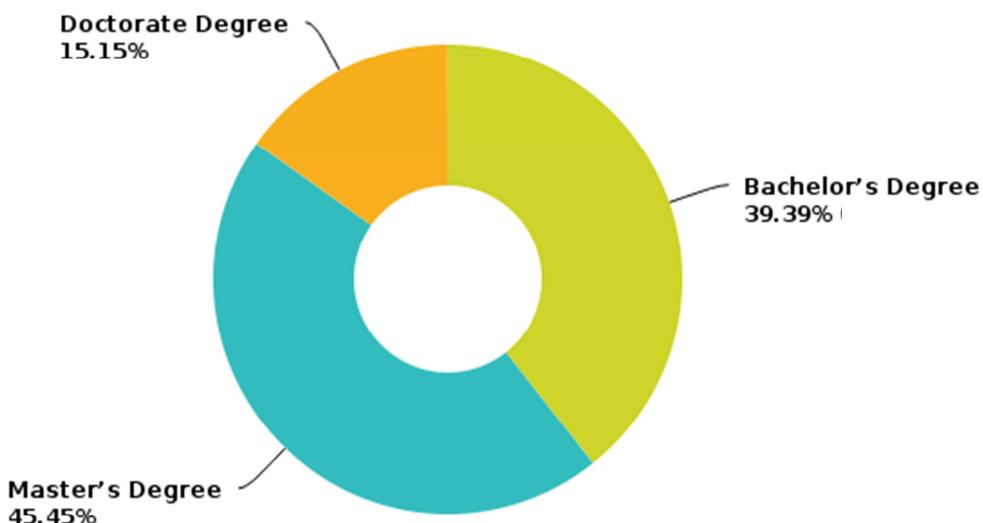


Fig: 4.3 Respondents Education by Category

4.1.4 RESPONDENTS ORGANIZATIONAL TENURE

Respondents were requested to answer for how long they work for or work with NBI and the reply ranged from less than 2 years to over 10 years. 42 (43.75%) had been with the organization for 2 to 1 years, 35(35.94%) for 3 to 5 years, 16 (17.19%) for 6 to 10 years, 2 (3%) for over 11 years. Figure 4.4 shows respondents distribution for the organizational tenure category.

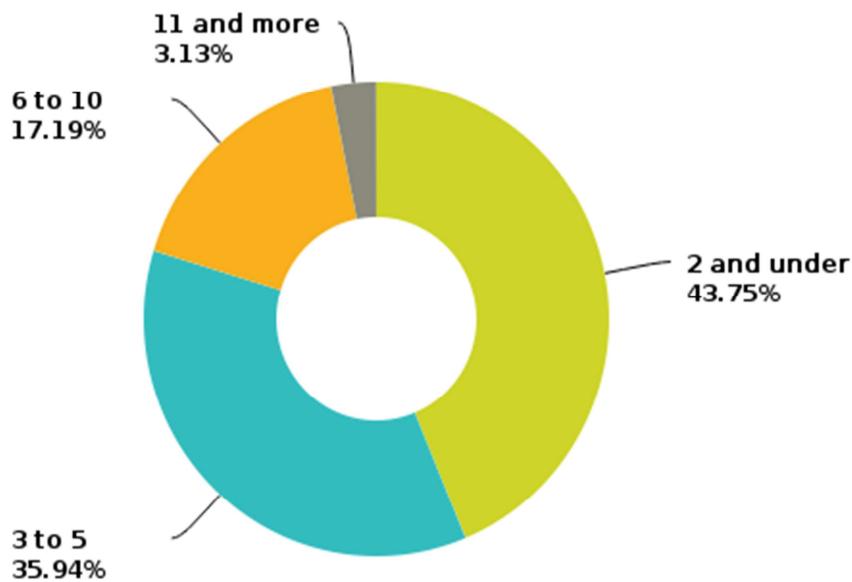


Fig: 4.4 respondents distribution for the organizational tenure category.

4.2 PRESENTATION OF THE FINDINGS

This section presents details of the findings of PLS-Graph 3.0 analysis and the findings during unstructured interviews and observations. The study identified three sets of critical factors based on the conceptual of the study: *psychological, organizational and technological* that are believed to influence the knowledge sharing behaviors. The study applied theory of planned behavior framework (TPB) (Ajzen, 1991) to investigate the impact of these factors on knowledge sharing behaviors.

- **Psychological factors:** Perceived organizational incentives and benefits of knowledge sharing and perceived loss of knowledge power;
- **Organizational factors:** perceptions of organization's climate, social network and trust and shared goals;
- **Technological factors:** perceptions of organization's available tools and technology that facilitate knowledge sharing.

The findings exhibited that 9 of the 11 hypothesis theorized in the research model were supported indicating the significant predictors of knowledge sharing behaviors to be TPB components: intention towards knowledge sharing, attitude towards knowledge sharing, and perceived behavioral control towards knowledge except Subjective norms towards knowledge sharing which exhibited insignificant path towards intention of knowledge sharing when it was loading together with the other predictors.

The predictors explained about 52 percent of the variance in the behavioral intention to share knowledge and 42 percent variance in the actual knowledge sharing behavior. Fig 4.7 below presents the r-square and path coefficient value readings of the constructs and associated predictors from the PLS-Graph 3.0 analysis.

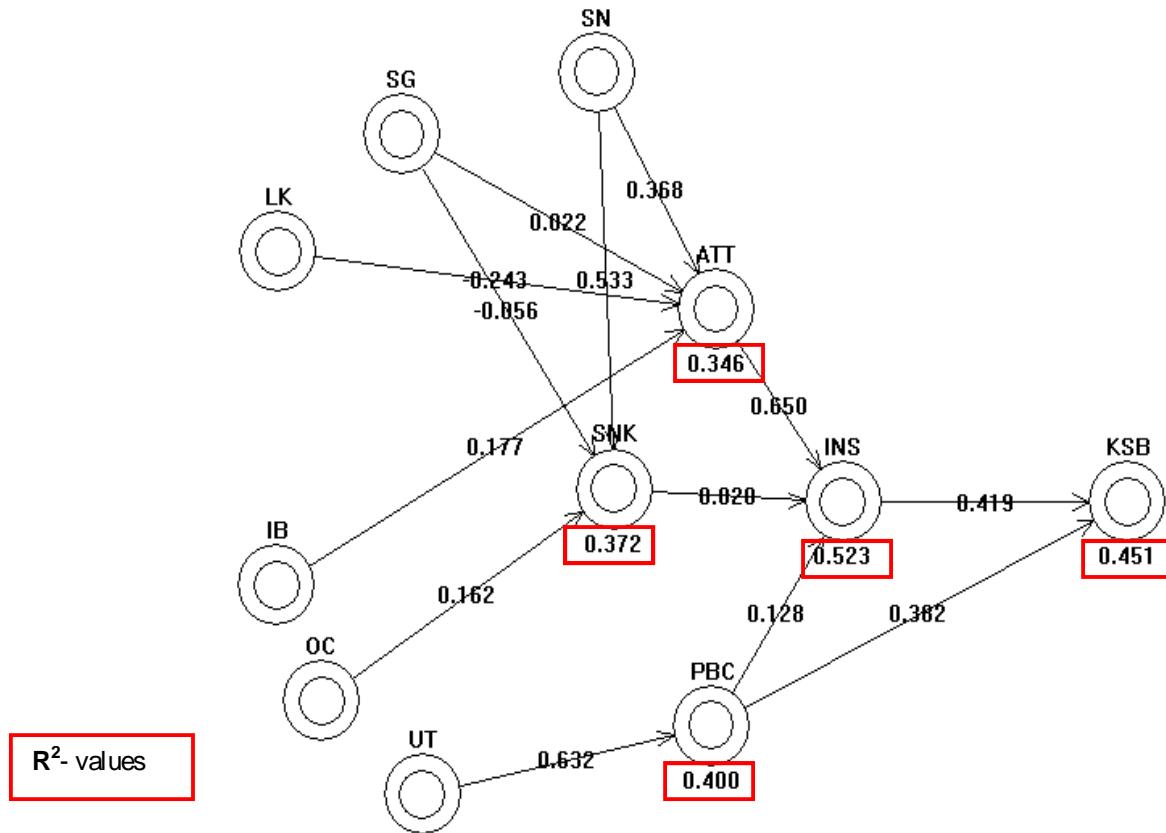


Fig 4.5: the r-square and path coefficient value readings from the PLS-Graph analysis.

The findings related to the individual predictors with respect to their hypothesized constructs are discussed in detail in the following sub sections.

4.2.1 DETERMINANTS OF KNOWLEDGE SHARING BEHAVIOR (KSb)

Following TPB, the study theorized the knowledge sharing behaviors of individuals to be collectively determined by intention towards knowledge sharing and perceived behavioral control. As theorized, intention towards knowledge sharing and perceived behavioral control emerged as a significant predictors of actual knowledge sharing behaviors. Intention towards knowledge sharing presented a significant effect on knowledge sharing behavior with a path coefficient of 0.42. Perceived behavioral control also exhibited a substantial effect on knowledge sharing behavior at 0.36 path coefficient. Collectively, intentions towards knowledge sharing and perceived behavioral control explained about 45 percent of the variance in knowledge sharing behavior of the study population examined.

4.2.2 DETERMINANTS OF KNOWLEDGE SHARING INTENTION. (INS)

According to the theory of planned behavior, the study hypothesized the predictors of knowledge sharing intention to be attitude towards knowledge sharing, subjective norm and perceived behavioral control. As hypothesized, while ATT and PBC emerged as significant predictors of intention towards knowledge sharing, which is consistent with previous TPB related research (Taylor and Todd, 1995, Bock et al., 2005), subjective norm towards knowledge sharing emerged as weak or insignificant predictors of intention towards knowledge sharing when all the factors were included in the analysis. Collectively, all the three factors explained about 52 percent of the variance in Knowledge Sharing Intention of the respondents.

Attitude towards knowledge sharing had a strong effect on the behavioral intention to share knowledge with a path coefficient of 0.65. Perceived behavioral control was also found to have significant but moderate effect on behavioral intention towards knowledge sharing with path coefficient of 0.127 and when we come to subjective norm, examination of

path analysis obtained using PLS graph show interesting results. As hypothesized, Subjective norm had a significant effect on INS while it is loading independently, with path coefficient of 0.375. However, the independent contribution of subjective norm towards intention was washed out when other Factors, attitude towards knowledge sharing and perceived behavioral control, were included in the analysis. Exhibiting weak positive effect with path coefficient of 0.02.

4.2.3 DETERMINANTS OF KNOWLEDGE SHARING ATTITUDE (ATT)

The study applied four motivational drivers, social network and trust, shared goals, perceived loss of knowledge power and perceived organizational Incentives and benefits, towards knowledge sharing attitude. Of these antecedents three of them emerged as significant predictors. Which were social network and trust, perceived loss of knowledge power and perceived organizational Incentives &benefits, collectively explaining about 35 percent of the variance in attitude towards knowledge sharing. Shared goal was found not to have a substantial impact on individual's knowledge sharing attitude.

4.2.3.1 PERCEIVED ORGANIZATIONAL INCENTIVES AND BENEFITS (IB)

The study hypothesized a positive relationship between perceived organizational incentives and individuals attitude towards knowledge sharing. As hypothesized, perceived organizational incentives and benefits presented significant but moderate effect on attitude towards knowledge sharing with path coefficient of 0.177 when all the factors were included in the analysis. But when it is loading independently gives stronger effect with path coefficient of 0.345.

4.2.3.2 SOCIAL NETWORK AND TRUST (SN)

The study hypothesized a positive relationship between social network and trust and individuals attitude towards knowledge sharing. As hypothesized, social network and trust presented strong significant effect on individual's attitude towards knowledge sharing with path coefficient of 0.438.

4.2.3.3 PERCEIVED LOSS OF KNOWLEDGE POWER (LK)

The study hypothesized a negative relationship between individual's perceived loss of knowledge power and attitude towards knowledge sharing. As hypothesized, perceived loss of knowledge power had significant negative effect on individual's attitude towards knowledge sharing with path coefficient of -0.243.

4.2.3.4 SHARED GOALS (SG)

The study hypothesized a positive relationship between individuals shared goal and attitude towards knowledge sharing. Against the hypothesis shared goal between individuals exhibited insignificant or weak effect on individual's attitude towards knowledge sharing with path coefficient reading of 0.022.

4.2.4 DETERMINANTS OF SUBJECTIVE NORMS (SNK)

The study applied three motivational drivers, which were social network & trust, shared goals and perceived organizational climate .Of these hypothesized factors while shared goal emerged as insignificant predictor of subjective norm towards knowledge sharing the other two emerged as significant predictors, collectively explaining about 37 percent of the variance in subjective norm towards knowledge sharing.

4.2.4.1 SOCIAL NETWORK & TRUST (SN)

The study hypothesized a positive relationship between social network & trust and subjective norm towards knowledge sharing. As hypothesized, social network and trust presented significant effect on individual's attitude towards knowledge sharing with path coefficient of 0.533.

4.2.4.2 PERCEIVED ORGANIZATIONAL CLIMATE (OC)

Similar to Bock et al., (2005), the study hypothesized a positive relationship between organizational climate and subjective norm towards knowledge sharing. As hypothesized perceived organizational climate emerged having positive effect on individual's perceived subjective norm towards KS presenting positive but moderate significant path coefficient of

0.162. In addition path analysis of this predictor obtained using PLS graph shows perceived organizational climate had much stronger significance while it is loading independently from social network and trust predictor, with path coefficient of 0.388.

4.2.4.3 SHARED GOALS (SG)

The study hypothesized a positive relationship between individuals shared goal and perceived subjective norms towards KS. Against the hypothesis, similar to its effect towards individuals attitude towards KS, presented weak or insignificant effect on subjective norm towards knowledge sharing with the reading of path coefficient of 0.090.

4.2.5 DETERMINANTS OF PERCEIVED BEHAVIORAL CONTROL

The study applied the usage of tools and technology for knowledge sharing as motivational factor of perceived behavioral control towards knowledge sharing. As hypothesized PBC was emerged as strong predictor, explaining about 40 percent of the variance in perceived behavioral controls.

4.2.5.1 THE USAGE OF TOOLS AND TECHNOLOGY

The study hypothesized a positive relationship between individual's usage of tools and technology for knowledge sharing and perceived behavioral control. As hypothesized usage of tools and technology presented a strong and significant effect, with path coefficient of 0.632.

Respondents usage of tools and technology to share knowledge with coworkers was measured in terms of e-mail, discussion forum (using tools like electronic bulletin board, chat room etc), knowledge repository/company databases (containing existing expertise, lessons learned, best practices etc.), intranet (including corporate portal), videoconferencing, teleconferencing and so forth. Responses were recorded along a five point frequency of usage scale ranging from 1 "Very infrequently" to 3 "Moderate Frequency (Few times per month)" to 5 "Very Frequently(Many times/daily)". The mean values for the usage of various tools and technologies shows that moderate or less frequency usage except emails and face to face KS techniques. Fig 4.5. Below reports the result in detail.

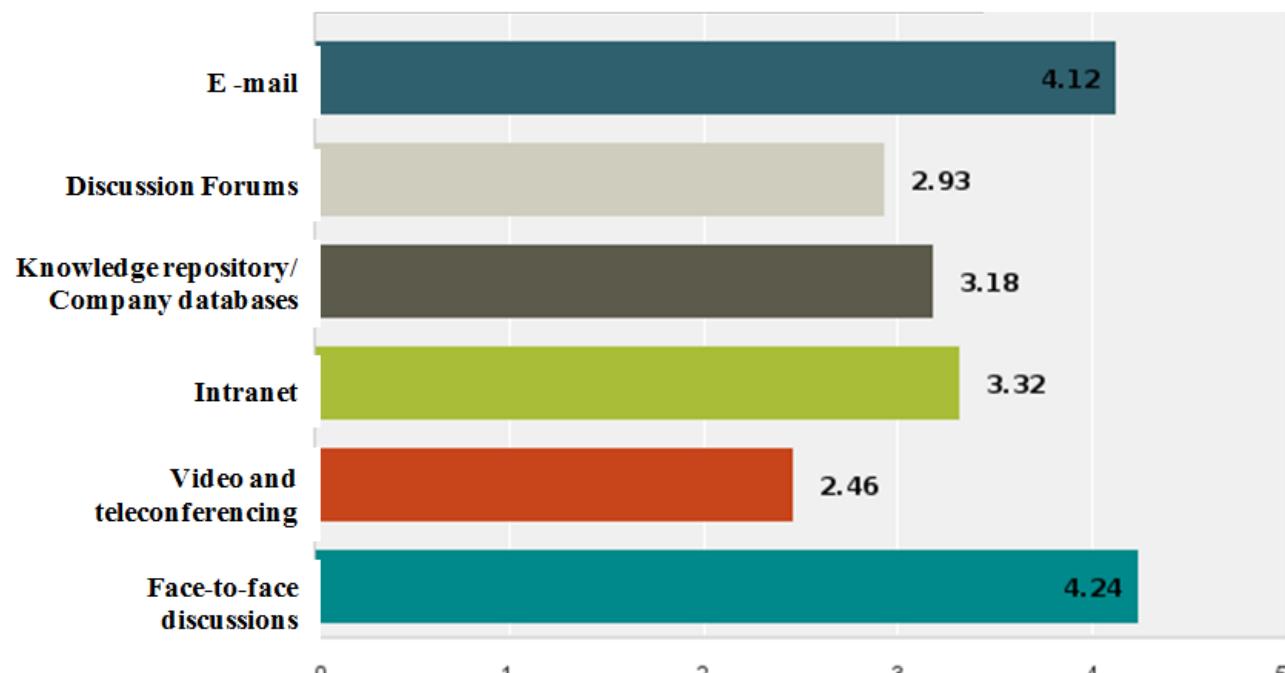
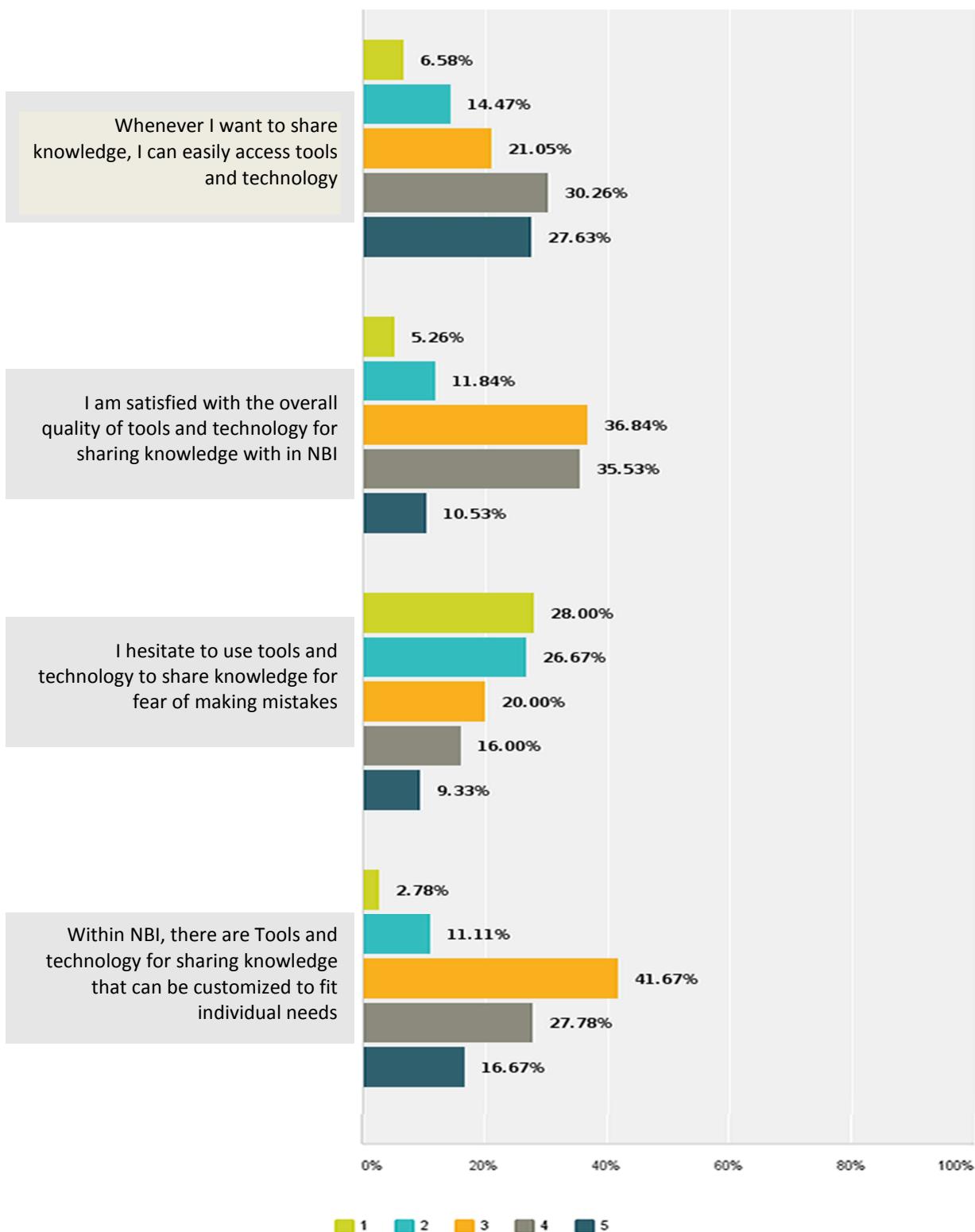


Fig: 4.6 Respondent's usage of tools and technology.

4.2.5.2 THE AVAILABILITY, ACCESSIBILITY AND USERS SATISFACTION

The availability, accessibility, and respondents satisfaction of the available ICT tools and technology was also measured using a five point degree of measure ranging from 1=Strongly Disagree, 3 = Moderate, 5= Strongly Agree. More than 70% of the respondents agreed on the easy access to the tools and technologies at moderate and above level, 41% of them replied the existence of ICT tools and techniques customizable to their needs at a moderate level, 45 % of them are also satisfied with the available tools and techniques above moderate level and 45 % again replied that they hesitate to use tools and technologies on the fear of making mistakes at moderate and above level. The series of histograms below on fig 4.6 reports the details of the results.

*Fig: 4.7 Measurement of ICT availability, accessibility and respondents satisfaction*

4.2.6 FINDINGS DURING UNSTRUCTURED INTERVIEWS, OBSERVATIONS AND DOCUMENT ANALYSIS.

The study gathered qualitative data using unstructured interviews, observations and document analysis to collect relevant information's that support findings and the conceptual model of the study. A line-by-line open coding technique and check lists was used for the analysis and the findings are summarized on table 4.1 below.

Table 4.1: Summary of findings during unstructured interviews and observations.

Code	Results	Summary of Findings
Knowledge management /Knowledge sharing activities (Achievements)	<ul style="list-style-type: none"> KM/KS awareness' and activities are getting stronger and framed with international practice. Substantial socio-economic, environmental, water resources, hydro-meteorological, data generation-management. Development of various water resources and optimization Models and toolkits. Development of efficient information systems (decision support system), knowledge portals, NBI websites. Development a spatial and non-spatial data base (at single center) on which various data collected under the previous project can be organized for easy access to the user. Partnership with eastern nile universities, Internship programs. 	<ul style="list-style-type: none"> The importance of knowledge management as well as knowledge sharing is clear for NBI and accordingly there are several efforts have been taken but those efforts are not centrally managed in other words there is a lack of a central point of contact to manage or make the public audience and stake holders to have access to those substantial data/information developed or generated. There is a huge volume of essential information or knowledge available and developed but available on the hand of center specific projects.
Suggestions to strengthen KM/KS activities	<ul style="list-style-type: none"> NBI has to develop all inclusive KM/KS strategy to promote knowledge sharing as well as knowledge management in the NBI countries and institutions. More work on improving Availability of adequate and reliable data. More work need to be done in relation to quality assurance of all existing data. Importance of efficient ICT tool to support this activities and the need to train users on those tools to enable them full engage in. 	<ul style="list-style-type: none"> There is a need to develop an all-inclusive strategy of knowledge management as well as knowledge sharing to improve the availability, reliability and quality of the existing valuable information or knowledge. NBI should give more attention on making the knowledge resources available for all through integrating the available ICT tools, training users and making those tools accessible for public domain of the NBI region.
Knowledge management/Knowledge sharing challenges	<ul style="list-style-type: none"> Lack of quality assurance of all the existing data. Lack of primary water resources, socio-economic and environmental data. Lack of efficient dissemination of the developed and existing water resources, socio-economic and environmental data. The available knowledge is scattered throughout the region. Lack of essential tool that integrates all the available knowledge resources. 	<ul style="list-style-type: none"> Lack of primary water resources, socio-economic and environmental data is believed to be the major challenge. In addition the absence of tool or Technology to integrate the available knowledge scattered throughout the region as well as disseminate to the wider public. Furthermore quality assurance of all the existing data was found to be as another challenge of knowledge sharing.
Activities to strengthen social ties, trust and to reach out to its stakeholders.	<ul style="list-style-type: none"> There are initiatives to develop an information system that enables to support stakeholder's social ties and access to the available knowledge resources. (To regularly engage and inform its Stakeholders.) Social ties with stakeholders are maintained through networking with those civil societies (e.g. Nile Basin Discourse) and professional organizations (e.g. Nile Media Network) that have been partnering with us (e.g. NBD, NMN, Development partners, parliamentarians, women etc.). Mode of contact includes: annual Nile Day Celebrations; Project-specific launch events including consultations, Donor Open House events, Project Disclosure, News Letters, Annual Report distributions and knowledge dissemination workshop. Social network forum on the face book, for interns to share their experience/knowledge. 	<ul style="list-style-type: none"> Generally the strength of social ties found to be weak due to different factors such as, institutional arrangement and Nile political interference in the system and others. Within NBI social ties and trust is maintained through networks with civil societies, professional organizations and development partners. And the major mode of contacts are :annual Nile Day Celebrations; Project-specific launch events including consultations, Donor Open House events, Project Disclosure, News Letters, Annual Report distributions and knowledge dissemination workshop.

Existence and use KM/KS related document or guideline	<ul style="list-style-type: none"> NBI Stakeholder Involvement and Communication Strategic document. KM strategic document for NelSAPCU and ENTRO started to develop Knowledge Management Strategy. Document sharing strategic document. There is no NBI wide ,KM/KS strategic document 	<ul style="list-style-type: none"> There is NO NBI wide KM/KS strategic document but there are other documents such as: NBI Stakeholder Involvement and Communication Strategic document, Center specific KM strategic document for NelSAPCU and ENTRO, Document sharing strategic document and others which are currently being used to spells out key communication and outreach strategies to engage stakeholders, keep them informed and guide KM/KS activities.
Usage of ICT for KM/KS	<ul style="list-style-type: none"> The widespread adoption and use of ICT in NBI, especially as a means to engage and stakeholders is at the incipient stage and is promising, if leveraged well. Depends also on how the ICT/media climate in NB countries evolves. For example in some countries the internet connectivity is not reliable . There are ICT facilities such as internet, teleconferencing, fiber communications, web page where information's for public domain is displayed Decision support systems and ENTRO has developed a web portal but Limited group have the knowledge and access to the knowledge product available on the existing ICT tools. 	<ul style="list-style-type: none"> The degree of individual's usage of, access to and availability of existing tools and technologies are not well developed, but there are significant efforts. There are different facilities (ICT) but Limited group have the knowledge and access to the knowledge product available on those tools more over individuals usage of those tools highly depends on how the ICT/media climate in NB countries.
Organizational learning activities	<ul style="list-style-type: none"> Happens thru internal task group meetings, collaborative work and program planning and budgeting, committee meetings, sub-basin and NBI Strategic planning sessions, the biannual Nile Basin Development Forum, etc. Several trainings and participating in consultation workshops to exchange knowledge and build individuals efficiency but it lacks inclusiveness of all because the sessions are more center or project specific. 	<ul style="list-style-type: none"> There are different organizational learning activities with in NBI through trainings, meetings, committee and group meetings, consultation workshops, sub-basin and NBI Strategic planning sessions, and others but with limited inclusiveness or awareness of the wider public of NBI.

In addition during the analysis of existing KM related documents findings pointed out that most of these documents are center or project specific and lacks to clearly set NBI wide standards to guide the overall KM activities which includes the capturing ,codification and sharing as well as standards to maintain the quality of primary information or knowledge.

4.3 SUMMARY

Based on the findings the study like to underline the need to carefully understand and study those determinant of the actual knowledge sharing behavior identified during the survey study and relevant information's captured during interviews ,observations and document analysis. Once those factors are clearly studied the identification technical and non-technical solutions will be at ease because the information we gather while studying those factors will allow as to clearly visualize the gap that needed to be filled to enhance KS as well as KM activities. For example, Factors affecting individuals KS behavior such as weak social network, large physical distance, perceived loss of knowledge power, lack of ease availability and accessibility of quality primary information, and so on can be minimized with the implementation of organization wide knowledge portal which provides a means for easy collaboration, capturing, codifying and sharing standard information/knowledge, virtual space for easy communication/organizational learning etc.

Accordingly, based on the findings the study presented a technical solution (Knowledge portal) in the next section, Chapter 5, followed by recommendations for practice and summary /conclusions to strengthen our collective understanding on the factors affecting individual's actual knowledge sharing behavior on the last section, Chapter 6.

5 PROPOSED PROTOTYPE KNOWLEDGE PORTAL

5.1 OVERVIEW

Recent developments have witnessed the emergence of a new economy where knowledge has become a valuable resource and asset. The dynamism of the new economy requires us to not only quickly create knowledge, but also to acquire and apply knowledge quickly. One possible way to do so is to share our knowledge effectively, where technology playing an

important mediating role in knowledge sharing. The intervention of information technology (IT) is inevitably important as a tool for a successful knowledge management implementation (Bhatt, 2001; Kim, Suh, and Hwang, 2003). However, ICT functions as a platform for knowledge sharing is by itself insufficient to encourage knowledge sharing as suggested by Hendricks (1999): "The role of ICT for knowledge sharing can only be fully understood if it is related to the motivation for knowledge sharing..." On top of the motivation for knowledge sharing, Braselton and Gorry (2003) had also exposed the idea that technology alone may not effectively encourage knowledge sharing activities. Kim and Jarvenpaa (2008) had supported the importance of the. Knowledge activities.

A fundamental aspect of knowledge management is capturing knowledge and expertise created by knowledge workers as they go about their work and making it available to a larger community of colleagues. Technology can support these goals, and knowledge portals have emerged as a key tool for supporting knowledge work. Knowledge portals are single-point-access software systems intended to provide easy and timely access to information and to support communities of knowledge workers who share common goals. In other words, the success of knowledge exchange depends on the organizational KM systems social and technological attributes (Holsthause, 1998). Identifying the enabling technologies for knowledge sharing such as knowledge portal with all the essential components and integrating it to organizational KM system is important to address KM as well as knowledge share limitations of organizations. Such as:

- Narrows the physical gap that exists between individuals scattered with in a broad organizational environment such as NBI.
- Provides a platform for individuals to improve social relations and develop trust.
- Provides an ease platform to capture, codify and share different forms of valuable organizational knowledge resources, Explicit vs. tacit.
- Provides a common interface and easy navigations to access valuable organizational knowledge resources etc.

Therefore a capable knowledge portal with all the essential functionalities is important for organizations functioning in a broad work environment, such as Nile Basin Initiative (NBI). In relation to the findings of this study the integration of technological solution is important to support KM/KS activities by providing a single-point, easy and timely access to information/knowledge as well as facilitating the necessary tools and techniques to ease interaction of communities of knowledge workers. In addition such a solution could help to efficiently capture, codify and share the vast volume of information or knowledge generated in different activities.

Accordingly, this research study develop a prototype, knowledge portal, which can support the overall knowledge management as well as knowledge sharing initiatives. The proposed prototype is anticipated to provide a single-point-access to all NBI knowledge resources and information systems. Furthermore it is intended to deliver a common virtual platform to strengthen social ties and trust through providing tools of the modern technology to support collaboration and knowledge sharing between NBI staffs and stakeholders scattered throughout the region.

5.2 DEFINITION OF TODAY'S PORTALS

Traditionally, a portal denotes a gate, a door, or entrance. In the context of the World Wide Web, it is the next logical step in the evolution to a digital culture. Web pages are not completely self-referential anymore, but allow for personalization, workflow, notification, knowledge management and groupware, infrastructure functionality, and integration of information and applications. The idea of a portal is to collect information from different sources and create a single point of access to information - a library of categorized and personalized content. It is very much the idea of a personalized filter into the web.

Portals are often the first page the web browser loads when users get connected to the Web or that users tend to visit as an anchor site. They offer users a surplus value of service based on the features of classic search engines. Thus, the traditional virtual roadhouses -the search engines- become feel-good entrance halls, a gateways to the internet, easy, one-stop embarkation points for the daily Web-surfing sessions. The hope behind the idea of a portal: surfer start their voyage into the web in a modern entrance hall, and preferably find their way back to the starting point without major difficulty.

Table 5.1 Summary of portal predicates,

What a portal does	Key features of portals	What a portal is NOT
<ul style="list-style-type: none"> • Enables universal login • Handles both structured and unstructured data • Facilitates multi-channel consistency • Facilitates messaging and notification • Automated tuning: pervasive content can be tuned based on personalization, location, browser, etc. • Integration to other systems 	<ul style="list-style-type: none"> • Security • Access different data • Transactions • Search • Publish Content • Personal Content 	<ul style="list-style-type: none"> • It is not just a Website (which is usually characterized by static information) • It is not just a personalized intranet • It is not just a personalized extranet • It is not just a personalized front end for business applications • It is not just groupware • It is not just a personalized knowledge management solution • It is not just a sophisticated search engine <p>Instead, a portal is nothing less than just one personalizable, browser based user interface to all the components mentioned above.</p>

Source: own-survey

5.3 THE MAJOR FUNCTIONALITIES OF KNOWLEDGE PORTAL

Based on the Ovum (2000), analyst and consulting company, the following eight functionality areas are identified:

- **Search and navigation:** This functionality forms the basis for most of the successful public web portals meaning that a successful portal should support its users in an efficient search for contents.
- **Information integration (content management):** A portal should warrant the integration of information from disparate sources. Moreover, the user should also be able to optimally use this information.
- **Personalization:** Personalization is vital to the delivery of appropriate information to portal users: each user gets only the information which is specifically tailored to his/her needs. Personalization should be based on user roles, as well as user preferences.
- **Notification (push technology):** Notification (push technology) is referred to as a system in which a user receives information automatically from a network server. Push technologies are designed to send information and software directly to a user's desktop without the user actively requesting it. Thus, the user has the opportunity to subscribe to active information sources (such as newsfeeds and periodically updated reports) and ask to be alerted when documents are updated.
- **Task management and workflow:** Portals providing task management services can help users take part in and/or manage formally defined business processes.
- **Collaboration and groupware:** Knowledge management and groupware ensure that the required information is stored in the right place and in the right mode. By this means the right persons are brought together with the right information. Groupware software assists in less formal collaboration than workflow tools.
- **Integration of applications and business intelligence:** In addition to the already mentioned functionalities, a portal can integrate and support a specific application types, for example: an application service provider (ASP) application, business intelligence (BI) functionality, support for e-commerce etc.
- **Infrastructure functionality:** The infrastructure functionality constitutes the fundament for the work environment - the other 7 functionalities mentioned above build up on this one. The runtime infrastructure associated with the portal will have a primary effect on manageability, scalability, security and availability.
- **Knowledge Mapping:** Provides guide to, or inventory of, an organization's internal or external repositories or sources of information or knowledge. These sources may include documents, files, and databases, recordings of best practices or activities, or webpages.

Although most of the functionality is not new, what is new is the idea that the business value of the whole is considerably more than the sum of its parts. Thus, a successful portal does not only consist of either a good collaboration support or a good integration of the information sources. Rather it is a well-integrated mixture of the basic portal functionalities.

5.4 REQUIREMENTS OF THE PROPOSED KP

Initially identifying the major purposes of the proposed knowledge portal, together with important portal functionalities which is basically intended to overcome Knowledge sharing as well as knowledge management factors, this study like address the following requirements that the proposed portal shall fulfill.

5.4.1 ACCESS TO KNOWLEDGE/INFORMATION

The proposed portal should provide access to different knowledge from internal and external sources and those knowledge products should be in different forms such as spreadsheets, charts, spital and non-spital data, multimedia files and etc. The sources for this knowledge's or information's that meets need could be:

- Document/content management systems (website, NBI and other web portal, Nile-IS, e-library etc.)
- Spatial and non-spatial data repositories,
- Through aggregating content from different sources (repositories, external knowledge systems) and search engines to retrieve information from all underlying knowledge repositories or systems.
- Social networking functionalities and community of practice portals.
- Multimedia applications such as videos, animations, images, sound etc.
- The global search facility to retrieve information from all underlying integrated repository or knowledge system (i.e. search within the knowledge portal itself, underlying systems and internal/external repositories).

5.4.2 KNOWLEDGE SHARING/COLLABORATION

The proposed portal should provide all NBI staffs and related stakeholders A tool that facilitate collaboration, team building and knowledge sharing.in other words the proposed portal should provide users a virtual workspace where they can easily communicate, strengthen social ties or trust and work together despite the broad NBI organizational environment with efficient functionalities like groupware, workflows, discussion forums, chat rooms etc.

5.4.3 EASE/USER FRIENDLINESS

The portal should have consistent and uniform user interface with friendly and easy to navigate design. Such as

- Provides a common platform or interface that lead to all NBI knowledge resources (Centralized interface).
- Consistent and uniform presentation of knowledge resources.
- Personalization functionality to provide user with information which is specifically tailored to his/her needs based on user roles, as well as user preferences.
- Notifications to allow users to subscribe to active information sources and get notifications and updates furthermore to push essential software or plugin to users' desktop.
- Interactive/Dynamic functionalities to present data and the ability to categorize and perform multilevel classification of knowledge resources using controlled vocabulary, taxonomy or ontology.
- Ability to present information in a multi lingual interface.
- The ability to manage/operate the system with minimal or no programing experience.

5.4.4 INFRASTRUCTURE REQUIREMENTS

The proposed portal should go along with the associated runtime infrastructure or work environment and meet requirements related to manageability, scalability, security and availability.

- **Security:** The ability to enforcement security across all knowledge/information resources with multiple level of access. Single sign-on to access knowledge resources in underlying integrated knowledge resources.
- **Scalability:** the ability to support large number of concurrent users and process large volume of data or information. Moreover integrating geographically dispersed servers and user community.
- **Availability:** the design of the portal should consider unplanned outage provide solution measures like failover clustering to provide maximum availability, in addition the portal should open with different browsers and common internet connectivity. Furthermore it should have feature to open from mobile machines like phones, IPad etc.

- **Manageability:** the portal should have efficient/easy functionality to ease the task of system administrators with customized error messages (404) and system statistics, such as usage statistics, which the web master can generate and utilize.
- **Expandability:** should incorporate open standards and have the capability for integrating existing and future KM systems and advances in information technology.

5.5 USE CASE DIAGRAM OF THE KNOWLEDGE PORTAL.

Use Case diagram helps to define the interaction between external actors and the system to attain a particular goals. In other words it helps in defining the interaction between a role (actor) and a system. Figure 5.1 below presents the use case model of the prototype knowledge portal.

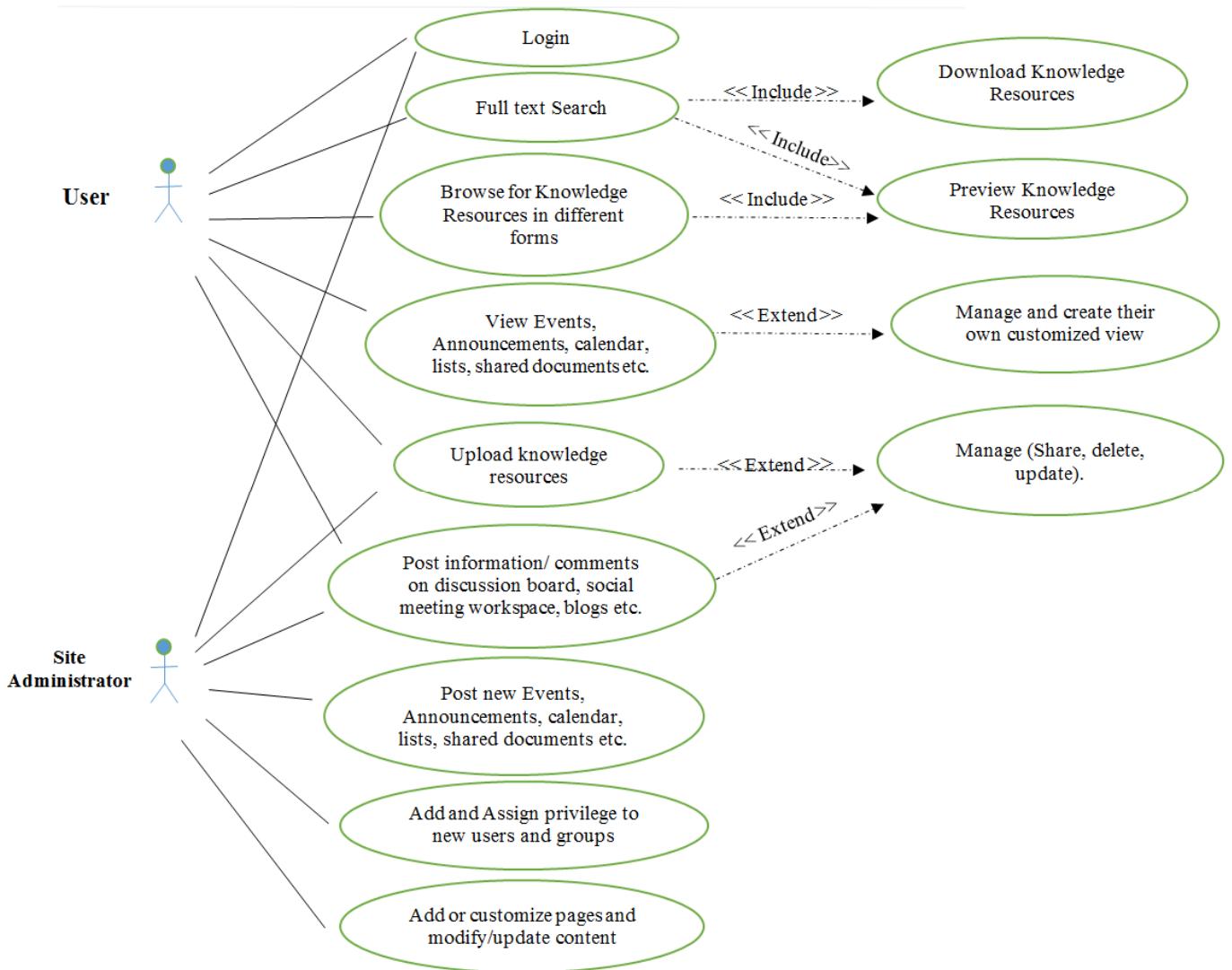


Fig 5.1: The Use Case model of the proposed knowledge portal.

Source: own-survey

5.6 IMPLEMENTATION DETAILS

After identifying the basic portal functionalities imperative to make a given portal complete together with the intended purpose or high level requirements of the proposed web portal, which could aid the process of undertaking measures to overcome KM/KS challenges, SharePoint2013 is proposed for the implementation of the proposed knowledge portal development. The study recommend SharePoint2013 for implementation due to the fact that SharePoint Server has quite a

number of built-in applications and features that satisfy most of the portal functionalities as well as requirements mentioned above, which could significantly help in address Knowledge sharing challenges identified during this study.

The major capabilities that makes SharePoint2013 the best alternative for the development of the proposed knowledge portal are described below in table 5.2 below.

Table 5.2: Descriptions of SharePoint capabilities

SharePoint Capability	Description
Easy to create and administration of collaborative sites.	<ul style="list-style-type: none"> • Minimal technical skill requirements: m-windows, m-office, familiar with web browsing. • Easy to define relevant access and information/knowledge sharing. • Once deployed appropriately doesn't have to deal with updating content, defining privileges, maintaining a document repository
Efficient information management	<ul style="list-style-type: none"> • Tools to centralize and manage info like, schedule, documents, change requests, risk /issue log, Budget. • Document management feature such us information storage, check-in/check-out, version control, central approval
Facilitate team collaboration	<ul style="list-style-type: none"> • Document collaboration, document workspaces to jointly develop requirement documents, reports, templets, etc. • Tools: wiki to document lessons learned, discussion board for offline communication, meeting workspace to support meetings etc.
Enhanced communication mechanisms	<ul style="list-style-type: none"> • The right information for the right person at the right time such as tasks, schedules, reports, dashboard etc. • Relevant information access can be defined based on needs.
Automation of business processes	<ul style="list-style-type: none"> • Common project work flows such as change control, expense reimbursements, Vacation requests, purchase and procurement requests, etc. • SharePoint workflows such as custom workflows.
Relevant Report Generation	<ul style="list-style-type: none"> • Project reports such as interactive summary of projects, project task information, automated alerts, etc. • Dashboards can be created using web parts containing information like status (Red ,Amber ,Green),key performance indicators, charts ,etc.
Easy integration with existing systems	<ul style="list-style-type: none"> • Integration with SQL based data, web services,XML • Integration with non-Microsoft enterprise systems such as SRM ,reporting tools ,etc.
Components, features, and functionality to content delivery	<ul style="list-style-type: none"> • Core content structures. • Web applications, site collections, sites, lists, libraries. • Services to render content • Multiple browsers • Mobile browsers • Accessibility standards (WCAG 2.0) • Rich Web experience • Ribbon user interface (UI): Familiar Office UI • Web Edit: Rich content editing • Interfaces for rich and offline client experiences • Office client applications • SharePoint Workspace • Office Web Applications

5.7 HARDWARE /SOFTWARE REQUIREMENTS FOR DEPLOYMENT OF SHAREPOINT 2013

The following hardware and software requirements for SharePoint deployment are extracted from Microsoft website and the content was last updated on 2014-01-09.

5.7.1 HARDWARE REQUIREMENTS

For web servers, application servers, and single server installations.

Table 5.3: Descriptions of SharePoint Hardware Requirements

Installation Scenario	Deployment type and scale	RAM	Processor	Hard disk space
Single server with a built-in database or single server that uses SQL Server	Development or evaluation installation of SharePoint Server 2013 or SharePoint Foundation 2013 with the minimum recommended services for development environments.	8 GB	64-bit, 4 cores	80 GB for system drive
Single server with a built-in database or single server that uses SQL Server	Development or evaluation installation of SharePoint Server 2013 or SharePoint Foundation 2013 running Visual Studio 2012 and the minimum recommended services for development environments.	10 GB	64-bit, 4 cores	80 GB for system drive
Single server with a built-in database or single server that uses SQL Server	Development or evaluation installation of SharePoint Server 2013 running all available services.	24 GB	64-bit, 4 cores	80 GB for system drive
Web server or application server in a three-tier farm	Pilot, user acceptance test, or production deployment of SharePoint Server 2013 or SharePoint Foundation 2013.	12 GB	64-bit, 4 cores	80 GB for system drive

Hardware requirements—database servers

Component	Minimum requirement
Processor	<ul style="list-style-type: none"> • 64-bit, 4 cores for small deployments (fewer than 1,000 users) • 64-bit, 8 cores for medium deployments (between 1,000 to 10,000 users)
RAM	<ul style="list-style-type: none"> • 8 GB for small deployments (fewer than 1,000 users) • 16 GB for medium deployments (between 1,000 to 10,000 users)
Hard disk	80 GB for system drive Hard disk space depends on how much content that you have in your deployment.

5.7.2 SOFTWARE REQUIREMENTS

This section provides minimum software requirements for each server in the farm.

1. Minimum requirements for a database server in a farm:
 - One of the following:
 - The 64-bit edition of Microsoft SQL Server 2012.
 - The 64-bit edition of SQL Server 2008 R2 Service Pack 1
 - The 64-bit edition of Windows Server 2008 R2 Service Pack 1 (SP1) Standard, Enterprise, or Datacenter or the 64-bit edition of Windows Server 2012 Standard or Datacenter
 - The SharePoint parsing process crashes in Windows Server 2008 R2 (KB 2554876)
 - FIX: IIS 7.5 configurations are not updated when you use the Server Manager class to commit configuration changes (KB 2708075)
 - Hotfix: ASP.NET (SharePoint) race condition in .NET 4.5 RTM:
 - Windows Server 2008 R2 SP1 (KB 2759112)
 - Windows Server 2012 (KB 2765317)
 - Microsoft .NET Framework version 4.5
2. Minimum requirements for a single server with built-in database:
 - The 64-bit edition of Windows Server 2008 R2 Service Pack 1 (SP1) Standard, Enterprise, or Datacenter or the 64-bit edition of Windows Server 2012 Standard or Datacenter
 - The SharePoint parsing process crashes in Windows Server 2008 R2 (KB 2554876)

- FIX: IIS 7.5 configurations are not updated when you use the Server Manager class to commit configuration changes (KB 2708075)
- Hotfix: ASP.NET (SharePoint) race condition in .NET 4.5 RTM:
 - Windows Server 2008 R2 SP1 (KB 2759112)
 - Windows Server 2012 (KB 2765317)
- The Setup program installs the following prerequisite for a single server with built-in database:
 - Microsoft SQL Server 2008 R2 SP1 - Express Edition
- The Microsoft SharePoint Products Preparation Tool installs the following prerequisites for a single server with built-in database:
 - Web Server (IIS) role
 - Application Server role
 - Microsoft .NET Framework version 4.5
 - SQL Server 2008 R2 SP1 Native Client
 - Microsoft WCF Data Services 5.0
 - Microsoft Information Protection and Control Client (MSIPC)
 - Microsoft Sync Framework Runtime v1.0 SP1 (x64)
 - Windows Management Framework 3.0 which includes Windows PowerShell 3.0
 - Windows Identity Foundation (WIF) 1.0 and Microsoft Identity Extensions (previously named WIF 1.1)
 - Windows Server AppFabric
 - Cumulative Update Package 1 for Microsoft AppFabric 1.1 for Windows Server (KB 2671763)

3. Minimum requirements for front-end web servers and application servers in a farm:

- The 64-bit edition of Windows Server 2008 R2 Service Pack 1 (SP1) Standard, Enterprise, or Datacenter or the 64-bit edition of Windows Server 2012 Standard or Datacenter.
- The SharePoint parsing process crashes in Windows Server 2008 R2 (KB 2554876)
- FIX: IIS 7.5 configurations are not updated when you use the Server Manager class to commit configuration changes (KB 2708075)
- Hotfix: ASP.NET (SharePoint) race condition in .NET 4.5 RTM:
 - Windows Server 2008 R2 SP1 (KB 2759112)
 - Windows Server 2012 (KB 2765317)
- The Microsoft SharePoint Products Preparation Tool installs the following prerequisites for front-end web servers and application servers in a farm:
 - Web Server (IIS) role
 - Application Server role
 - Microsoft .NET Framework version 4.5
 - SQL Server 2008 R2 SP1 Native Client
 - Microsoft WCF Data Services 5.0
 - Microsoft Information Protection and Control Client (MSIPC)
 - Microsoft Sync Framework Runtime v1.0 SP1 (x64)
 - Windows Management Framework 3.0 which includes Windows PowerShell 3.0
 - Windows Identity Foundation (WIF) 1.0 and Microsoft Identity Extensions (previously named WIF 1.1)
 - Windows Server AppFabric
 - Cumulative Update Package 1 for Microsoft AppFabric 1.1 for Windows Server (KB 2671763)

5.7.3 SHAREPOINT 2013 PREREQUISITE

The SharePoint 2013 prerequisite installer (prerequisiteinstaller.exe) installs the following software, if it has not already been installed on the target server, in this order:

1. Microsoft .NET Framework version 4.5
2. Windows Management Framework 3.0
3. Application Server Role, Web Server (IIS) Role
4. Microsoft SQL Server 2008 R2 SP1 Native Client
5. Windows Identity Foundation (KB974405)
6. Microsoft Sync Framework Runtime v1.0 SP1 (x64)

7. Windows Identity Extensions
8. Microsoft Information Protection and Control Client
9. Microsoft WCF Data Services 5.0
10. Windows Server AppFabric

5.8 STRUCTURAL REPRESENTATION FOR THE DEVELOPED PROTOTYPE KNOWLEDGE PORTAL

Fig 5.2 shows the flowchart depicting the organizational design for the developed prototype knowledge portal. Again, this represented a critical element (high level abstraction) in the design and navigability of the site.

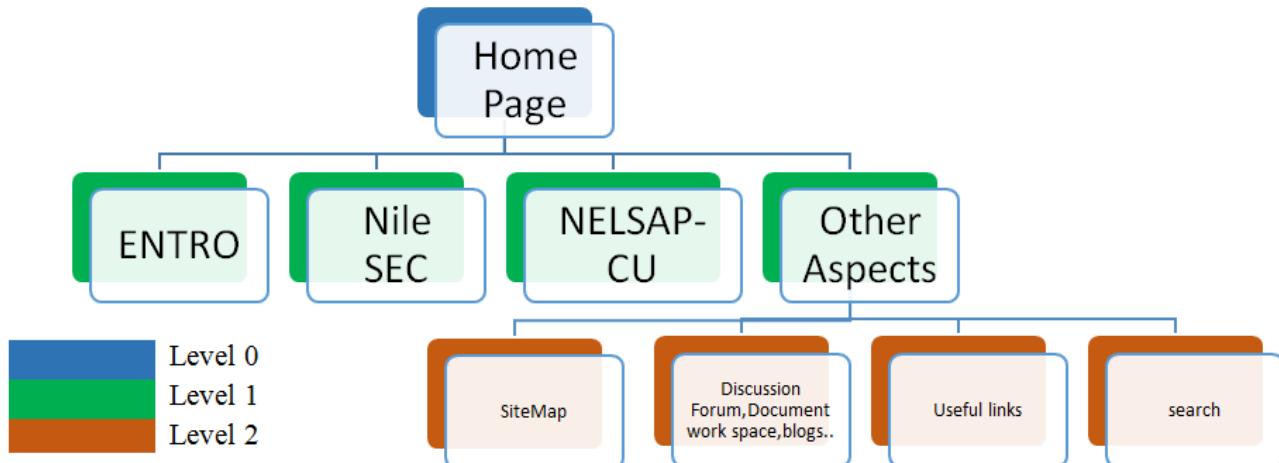


Fig 5.2: High level structural representation for the proposed prototype knowledge portal

5.9 PROTOTYPE OF THE KNOWLEDGE PORTAL

Prototyping was used to provide with an incomplete model of the proposed full-featured knowledge portal and to propose a technical solution that address research findings. Furthermore the developed prototype knowledge portal enables to visualize the basic functionalities, to have initial prototype to review system requirements with users, revise and enhance functionalities in the development of the fully featured knowledge portal.

The prototype Knowledge portal was developed on VMWARE, virtualization and cloud computing software provider for 32 bit (x86) compatible computers. Windows server 2008 environment was created with the necessary Active directory, DNS and other essential prerequisites for SharePoint deployment and the same virtual server was also used as Database server, SQL server 2005 .Finally SharePoint free version is configured to develop the prototype of the proposed technical solution ,Knowledge portal. Figures below presents, the screen shot of the major interfaces of the developed prototype knowledge portal.

The screenshot shows the 'Nile Basin Initiative Knowledge Sharing Portal' homepage. The URL in the address bar is <http://myserver/sites/NBI-KP/default.aspx>. The page title is 'NBI knowledge Portal'. The main content area features a large green banner with the text 'Nile Basin Initiative Knowledge Sharing Portal'. Below the banner, a paragraph describes the portal's purpose: 'This knowledge portal is designed to provide all NBI staffs and stakeholders a virtual space to collaborate, strengthen their social ties, share information/knowledge, and work together towards a common sense of purpose or goal. In addition it is intended to provide a single-point-access to essential information and knowledge from internal and external sources.' To the right of the text is a map titled 'The River Nile' showing the river's course through Egypt, Sudan, Eritrea, Ethiopia, and Kenya, with its tributaries the Blue Nile and White Nile. On the left side, there is a navigation menu with sections for 'Sites' (Nile SEC, NELSAP-CU, ENTRO), 'Documents' (Shared Documents, NBI Library), 'Lists' (Calendar, Tasks, NBI Contacts, NBI-Issue Tracking), 'Discussions' (Discussion bord), 'People and Groups' (Pictures Library), and 'Surveys' (Survey). Below the menu, there are three boxes: 'About NBI' (with a link to 'Add new event'), 'Calendar' (noting no upcoming events), and 'Announcements' (noting no active announcements).

Fig 5.3 Screen shot of the prototype home page –Level 0

[View All Site Content](#)

Sites

- Nile SEC
- NELSAP-CU
- ENTRO
- Social meeting workspace
- Document workspace
- Blog

Documents

- Shared Documents
- NBI E-library

Lists

- Calendar
- Tasks
- NBI Contacts

Discussions

- Discussion bord

People and Groups

Pictures

- Pictures Library

Surveys

- Survey

Nile Basin Initiative

About NBI

The Nile River originates in the highlands of East Africa and flows northward through the deserts of North Africa to its outlet into the Mediterranean Sea. It passes through several countries, including Ethiopia, Sudan, and Egypt, before reaching the sea. The river has been a major source of water for agriculture and human settlements for thousands of years. Its waters have supported the growth of civilizations along its banks for millennia. However, the Nile's flow is highly variable, and it has been subject to significant environmental challenges, such as evaporation rates and changes in precipitation patterns, which have affected the river's water levels and availability over time.

Announcements

There are current announcements.

[Add new announcement](#)**Calendar**

There are currently no events.

[Add new event](#)

Home - ENTRO - Windows Internet Explorer

http://myserver/sites/NBI-KP/ENTRO/default.aspx

Live Search

Home - ENTRO

NBI knowledge Portal

Welcome MYDOM\administrator |

This Site

ENTRO

View All Site Content

Documents

- Shared Documents

Lists

- Calendar
- Tasks
- Project Tasks

Discussions

- Team Discussion

Sites

People and Groups

Recycle Bin

NBI knowledge Portal > ENTRO

ENTRO Knowledge Resources

NBI Knowledge Sharing Portal - ENTRO

This section of the NBI knowledge portal connects individuals to relevant NBI wide information's and knowledge resources as well as information and knowledge management systems of the Eastern Nile Technical Regional Office (ENTRO).

Announcements

There are currently no active announcements. To add a new announcement, click "Add new announcement" below.

Add new announcement

Calendar

There are currently no upcoming events. To add a new event, click "Add new event" below.

Add new event

ENTRO Knowledge Resources



Links

There are currently no favorite links to display. To add a new link, click "Add new link" below.

Add new link

http://myserver/sites/NBI-KP/ENTRO/default.aspx

Initial Configuration Tasks

Home - ENTRO - Wind...

Trusted sites | Protected Mode: Off

Start

4:45 PM

100%

Fig 5.5 Screen shot of the Level 1 – Sub site

The screenshot shows a Microsoft SharePoint site titled "Social meeting workspace". The URL is <http://myserver/sites/NBI-KP/SMW/default.aspx>. The page has a header with the NBI knowledge Portal logo and navigation links for Home, Nile SEC, NEL SAP-CU, and ENTR0. On the right, there's a "Site Actions" dropdown. The main content area includes:

- Attendees:** A table with columns Name, Edit, Response, and Comment. It displays the message: "There are no items to show in this view of the 'Attendees' list." A link "Manage attendees" is provided.
- Discussion:** A section titled "What are the Nile Basin Development Challenges?" with a list of bullet points:
 - Growing population (180 m people) ?
 - Extreme variability (floods, droughts)?
 - High upland erosion & vulnerability ?
 - Low access electricity (<15%) & Agr. Productivity ?
 - Poverty & asymmetry (\$200 to \$1600 GDP)?
 - limited volume of drinking Water ?
 There is also a link "Edit text".
- Photos:** A large image of a young child with a beaded necklace, drinking water from a metal tap. The photo is captioned with the question about Nile Basin challenges.

Fig 5.6 Screen shot of the Level 2 – Sub site (Social meeting work space).

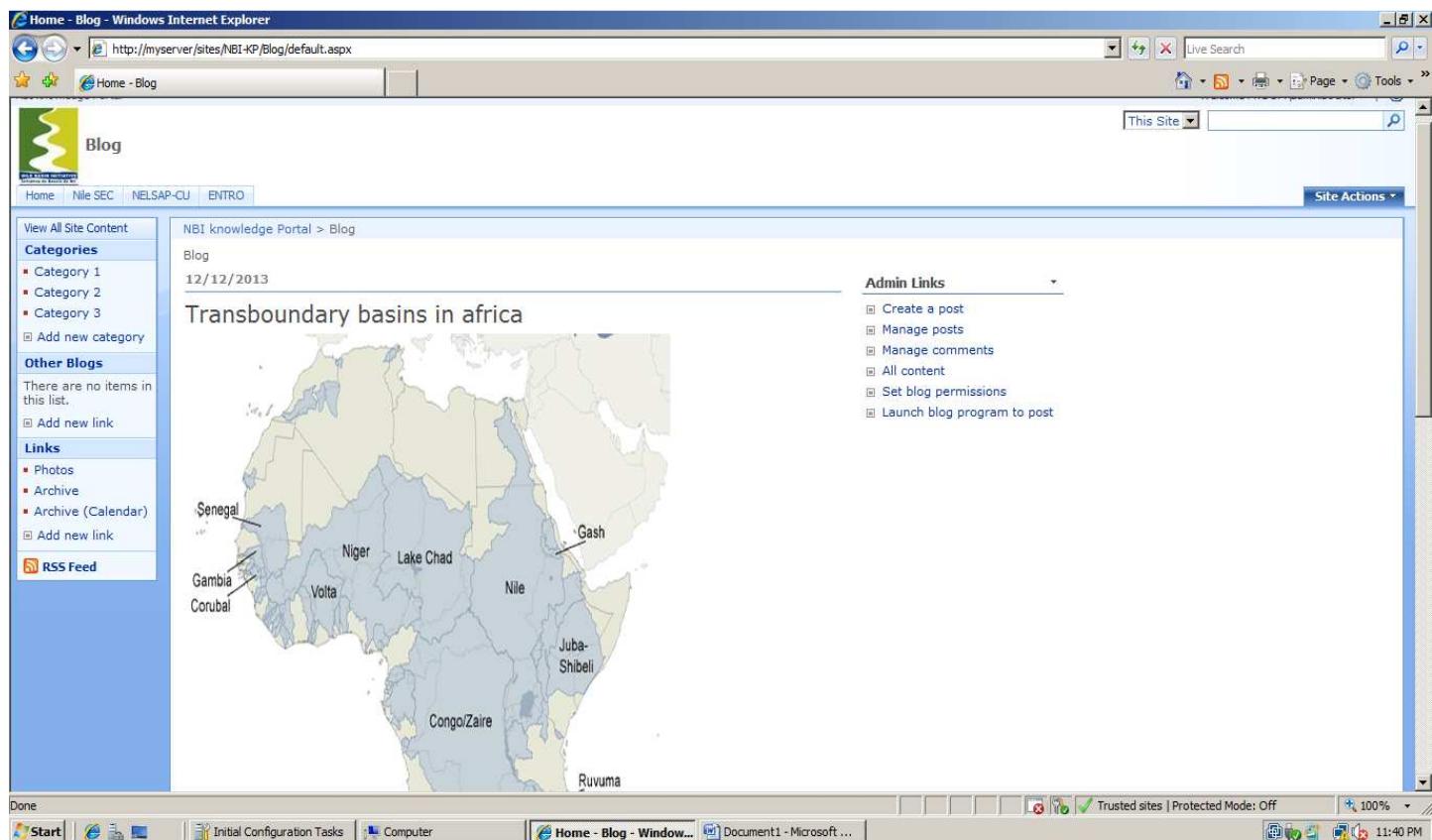


Fig 5.7 Screen shot of the Level 2 – Sub site (Blogs).

6 SUMMARY OF RESULTS, RECOMMENDATIONS AND CONCLUSIONS

6.1 SUMMARY OF RESULTS

The objective of this research study was to enhance our collective understanding of the factors affecting knowledge sharing behaviors of individuals in organizations with similar work environment context as NBI. The study drew upon theory and research from multiple streams of research such as social psychology, organizational learning, knowledge management, information systems and so forth and identified three sets of critical factors: psychological, organizational and technological that are believed to influence the knowledge sharing behaviors. The study applied theory of planned behavior framework (TPB) (Ajzen, 1991) to investigate the impact of these factors on knowledge sharing behaviors.

The results from the field survey of 103 valid respondents of NBI permanent staffs and related stake holders provide empirical support for the overall structure theorized in the research conceptual model. As supported by the findings of previous studies on knowledge sharing behaviors (Bock and Kim, 2002; Bock et al., 2005; Lin et al., 2004), the findings pointed out that the significant predictors of knowledge sharing behaviors to be TPB components: intention towards knowledge sharing, attitude towards knowledge sharing, and perceived behavioral control towards knowledge. Except subjective norms towards knowledge sharing which exhibited insignificant path towards intention of knowledge sharing when it was included in the analysis together with the other predictors. Based on findings the study like to underline the importance of applying technical solution ,knowledge portals ,as proposed on the previous chapter together with other non-technical solutions discussed in this chapter to minimize the effects of those factors and creating conducive environment for knowledge sharing.

In general, the prediction power of the hypothesized conceptual model was good explaining about 52 percent of the variance in the behavioral intention to share knowledge and 41 percent variance in the actual knowledge sharing behavior. The discussion of the results of the individual predictors with respect to the above TPB components and the summary of the findings during qualitative data analysis is presented below.

6.1.1 KNOWLEDGE SHARING BEHAVIOR

Perceived behavioral control and intentions towards knowledge sharing are found to be major determinant factors as hypothesized explaining 41 percent of the variance of the actual knowledge sharing behavior. Prior research has shown that the addition of perceived behavioral construct, increases the accounted variance in actual KS behavior by 2 to 12 percent over and above behavioral intention (Rivis and Sheeran, 2003; Armitage & Connor, 2001; Godin and Kok, 1996).

The significant impact of perceived behavioral control on knowledge sharing behavior showed in this study suggests that knowledge sharing is not largely under voluntary control. Individuals are prone to engage in knowledge sharing behaviors to the extent of their belief whether it is easy or difficult to engage in the knowledge sharing behavior. Therefore this study like to underline the importance of having the necessary organizational learning practices to improve individual's belief on the ease of involving in KS activists and perceived presence or absence of necessary resources and opportunities that may facilitate or impede actual behavior. Intention towards knowledge sharing was also found positively and significantly related to knowledge sharing behavior explaining the degree of one's belief that one will engage in Knowledge-sharing behavior determine the actual knowledge sharing behavior. Based on the findings related the above two factors the study underlines individuals are inclined to engage in knowledge sharing behaviors to the extent they have the time, resources and opportunities to do so.

6.1.2 INTENTIONS TOWARDS KNOWLEDGE SHARING

Consistent with the theory of planned behavior, the study hypothesized the predictors of knowledge sharing intention to be attitude towards knowledge sharing, subjective norm and perceived behavioral control. As hypothesized, the above three motivators collectively explained about 60 percent of the variance in the behavioral intention to share knowledge. While attitude and perceived behavioral control emerged as significant predictors of intention towards knowledge sharing, consistent with the findings of prior TPB related research (Taylor and Todd, 1995; Bock and Kim, 2002, Bock et al., 2005; Lin et al., 2004), subjective norm presented insignificant or weak effect .However the presented weak effect of subjective norms increased significantly when the other two motivators are removed from the analysis. This finding suggests the degree of one's perceived social pressure from important others to share or not to share one's knowledge is not as an important factor as the other two, attitude and perceived behavioral control, for this study population.

The high contribution of attitude towards knowledge sharing suggests that individuals with favorable attitudinal disposition are more likely to engage in knowledge sharing. This finding highlights the importance of one's favorable or positive feeling about sharing one's knowledge. Even though the importance of subjective norm is not as important as the other two motivators of intention towards knowledge sharing for this study population, the finding highlights the importance of the social influence of top management and peer group in knowledge sharing. The impact of perceived behavioral control on the intention towards knowledge sharing indicates that knowledge workers are motivated to engage in knowledge sharing to the extent they believe they have the resources and opportunities to do so.

6.1.3 ATTITUDE TOWARDS KNOWLEDGE SHARING

Attitude towards knowledge sharing explains the degree of one's favorable or positive feeling about sharing one's knowledge and the findings of this study pointed out social network and trust as a strong determinant factor towards individual's attitude towards knowledge sharing. The finding highlights the importance of strong social contact, accessibility and willingness to take risk to the actions of other people for achieving the necessary positive individual's attitude towards knowledge sharing. In addition individual's perceived loss of knowledge power emerged as another significant determinant factor of attitudes towards knowledge sharing presenting a negative effect as hypothesized. Accordingly the study like to underline the importance of individuals having the right perception towards their knowledge power in order to have the right attitude towards knowledge sharing. On the other hand during PLS-graph analysis perceived organizational incentives and benefits presented strong effect when it is loading independently. However, the independent contribution was washed out when other motivators were included in the analysis which explains individuals perceptions of organizational incentives and benefits are not as important as the above two motivators of attitudes towards knowledge sharing for the study population of this study. The findings also highlights the trivial effect of having shared goal towards individual's attitude towards knowledge sharing for the study area examined.

6.1.4 SUBJECTIVE NORM TOWARDS KNOWLEDGE SHARING

Subjective Norm towards knowledge sharing defines the degree of one's perceived social pressure from important others to share or not to share one's knowledge. The study hypothesized three motivation factors: social network and trust, shared goals and organizational climate. As hypothesized while social network & trust and perceived organizational climate emerged as important predictors of individual's perceived subjective norms towards knowledge sharing shared goals presented a trivial effect similar to its effect towards individual's attitude towards knowledge sharing.

The high contribution of social network and trust towards individual's perceived subjective norms towards knowledge sharing suggests that if there is a higher degree contact, accessibility and willingness to vulnerable to the actions of other people, the more likely for individuals to have positive perceptions of subjective norms towards their knowledge sharing behavior. On the other hand the higher the perceptions of organizational climate to be conducive of knowledge sharing, the higher was the formation of subjective norm towards knowledge sharing. Organizational climate is characterized by the degree of organizational affiliation, innovation and fairness.

6.1.5 PERCEIVED BEHAVIORAL CONTROLS TOWARDS KNOWLEDGE SHARING

Perceived behavioral control defines degree of one's belief that it is easy or difficult to engage in the knowledge sharing behavior .The study hypothesized tools and technology that facilitate knowledge sharing to have a strong positive relationship with perceived behavioral control towards knowledge sharing .As hypothesized tools and technology presented a strong positive effect explaining 40 percent of the variance in the perceived behavioral control. This is a significant finding since organizations are investing heavily in the development and acquisition of information and communication technologies in the form of knowledge management systems.

Although the findings showed that more than 80 percent of the respondents are satisfied with the overall quality of tools and technology for sharing knowledge with in the study area (NBI) at moderate and above level, more than 40 percent also replied that they hesitate to use tools and technology to share knowledge for fear of making mistakes at moderate and above level. The finding suggests the level of understanding and knowledge of individuals on the available tools and technology significantly determine their perceived behavior towards knowledge sharing.in addition the finding also suggest that the usage of the available different tools and technologies for knowledge sharing, other than email and face to face communication, should be motivated and facilitated in order to improve individuals perceived behavioral control towards the actual knowledge sharing behavior.

6.1.6 FINDINGS DURING QUALITATIVE STUDY

During unstructured interviews and observations the study identified that NBI has taken significant efforts to advance its information systems, reinforce internally and externally focused knowledge management and knowledge sharing activities . Though the wide spread adoption and use of ICT as a means to collaborate, engage in social interaction or build trust, to deliver valuable and high quality knowledge resources throughout the region is at the incipient stage, but promising if leveraged well. The study like to underline the following critical points based on the findings during qualitative study.

- NBI should develop an all-inclusive KM/KS strategic document or guideline to improve the availability and reliability of the existing substantial socio-economic, environmental, water resources and hydro-meteorological data and information or knowledge as well as to capture and codify new one. In addition such a guide line could help in alleviating lack of quality assurance of the existing data by setting region wide common standards for the overall KM/KS practices, which includes the capturing, codification and sharing of knowledge resources.
- NBI should also give strong attention in creating a common medium for collaboration and strengthen social ties which is better than the current common practices which requires face-to-face communications most of the time or lacks a mechanism to provide a simple means to formal and informal engagements for individuals scattered in wider work environment. NBI should develop a virtual environment or community of practice (CoP) where individuals or stakeholders scattered throughout the region regularly meet, strengthen their social network/ ties, collaborate, build their team and share their knowledge. A virtual environment could be online discussion forms, chat rooms, work groups, blogs, a document work space where individuals can easily share their ideas and work together, a common social network etc.
- Even though there are significant efforts, NBI should also need to give more attention and priority to find a way to integrate the available information system, knowledge portals and websites to a single platform that provide a single point of access to the wealth of knowledge already available in different forms such as: spatial and non-spatial data bases,

various water resources and optimization Models and toolkits, Decision support systems, projects study finding etc. Furthermore such an integrated system could enable NBI to improve the lack of efficient dissemination mechanism for developed knowledge products as well as to effectively gather substantial primary knowledge resources scattered throughout the wide NBI region.

- Finally, NBI should also strengthen organizational learning activities with the support of the modern technology tools such as teleconferencing /videoconferencing to make those learning practices reachable to the wider public of the region. Which will enable the widely scattered individuals to improve their knowledge and capabilities towards the actual knowledge sharing practice as well as their use of the ICT tools.

6.2 CONCLUSION

Knowledge sharing has been identified as the key enabler of knowledge management. To leverage knowledge resources and to support knowledge sharing, organizations are employing various knowledge management systems. While knowledge management systems are important, practical implementations observed during this exploratory study have shown that the mere availability of technology does not guarantee that knowledge will be shared. Findings of this study pointed out that usage of tools and technology for knowledge sharing was positively associated with high levels of perceived behavioral control towards knowledge sharing. In other words, though the ease availability, accessibility and integration of valuable organizational knowledge resources can be achieved through deployment of efficient tools and technology for knowledge sharing as proposed knowledge portal in the previous chapter, the usage of those tools & technologies depends on individual's belief on whether it is easy or difficult to engage in the knowledge sharing behavior. In addition the study also pointed out other important factors that determine the knowledge sharing behavior of individuals with in NBI and other knowledge based organizations.

This exploratory research attempted to fill the gap in the extant research on knowledge sharing by investigating the factors that influence the knowledge sharing behaviors of individuals with in organizations such as NBI. Drawing from multiple streams of research including social psychology, organizational learning, knowledge management, information systems, this research developed an integrated theoretical model and unveiled three sets of critical factors: psychological, organizational and technological that are believed to affect the knowledge sharing behaviors.

Using a field survey of 103 individuals from Nile Basin Initiative the theoretical model was validated within the context of a single empirical study. The findings provided significant statistical support for the research model accounting for about 52 percent of the variance in the behavioral intention to share knowledge and 45 percent variance in the actual knowledge sharing behavior. 9 of the 11 hypothesized relationships were supported. Knowledge sharing behavior was predicted by the individual's intention towards knowledge sharing and perceived behavioral control. Knowledge sharing intention in turn was predicted by individual's attitude towards knowledge sharing, subjective norm and perceived behavioral control. The strength of social network and trust was found positively associated with both favorable attitude and subjective norm towards knowledge sharing. Individual's perceptions of organizational incentives & benefits and organizational climate were positively associated with favorable attitude and subjective norm towards knowledge sharing respectively. On the other hand the perceptions of loss of knowledge power exerted a negative effect on individual's attitude. Additionally, usage of tools and technology was positively associated with high levels of perceived behavioral control towards knowledge sharing.

In addition the findings of the qualitative study and review of different literatures also helps to point out critical issues related to the importance of KM/KS strategic document or guideline aligned with business strategies and the need to have an efficient ICT tool to integrate all the knowledge resource as well as to create a virtual space to strengthen social ties and collaboration for organizations like NBI where individuals are dispersed in wider region. In addition the findings underlined the importance of strengthening organizational learning practices by making it reachable for the wider public domain through the use of the modern information and communication technologies.

Based on the findings, the study discussed theoretical implications and practical recommendations for knowledge sharing in this research area work context. Furthermore it proposed a prototype knowledge portal. Overall, the results of the study advance prior research in the area of knowledge sharing by shedding light on the determinants of knowledge sharing behavior of individuals with in organizations like NBI. The research model deepens our collective understanding of the underlying psychological processes that induce knowledge sharing behaviors. In addition to contributing to theory, the findings of the study also yield insights for practice and a prototype technical solution. The insights could be used by NBI as well as by other knowledge based organizations to developing realistic environment conducive to knowledge sharing.

6.3 RECOMMENDATIONS

The results of the study have many implications for NBI and other organizations especially for those initiating or striving to promote knowledge sharing behaviors. Based on the results the study presented the following recommendations for practice.

- **First**, prior to launching knowledge sharing initiatives, organizations should create an environment that is conducive to knowledge sharing. Organizations should develop and nurture cultural norms, practices and processes that build trust, collective cooperation and positive social interactions among knowledge workers. Work context exemplified by high levels of trust, collective cooperation, formal and informal networks, facilities of knowledge exchanges among individuals or knowledge workers. Organizations should have all inclusive KM strategic document which is essential to spell out key communications and outreach strategies to engage stakeholders, keep them informed and guide KM/KS activities.
- **Second**, the results of the study suggest that attitude towards knowledge sharing behavior affects intention and further the actual KS behavior of individuals. Organizations such as NBI should promote knowledge sharing behaviors by managing factors that influence knowledge workers attitude towards knowledge sharing. organizations should structure the knowledge sharing initiatives in such a way that strengthen social network and address social concerns of individuals have for such things as realizing reciprocal benefits, reputation enhancement, enjoyment in helping others, balance of power and so forth. The level of individual's perceptions of knowledge exchange in the organization should be raised by promoting knowledge centric culture and by encouraging workers to help their co-workers with the knowledge needs.
- **Third**, organizations such as NBI should employ knowledge management systems to help strengthen social ties, facilitate collaborative work or team building, to narrow the physical distance due to their wide work environment and provide single point of access to all the relevant organizational knowledge. The results of the study indicate that individual's perception of using tools and technology is an important factor in deciding to engage in knowledge sharing. Organizations should enhance the level of the individual's perception of using the available tools and technology by employing appropriate systems that are easy to access and available at time needed. Moreover promoting organizational learning activities are important to improve individual perceived behavioral control of using the available tools and technology for the actual knowledge sharing behavior as well as improve quality of data generated. The study proposed a prototype knowledge sharing portal for NBI, which attempted to address points mentioned above and other challenges of knowledge sharing.
- **Fourth**, organizations should address the knowledge workers fears about losing power in the organization. Individual's perceptions of the loss of knowledge power should be mitigated by reassuring their position, power and status in the organization.
- **Fifth**, management should demonstrate its support for knowledge sharing. Supportive organizational climate and intensified management commitment towards knowledge sharing promotes knowledge sharing behaviors for example having the appropriate KM strategic document could help in creating conducive organizational climate for knowledge management as well as knowledge sharing. The study findings indicate that individuals are likely to be influenced by the expectations of management and peer group in deciding to engage in knowledge sharing. So it may even be appropriate to exert some pressure on individuals to share knowledge through the social influence of top management and peer group.
- **Sixth**, knowledge sharing is time consuming. Organizations should ensure that workers have time, resources and opportunities to engage in knowledge sharing. Organizations should allocate time for engaging in knowledge sharing behaviors by integrating it into the work processes. Time needed to engage in knowledge exchanges should not be viewed as a cost factor.

6.4 FUTURE RESEARCH DIRECTIONS

The study would like to recommend the following research directions for future.

- This study findings are based on a sample size of 103 .Although PLS Graph handles small sample sizes and generates valid results, future research's should replicate the study findings with a larger sample and different analytical tool, will allow to add more statistical power on the findings.
- Future research should replicate the study's findings with different determinant factors of individuals knowledge sharing behavior within and outside the three unveiled sets of critical factors of this study ,psychological, organizational and

technological ,which are important for wider work environment context such as political factors , perceived ownership of knowledge, self-efficacy etc.

- Unlike this research study which uses cross-sectional data examination of NBI, which is “data collected by observing many subjects (such as individuals, firms or countries/regions) at the same point of time, or without regard to differences in time” (Wikipedia), to use longitudinal examination of those determinants of individuals knowledge sharing behaviors since such un examination would make findings more robust.
- Conclusions drawn in this study are based on a limited method – survey of a single set of respondents, only from NBI and qualitative data gathering –observation and interview of few officials. As such, it leaves open the possibility for the existence of bias. Future research should employ elaborate measures and multiple methodologies to analyze the study's findings as well as consider multiple organizations to maximize accuracy.

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LIST OF ACRONYMS

ASP	Application service provider
ATT	Attitude toward knowledge sharing
AVE	.....	Average variance extracted
BI	.....	Business intelligence
CFA	.....	Cooperative framework agreement
CoP	.....	Community of practice
DB	.....	Data Base
DSS	.....	Decision Support System
EKR	.....	Electronic knowledge repositories
ENTRO	.....	Eastern Nile Technical Regional Office
H1....11	.....	Hypothesis
IAR	.....	Instructional assessment resource
IB	.....	Perceived Organizational Incentives and benefits of KS.
INS	.....	Intention towards sharing knowledge
IT/ICT	.....	Information Technology/Information communication technology
IWRM	.....	Integrated water resource management
KM	.....	Knowledge Management
KMS	.....	knowledge management systems
KS	.....	Knowledge sharing
KS_B	.....	Knowledge sharing behavior
LK	.....	Perceived Loss of Knowledge Power
NBI	.....	Nile Basin Initiative
NELSAP	.....	Equatorial Lakes Subsidiary Action Program
Nile-COM	.....	Nile Council of Ministers
Nile-IS	.....	Nile Information system
Nile-SEC	.....	Nile Secretariat
Nile-TAC	.....	Nile technical advisory committee
OC	.....	Perceived organizational climate
PBC	.....	Perceived Behavioral Control
PLS	.....	Partial Least Squares
PRC	.....	People's Republic of China
SAP	.....	subsidiary action program
SG	.....	Shared Goals
SN	.....	Social Network And Trust
SNK/SU	.....	Subjective norm about knowledge sharing
SQL	.....	Standard Query Language
SVP	.....	Shared vision program
SWOT	.....	Strength ,Weakness ,Opportunity and Threat
TPB	.....	Theory of planned Behavior
TRA	.....	Theory of Reasoned Action
URL	Uniform resource locator
US	United States
UTT	Usage of tools and technology

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APPENDIXES**APPENDIX I – SURVEY QUESTIONNAIRES: DESIGNED AND DISTRIBUTED USING SURVEY MONKEY.**

Introduction to the Survey
<p>Welcome to the Knowledge Sharing Survey!</p> <p>This survey has been designed to identify the major determinants of knowledge sharing in knowledge based organizations by taking the case of Nile Basin Initiative (NBI). With the intention to provide useful insights and proposed solutions which are not always relay on Information technology.</p> <p>Knowledge sharing can be defined as “a set of behaviors that involve the exchange of information or assistance to other”, Connally and Kelloway (2003), Davenport and Prusak (1998) also define knowledge sharing as “Process that involve exchanging knowledge between individuals and groups.”</p> <p>Note: KNOWLEDGE includes :</p> <ul style="list-style-type: none"> • Know-what (important factual information, acquired through a process of learning-by-using) • Know-how (skill and procedures, acquired through a process of learning-by-doing or experience) • Know-why (understanding cause and effect relationships, acquired through Learning-by-studding or education). <p>All the information you provide will be kept confidential.</p> <p>Please don't forward the link of this survey to others since it uniquely linked to you or your email address.</p> <p>Your assistance is highly appreciated, Thank you for spending your valuable time to give you responses to this survey!</p>

This survey questioner incorporates questions categorized in 11 constructs including social network and trust ,shared Goals ,attitudes ,subjective norms ,intention, usage of tools and technology, perceived loss of knowledge power, organizational incentives and benefits,behavioural Controls, organizational climate and knowledge sharing behavior.

Please indicate how strongly you agree or disagree with each statement by circling (selecting) a number. 1= Strongly Disagree, 5= Strongly Agree.

Social Network And Trust

SN1	In general, I have a very good relationship with my organizational members and related NBI stake holders	1	2	3	4	5
SN2.	In general, I am very close to my organizational members and related NBI stake holders.	1	2	3	4	5
SN3	I always hold a lengthy discussion with my organizational members and related NBI stake holders.	1	2	3	4	5
SN4.	I know my organizational members will always try and help me out if I get into difficulties	1	2	3	4	5
ST5	I can always trust my organizational members to lend me a hand if I need it	1	2	3	4	5
SN6	I can always rely on my organizational members to make my job easier	1	2	3	4	5

Shared Goals

SG1	My organizational members and I always agree on what is important at work,	1	2	3	4	5
SG2	My organizational members and I always share the same ambitions and vision at work.	1	2	3	4	5
SG3	My organizational members and I are always enthusiastic about pursuing the collective goals and missions of the whole organization.	1	2	3	4	5

Attitude toward knowledge sharing						
AT1	Sharing of my knowledge with organizational members is always good	1	2	3	4	5
AT2	Sharing of my knowledge with organizational members is always beneficial	1	2	3	4	5
AT3	Sharing of my knowledge with organizational members is always an enjoyable experience	1	2	3	4	5
AT4	Sharing of my knowledge with organizational members is always valuable to me	1	2	3	4	5
AT5	Sharing of my knowledge with organizational members is always a wise move	1	2	3	4	5

Subjective norm about knowledge sharing

SU1.	My chief executive officer (CEO) always thinks that I should share my knowledge with other members in the organization.	1	2	3	4	5
SU2	My boss always thinks that I should share my knowledge with other members in the organization.	1	2	3	4	5
SU3	My colleagues always think that I should share my knowledge with other members in the organization.	1	2	3	4	5

Intention towards sharing knowledge

IN1	I will share my work reports and official documents with my organizational members more frequently in the future.	1	2	3	4	5
IN2	I will always share my manuals, methodologies and models with my organizational members in the future.	1	2	3	4	5
IN3	I will always share my experience or know-how from work with my organizational members in the future.	1	2	3	4	5
IN4	I will always share my know-where or know-whom at the request of my organizational members.	1	2	3	4	5
IN5.	I will always try to share my expertise obtained from education and training with my organizational members in a more effective way.	1	2	3	4	5

Please indicate how strongly you agree or disagree with each statement by circling (selecting) a number. 1= Strongly Disagree, 5= Strongly Agree.

Or how frequently you use the tool or technology: 1 = Very Infrequently , 3= Moderate frequency (Few times per month), 5= Very Frequently (Many times daily)

Usage of tools and technology

UT1	Whenever I want to share knowledge, I can easily access tools and technology in our organization	1	2	3	4	5
UT2	In our organization, it is available and easy to use tools and technology to share knowledge.	1	2	3	4	5
UT3	I am satisfied with the overall quality of tools and technology for sharing knowledge in our organization	1	2	3	4	5
UT4	I hesitate to use tools and technology to share knowledge for fear of making mistakes	1	2	3	4	5
UT5	Tools and technology for sharing knowledge can be customized to fit individual needs	1	2	3	4	5
UT6	I use e-mail to share knowledge with my co-workers	1	2	3	4	5
UT7	I use discussion forum (using tools like electronic bulletin board, chat room etc.) to share knowledge with my co-workers	1	2	3	4	5
UT8	I share knowledge by inputting it into knowledge repository/company databases (containing existing expertise, lessons learned, best practices etc)	1	2	3	4	5
UT9	I use intranet (including corporate portal) to share knowledge with my co-workers	1	2	3	4	5
UT10	I use video and teleconferencing to share knowledge with my co-workers.	1	2	3	4	5
UT11	I share knowledge through face-to-face discussions with my coworkers	1	2	3	4	5

Perceived Loss of Knowledge Power

LK1	Sharing knowledge with my co-workers makes me lose my unique value in the organization.	1	2	3	4	5
LK2	Sharing knowledge with my co-workers makes me lose my power base in the	1	2	3	4	5

	organization.					
LK3	When I share knowledge with my co-workers, I believe I will lose my knowledge that no one else has.	1	2	3	4	5
LK4	Sharing knowledge with my co-workers makes me lose my knowledge that makes me stand out with respect to others.	1	2	3	4	5

Perceived Organizational Incentives and benefits of knowledge sharing

IB1	Sharing knowledge with my co-workers improves the likelihood of getting a better work assignment or promotion for me.	1	2	3	4	5
IB2	Sharing knowledge with my co-workers improves the likelihood of getting a higher salary or bonus for me.	1	2	3	4	5
IB3	I expect to get more job security when I share knowledge with my co-workers.	1	2	3	4	5
IB4	When I share knowledge with my co-workers, I believe that my queries for knowledge will be answered in the future.	1	2	3	4	5

Perceived Behavioral Control

PBC1	I have enough time available to share knowledge with my co-workers	1	2	3	4	5
PBC2	I have the necessary tools to share knowledge with my co-workers.	1	2	3	4	5
PBC3	I have the ability to share knowledge with my co-workers.	1	2	3	4	5
PBC4	Sharing knowledge with my co-workers is within my control.	1	2	3	4	5
PBC5	I am able to share knowledge with my co-workers easily.	1	2	3	4	5
PBC6	Even if I wanted to share, I do not have the means to share knowledge	1	2	3	4	5

Please indicate how frequently you shared work-related knowledge with your co-workers in the past year.

1 = Very Infrequently , 3= Moderate Frequency(Few times per month), 5= Very Frequently (Many times daily).

Knowledge sharing behavior

KS1	I shared factual knowledge (know-what) from work with my coworkers.	1	2	3	4	5
KS2	I shared business knowledge about the customers, products, suppliers and new technology with my co-workers.	1	2	3	4	5
KS3	I shared internal reports and other official documents with my coworkers	1	2	3	4	5
KS4	I shared work experiences with my co-workers.	1	2	3	4	5
KS5	I shared know-how or tricks of the trade from work with my coworkers.	1	2	3	4	5
KS6	I shared expertise from education or training with my co-workers.	1	2	3	4	5
KS7	I shared know-why knowledge from work with my co-workers	1	2	3	4	5

Perceived organizational climate.

POC1	Members in our department keep close ties with each other.	1	2	3	4	5
POC2	Members in our department consider other members standpoint highly.	1	2	3	4	5
POC3	Our department encourages suggesting ideas for new opportunities.	1	2	3	4	5
POC4	Our department puts much value on taking risks even if that turns out to be a failure.	1	2	3	4	5
POC5	Our department encourages finding new methods to perform a task	1	2	3	4	5
POC6	In our department, objectives which are given to us are reasonable.	1	2	3	4	5
POC7	In our department, our boss doesn't show favoritism to anyone	1	2	3	4	5
POC8	Members in our department can trust department head's judgment to be good.	1	2	3	4	5

Demographics - Please check the category that is most appropriate.

Gender	Male	Female	
Age Group	18 to 21 years old		
	<input type="checkbox"/> 21 to 30 years old		
	<input type="checkbox"/> 31 to 40 years old		
	<input type="checkbox"/> 41 to 50 years old		
	<input type="checkbox"/> 51 to 60 years old		
	<input type="checkbox"/> Above 60 years old		

Level of education	
<input type="checkbox"/> Some High School	
<input type="checkbox"/> High School Degree	
<input type="checkbox"/> Diploma/ Advance diploma	
<input type="checkbox"/> Associate's Degree	
<input type="checkbox"/> Bachelor's Degree	
<input type="checkbox"/> Master's Degree	
<input type="checkbox"/> Doctorate Degree	
<input type="checkbox"/> Other – Please Specify _____	
Your job title	_____
Total Years of work experience	
<input type="checkbox"/> Under 2 years	
<input type="checkbox"/> 3 to 5 years	
<input type="checkbox"/> 5 to 10 years	
<input type="checkbox"/> 11 to 20 years	
<input type="checkbox"/> 21 to 30 years	
<input type="checkbox"/> Above 30 years	
<input type="checkbox"/> Other – Please Specify _____	
Years closely work with/working for NBI	
<input type="checkbox"/> Under 2 years	
<input type="checkbox"/> 3 to 5 years	
<input type="checkbox"/> 5 to 10 years	
<input type="checkbox"/> More than 10 years	
<input type="checkbox"/> Other – Please Specify _____	

APPENDIX II – SAMPLE INTERVIEW QUESTIONS

Sample interview questions used.
1. Can you please describe or list the major KM/KS activities within NBI? What do you think are the major achievements so far? Any challenges? If yes, do you have any suggestion as solution to those challenges?
2. Can you please describe how NBI strengthens social ties to reach out to its stakeholders? Any suggestions for enhancing the current scope of these activities?
3. Is there clearly stated KM/KS related document or guideline for NBI that you have come across or used? Any suggestions in this regard.
4. Can you describe your experience in usage, access and availability of existing ICT tools within NBI? Do you believe the necessary tools are there for collaboration and knowledge sharing? Any suggestions for improvement?
5. From your experience, can you describe the organizational learning activities within NBI? Any suggestions.

Comparative Analysis of 64-bit Low Power SRAM Cell Designs by Using Charge Recycling Scheme

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ABSTRACT: SRAM cell design takes a big fraction of the entire power and die area in high performance processors. The overall power consumption in SRAM can be reduced either by decreasing the dynamic or static power. A Charge Recycling (CR) is a very efficient means to reduce the power dissipation in the write cycle of SRAM cell designs. To keep this point in view, this paper represents the simulation of four 64-bit SRAM cell topologies by using Charge Recycling scheme and their comparative analysis on the basis of their average write power consumption. The 64-bit SRAM cell designs are arranged in 8X8 form. Simulation reveals that 64-bit 9T SRAM cell with CR perform better than others in the term of power consumption but if die area and average power consumption both considers, then 64-bit 7T SRAM cell with CR perform well as compared to 64-bit 9T SRAM cell with CR. All the simulations of SRAM cell designs have been carried out on 180nm, 130nm and 100nm CMOS technology at 100 MHz and Vdd = 1.8 V.

KEYWORDS: low power SRAM, power consumption, CR, charge recycling scheme, write cycle, 6T, 7T, 8T, 9T.

1 INTRODUCTION

Demand of today's electronic market is to have high performance, high speed and long battery life devices become a major concern for VLSI on chip designs. To achieve this, SRAM plays a vital role which is used such as a cache memory in high speed applications. As cache memory presents very close or in the processors, the power dissipation in the form of heat in SRAM may create a problem for the processor. Hence a low power SRAM cell design is needed. SRAM tends to have a large number of bits per word, as system become more complex [1]. In this type of SRAM, the power dissipation occurs in the form of dynamic power and static power [3]. These are the two major sources of power dissipation in digital CMOS circuits, each one being affected by different factors and influencing the system in a different way.

Static power dissipation occurs by the leakage currents and sub-threshold currents. The power dissipation is usually quite small in the reverse biased p-n junction which is accountable for the leakage currents but sub-threshold conduction exponentially depends on parametric conditions so therefore it is important, to be considered in some circumstances. Dynamic power dissipation occurs mainly due to the power consumed during read and write operation or in other words, charging and discharging of the load capacitance during circuit switching and due to short circuit power consumption. A dynamic power account for the majority of the total power in digital CMOS VLSI circuits is dissipated during the rise time and fall time of the highly capacitive data bit lines [2]. Dynamic power dissipation is more during write cycle than that of the static power dissipation in low power SRAM cell due to the full voltage swing in bit lines.

Many authors proposed different approaches to reduce power consumption in SRAM but reusing of a charge on the adjacent bit line which was already used charge on a bit line to create a low voltage swing for the operation of writing, is a very efficient mean to reduce the power dissipation. This technique was introduced by H.Yamauchi et al. [4] in bus architecture for ultrahigh data rate low power on chip design. B. D. Yang and L. S. Kim were proposed charge recycling scheme on ROM architecture [5] then by using hierarchical bit line architecture and local sense amplifier SRAM cell was proposed [6]. But K. Kim

et al. were the first to proposed charge recycling scheme directly to bit lines to reduce dynamic power consumption during the operation of writing, associated with the voltage swing created on bit lines [1]. B. D. Yang then again used this scheme for the both read and write operation [2]. A zero aware asymmetric cell was proposed to minimize power consumed to write '0' only and three bit lines in each column increase total capacitance for the memory [7]. A shared bit line architecture was proposed by H. Morinura et al. [8] in which dynamic power reduces but no one can perform read and write operation in a row on adjacent cells.

After carefully analyzing all the previous work this paper proposed a comparative analysis of 64 bit low power SRAM cell designs using already used charge on the adjacent bit line during write cycle on the basis of their average power consumption.

This paper is arranged in the following manner in VI sections. Section II briefly describes schematic of 6T, 7T, 8T and 9T SRAM cell designs. In section III, charge recycling scheme is explained with the help of detailed circuit diagram and operational waveform. Section IV describes schematic of 64-bit low power CMOS SRAM cell designs by using charge recycling scheme and section V shows the results on the basis of their average power consumption during write cycle. All discussions are summarized in section VI and at the end references are given.

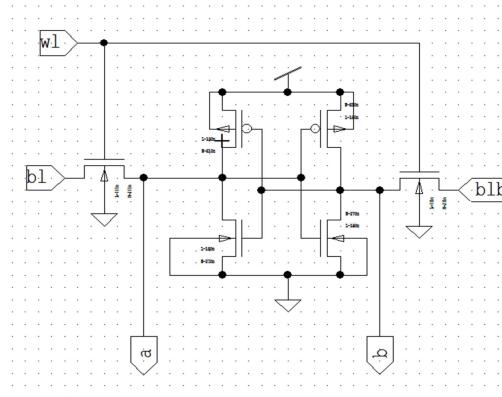


Figure 1. Schematic of 6T SRAM cell

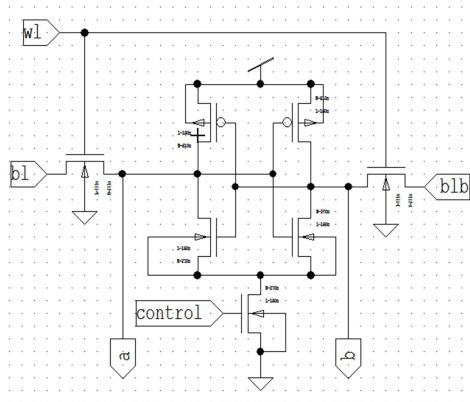


Figure 2. Schematic of 7T SRAM cell

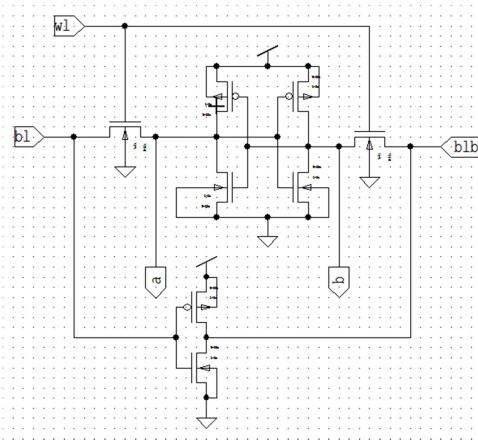


Figure 3. Schematic of 8T SRAM cell

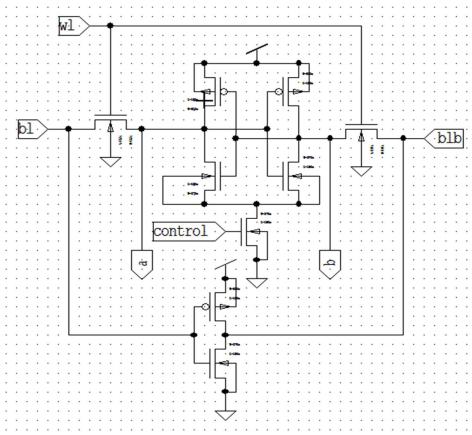


Figure 4. Schematic of 9T SRAM cell

2 SCHEMATIC OF LOW POWER SRAM CELL DESIGNS

A 6T SRAM cell consists of two cross connected inverter with two transistors of access as shown in figure 1. A cell gains access by the word line (WL) that controls two NMOS transistors of access and these transistors controls if the cell must get connected to the bit lines (BL and BLB). For the operation of writing one bit line is to be at high place and another bit line is to be in conditions of fall. In SRAM, the active power is dissipated due to his full swing nature in write cycle [2].

7T SRAM cell consists of an extra N MOS transistor than that of the 6T SRAM cell. An additional N MOS transistor connected to the source of driver N MOS transistors of the SRAM memory cell, enable small swing of bit lines in the write operation and also act as a sense amplifying memory cell which is used to achieve read disturb free operation. It is controlled by a separate control signal as shown in figure 2 [9].

8T SRAM cell is created by adding one more inverter in 6T SRAM cell as shown in the figure 3. An additional inverter helps to reduce power consumption during write cycle. The upper circuit of 8T SRAM cell is essentially a conventional SRAM cell. Data is stored within this circuit. Its working is similar to that of 6T SRAM cell operation.

9T SRAM cell is created by using an additional inverter as used to design 8T SRAM cell with one more NMOS transistor which is connected totally as like in designing of a 7T SRAM cell as shown in figure 4. In other words, 9T SRAM cell is the combination of 7T and 8T SRAM cell which helps to enable a small swing of bit lines and also with the help of additional inverter to reduce more power consumption during write cycle.

3 CHARGE RECYCLING SCHEME

Charge recycling scheme is that in which already used charge on a bit line is reused to produce a low voltage swing on the adjacent bit line throughout write operation. In this scheme,

Two switches on 'b1' and 'b2' nodes are used as transmission gate switches and these switches are ordered by signal 'in' and 'in1'. Data in the form of 'bl' and 'blb' are connected with nodes 'b1' and 'b2' through these two switches. An extra pass transistor switch for charge recycling is connected between both the nodes 'b1' and 'b2', controlled or ordered by signal 'cr' and 'crb' (Charge Recycle and Charge Recycle bar). Two capacitors C1 and C2 are connected to nodes b1 and b2 at one end and other end is grounded as shown in the figure 5.

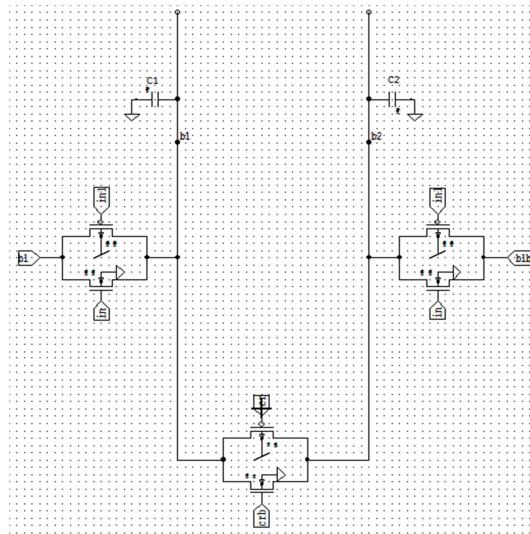


Figure 5. Schematic of a charge recycling scheme [3].

During a first cycle, both the switches on 'b1' and 'b2' nodes are closed and switch between the nodes is open. Capacitor C1 on a node 'b1' is charged to zero volts and C2 on a node 'b2' is charged to V volts. Then during a cycle which is introduced as an extra cycle between first and second cycle, switches on 'b1' and 'b2' nodes are open and switch in between 'b1' and 'b2' nodes is closed. In this way node 'b1' and 'b2' shorts so that the charges on capacitors redistributed equally. The levels of voltage on both the capacitors are $V/2$ volts after redistribution of charges without the necessity of any further electric charge[3].

After this in the next cycle, C1 is charged from $V/2$ volts to V volts and C2 is discharged from $V/2$ to zero volts and in the normal case as shown in the figure 6, capacitor C1 is to be fully charged and C2 is to be fully discharged but by using charge recycling scheme, charges on C1 and C2 are charged and discharged from $V/2$ volts as shown in the figure 7. This scheme saves power consumption as the previously used charge is reused on the adjacent bit line and also increases the speed of SRAM during write operation [1-3].

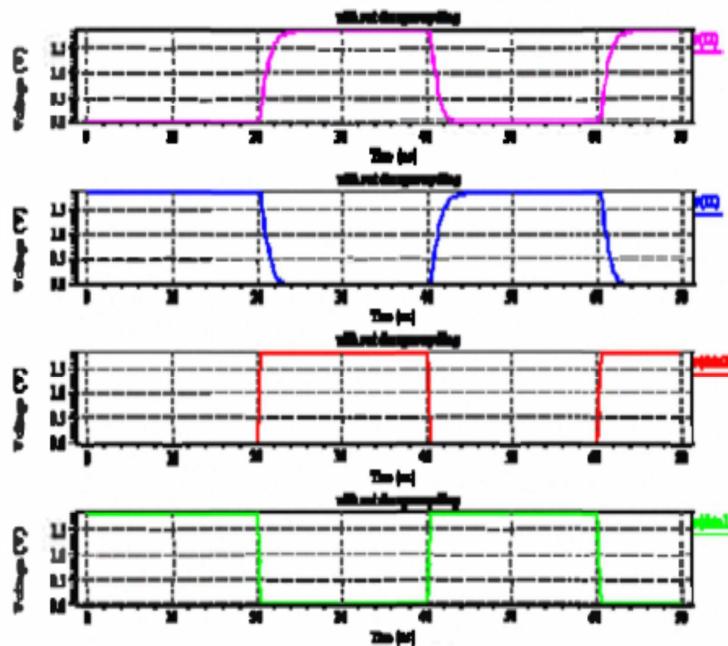


Figure 6. Waveform of a normal operation.

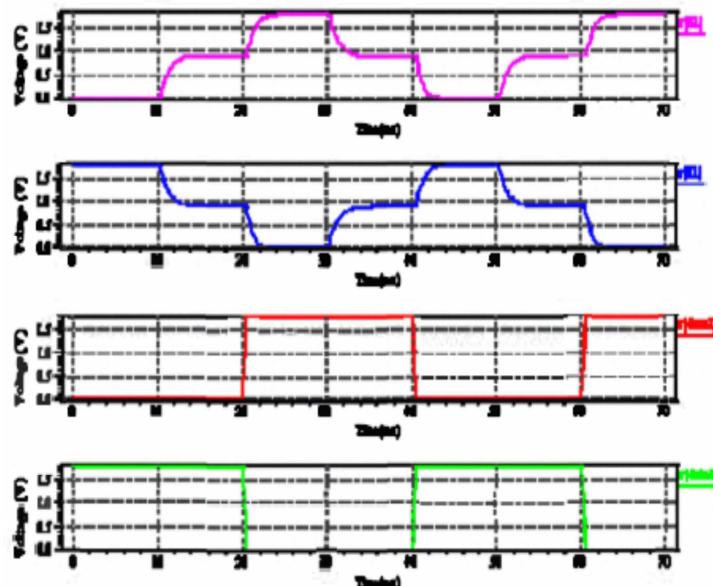


Figure 7. Waveform by using CR.

4 SCHEMATIC OF 64-BIT LOW POWER SRAM CELL DESIGNS BY USING CHARGE RECYCLING SCHEME

The charge recycling scheme is implemented on 64 bit low power SRAM and simulated on 180nm, 130nm and 100nm CMOS technology. Schematic of 64 bit 6T low power SRAM using charge recycling scheme is shown in figure 8, in which SRAM cell design is organized in 8X8 form i.e. 8 rows and 8 columns. Each column has three transmission gates. Two transmission gates are used as switches to separate the data from bit lines and one transmission gate is used as a switch for recycling of a charge of bit lines of every column throughout the charge recycling cycle.

A transmission gate which is used as a switch for recycling of a charge connected in between bl and blb lines. Other two transmission gates are connected to bl and blb lines respectively to separate the data on bl and blb during the charge recycling

scheme. When switches connected to bl and blb are ON and switch in between bl and blb remains OFF then it works as a conventional SRAM.

In the next cycle, switches connected to bl and blb are OFF and switch in between bl and blb is ON. During this period, the previous charges on the bit lines redistributed equally on both the bit lines and voltage level can say, will be $V_{dd}/2$ on both the bit lines. After this, one line charges from $V_{dd}/2$ to V_{dd} and other discharges from $V_{dd}/2$ to ground but power is also consumed by the switches used for the charge recycling scheme. So this process saves almost half charge is to be supplied from the source. Overall 24 transmission gates are used as switches for charge recycling scheme in 64 bit SRAM. As it saves almost half charge in every cycle, hence the power dissipation reduces at a large amount.

Similarly this scheme works on 7T and 9T low power SRAM cell design as shown in figure 9 and figure 11, in which an additional NMOS transistor provides help to charge recycling scheme by enabling a small swing on bit lines to reduce power consumed during write cycle as discussed earlier whereas in 9T presence of an additional inverter also help to reduce more power consumption similarly like this additional inverter helps in 8T SRAM cell. Figure 10 shows the schematic of 64 bit 8T low power SRAM cell design by using charge recycling scheme.

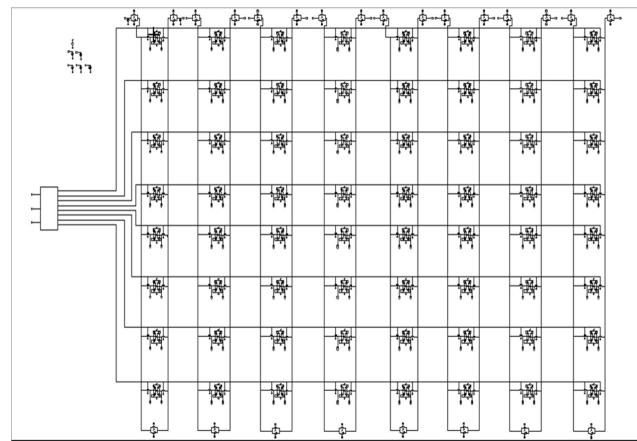


Figure 8. 64-bit 6T low power SRAM cell using CR

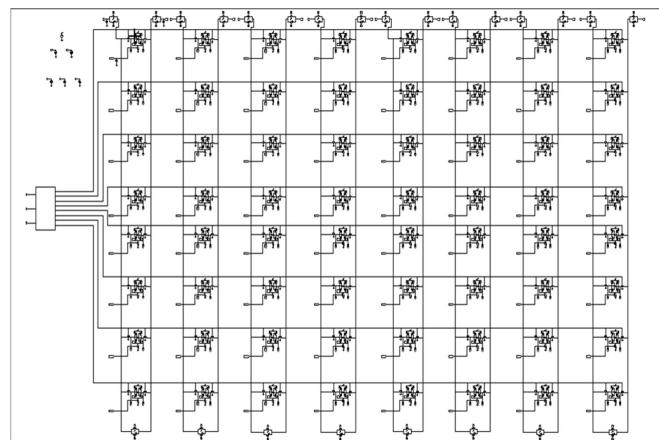


Figure 9. 64-bit 7T low power SRAM cell using CR

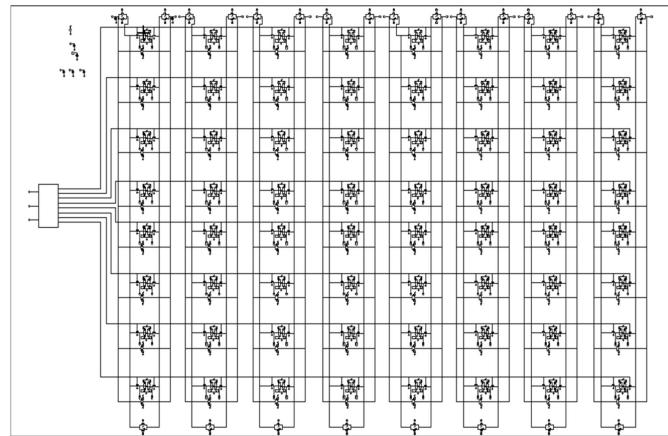


Figure 10. 64-bit 8T low power SRAM cell using CR

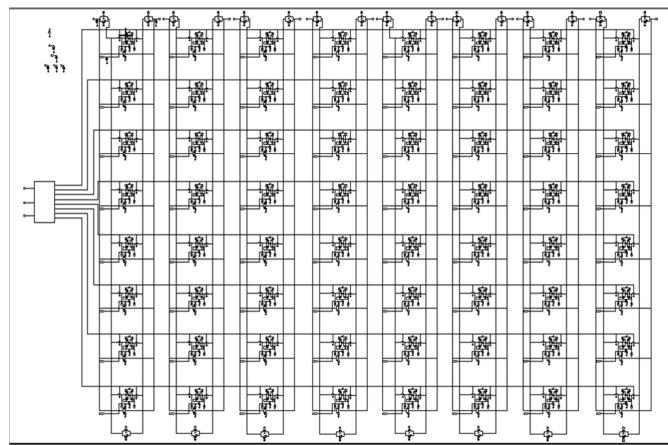


Figure 11. 64-bit 9T low power SRAM cell using CR

5 RESULTS

Table I. shows the comparative analysis of 64-bit low power SRAM cell designs by using charge recycling scheme on the basis of their average power consumption. All the simulations have been carried out on 180nm, 130 nm and 100nm CMOS technology respectively at 100 MHz and Vdd = 1.8V.

64-bit 6T SRAM cell consumes average of 3.060222mW, 2.676775mW and 2.613168mW power, 64-bit 7T SRAM cell consumes average of 1.596712mW, 0.157291mW and 1.621887mW power, 8T SRAM cell consumes average of 2.213734mW, 1.998538mW and 2.013592mW power and 9T SRAM cell consumes average of 1.319183mW, 0.106387mW and 1.229541mW power at 180nm, 130 nm and 100nm CMOS technology respectively. As technology scales down more, the average power consumption increases at Vdd= 1.8V. Average power consumption results are also shown in the form of bar chart in figure 12.

Average power consumption results of 64-bit SRAM cell designs by using CR scheme in this paper is less than as compared to SRAM cell designed by V.K. Singhal [3] and a low power SRAM using charge recycling proposed by K. Kim [1].

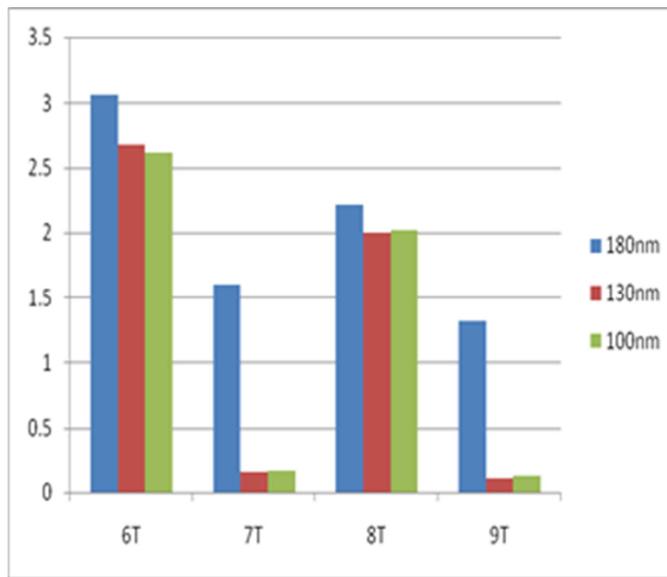


Figure 12. Average power consumption of 64-bit SRAM cell designs using charge recycling scheme.

Table 1. comparison of 64-bit low power SRAM cell designs by using charge recycling scheme on the basis of their power consumption.

Technology	6T SRAM cell			7T SRAM cell			8T SRAM cell			9T SRAM cell		
	Average Power (in mW)	Max. Power (in mW)	Min. Power (in mW)	Average Power (in mW)	Max. Power (in mW)	Min. Power (in mW)	Average Power (in mW)	Max. Power (in mW)	Min. Power (in mW)	Average Power (in mW)	Max. Power (in mW)	Min. Power (in mW)
180nm	3.06022	8.28749	1.94378	1.59671	2.28418	1.28507	2.21373	6.86197	1.45321	1.31918	6.57190	0.92968
130nm	2.67677	3.79242	1.95841	0.15729	0.49341	0.00002	1.99853	5.81349	1.45816	0.10638	3.72833	0.00007
100nm	2.61316	3.82970	1.97433	0.16218	0.62642	0.00031	2.01359	8.07961	1.45412	0.12295	5.58127	0.00005

6 CONCLUSION

The power of SRAM cell is mainly dissipated by the charging and discharging of highly capacitive bit lines because of their full swing nature. Charge recycling scheme is used in this paper to reduce power consumption of SRAM while charging and discharging of highly capacitive bit lines. This paper find out an efficient, low power SRAM cell memory by comparative analysis of 64-bit low power SRAM cell designs by using charge recycling scheme on 180nm 130nm and 100nm CMOS technology respectively. Based on the results it is clearly observed that 9T SRAM cell consumes less power as compare to 6T, 7T and 8T SRAM cell designs using CR.

Charge recycling scheme holds good for 7T and 9T SRAM cell as compared to 6T and 8T SRAM cell. 64-bit 9T SRAM cell covers large area on die as it consists of 624 transistors in which 216 transistors are PMOS and 408 transistors are NMOS while 64-bit 7T SRAM cell consists of 448 transistors in which 128 transistors are PMOS and 320 transistors are NMOS. Therefore, if the average power consumption also with the die area considers than 7T SRAM cell with CR performs well as compared to 9T SRAM cell but 9T SRAM cell shows better performance in terms of average power consumption than 6T, 7T, 8T SRAM cell designs.

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A Review on Security Issues in Cloud Computing

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ABSTRACT: The Cloud computing offers a distributed system over a network in which a program or any application run on many connected computers at the same time. Cloud computing is a hosted service in which an end user can access the cloud based applications through the browser or any mobile application. Though the cloud computing is a very vast and useful technology but there are still some challenges to be solved. Among all of these there are security issues. The security is most important impact of any software or any hardware. So this paper focuses on the security issues arising from the usage of Cloud services and security issues in different service models of cloud computing.

KEYWORDS: Cloud computing, Security, Issues, virtualisation, cloud system models.

1 INTRODUCTION

The technology with less resource uses and higher with output always attract the users. Cloud computing entice the users for the same. The Cloud computing offers a distributed system over a network in which a program or any application run on many connected computers at the same time [1]. Cloud computing in other words is the allegory of the internet [2]. The cloud service providers must certain about that they get the security flanks right, for they are the ones who will took the responsibility if things go wrong. Cloud system offers many benefits like fast deployment, pay-for-use, lesser costs, scalability, elasticity, ubiquitous network access, greater resiliency, hypervisor protection against network attacks, low-cost recovery and data storage solutions, on-demand security controls, real time detection of system tampering and rapid re-constitution of services [3]. The major advantage of cloud computing in which we can pay-for-use for any software i.e. if a user doesn't have a particular software that he wants to use say MS word, the user can use that particular software on the cloud system by paying for it. Cloud system consists of three service models based on the resource focus [4] i.e. SaaS, PaaS and IaaS. Software as a Service (SaaS) grants end users to use cloud applications. The Google application is good example of it. With Platform as a Service (PaaS), developer can develop applications using the programming languages and tools supplied by the cloud provider. And the last service model Infrastructure as a Service (IaaS) allows user to quickly regulate the physical resources for the applications and run any software ranging from operating systems to application software. Amazon and Amazon S3 are the best known examples. While the cloud offers spectacular advantages, but there are several security and trust issues yet to be resolved. Whether we design hardware or a software the security matters a lot. The designing of our any system is not worth if it is not secure. In the cloud system software there are also many security issues related to data and its service models.

2 TECHNICAL SECURITY ISSUES IN CLOUD COMPUTING

In this discussion, we present some security issues related to Cloud Computing. Each issue is explained briefly and tells how it gives impact on the cloud system technology.

2.1 XML SIGNATURE ATTACK

There are many protocols that use the XML Signature for their authentication and integrity process. To those protocols XML Signature attack is very common and called as XML Signature Element Wrapping [5]. As this type of attack applies on the web services so it's obvious that it is common in the cloud computing too. The initial message presents a message sent by a legitimate client. The body contains a request for the file signed by the sender. The Signature is enclosed in the message header and refers to the signed message. The message fragment use an X Pointer to that contain the value of "body". If an attacker eavesdrops such a message, he can perform the attack as followed. The original body of message is moved to a freshly inserted wrapping element (giving the attack its name) inside the message header, and a new body is created. This body contains the all operation the invader wants to perform with the original sender's authorization, here the request for the particular file. But the resulting message will still contains a valid signature of a legitimate user, thus the service executes the modified request. Since the original signature still exist in the message so the invader can easily access the information on the cloud and so can modify it.

2.2 BROWSER SECURITY

The main feature of Cloud, computation is that it can be accessed from anywhere remotely. The client computer used for authentication and for I/O and that computer further commands to the cloud for the further operation. So it is obvious that for accessing any system or a network the browser is a key point. With the focusing on the Same Origin Policy (SOP) [6], this document unfolds many shortcomings of browser security in cloud system. For this discussion we have to additionally take into account TLS, which is used for host authentication and encryption of data. The shortcomings in the Web browsers are that it cannot directly make XML Signature or XML Encryption. As Data can only be encrypted through TLS, and signatures are only used in the TLS handshake. In here the browser acts as passive data storage. Since the browser itself is unable to generate cryptographically valid XML tokens to authenticate against the Cloud, this is done with the help of a trusted third party. With the anatomises of scripting languages (as JavaScript) into Web pages, it became crucial to define access rights for these scripts. So it's a natural thing, the browser with same origin, [7] allows the operations of read/write operations and to disallow any access to content from a different origin.

2.3 CLOUD MALWARE INJECTION ATTACK

Among the vital attacks on the cloud system the malware injection attack is a considerable attack attempt aims at injecting a malicious service implementation into the Cloud system. Such type of Cloud malware serves for a particular purpose. The purpose of cloud malware is adversary that may be ranging from eavesdropping via minute data modification to full functionality changes or blockings. To create the adversary the malware needs to create its own implementation module (SaaS or PaaS) or virtual machine instance (IaaS), and add it to the Cloud system.

2.4 FLOODING ATTACKS

Outsourcing is a major aspect of Cloud Computing consists in basic operational tasks to a Cloud system provider. Among these basic tasks, maintenance of server hardware is the most important one. So instead of operating an own, internal data centre, the paradigm of Cloud Computing enables companies (Users) to rent server hardware on demand (IaaS). This approach is economically beneficial when it comes to dynamics in server load, as for instance day-and-night cycles can be attenuated by having the data traffic of different time zones operated by the same servers. No doubt the feature of providing more computational power on demand is appreciated in the case of valid users; it poses severe troubles in the presence of an attacker. The corresponding threat that arises or may arise is flooding attacks, in which basically an attacker sending a large amount of meaningless requests to a certain service. As each of these requests has to be processed by the service implementation in order to determine its invalidity; and due to this heavy load it causes a certain amount of workload per attack request, which creates flood of requests usually would cause a Denial of Service to the server hardware [8], [9]. In the specific case of Cloud Computing systems, the impact of such a flooding attack is expected to be amplified drastically. This is due to the different kinds of impact. Flooding of requests then further may lead to halt the running system and it makes easy to attack of denial of service. The denial of service is of two types direct and indirect [10].

3 MODEL BASED CLOUD SECURITY ISSUES

Cloud system consists of three delivery models that define the structure of the cloud system. Three models in cloud system are SaaS, PaaS and IaaS. SaaS stands for software as a service in which user can use the data from outsider boundaries of any enterprise. PaaS stands for Platform as a service that provides the platform for developing the applications on the cloud. The last one IaaS stands for infrastructure as a service which provides hardware support for cloud system. But these models also have some security holes that are discussed as follows in the paper.

3.1 DATA SECURITY ISSUES IN SOFTWARE AS A SERVICE (SAAS) MODEL

The SaaS mainly emphasising on replacing the old application software with the new ones instead of making the portability of application software in which the security functionality of software application is main focus [11]. . The main issue in SaaS is that the data is very sensitive because it is stored on the outside the boundary of enterprise. For security measures the client has to depend upon the provider in SaaS. Due to visibility of data of one another users, the provider must do something so that the data theft or loss is avoided. There is also another problem i.e. if a particular user needs the same file which is being used by another user at the same time but due to security measures the user cannot get that file.

3.2 SECURITY ISSUES IN PLATFORM AS A SERVICE MODEL (PAAS)

PaaS is more extensible than SaaS as it provides platform to develop the application but security is the main issue again. When PaaS provides people to build their applications on the higher level of platform, the provider must assured about inaccessibility of data between two applications.

3.3 SECURITY ISSUES IN INFRASTRUCTURE AS A SERVICE MODEL (IAAS)

IaaS deals in virtualisation and VMware. Any issues arise in VM May leads to delay in delivery of packets in upper model like PaaS and SaaS. Moreover IaaS has higher security management techniques and leads to less security holes in it [12].

Table 1 Comparative Study of Technical Security Issues in Cloud Computing

Security issues	Attack Definition	Impact on Cloud System	Countermeasures
XML Signature Attack	Insert new body to original message	Original data information changed	use secure coding
Browser Security	Data is stored passively so browser is unable to generate tokens of authentication	Leads to data loss	Use xml encryption in TLS
Malware Injection Attack	Malware creates its own implementation module and add it to cloud system	May leads to malicious service implementation and wrong code executed	Store hash values on original service instance's file and compare it with the hash value of file
Flooding	Execution of unnecessary requests sent by intruder	Full loss of availability to intended services	Allow only authenticated service to execute and use scheduling

Table 2: Comparative Study of Model Based Security Issues

Cloud System Models	Security Issue	Impact on Cloud System	Countermeasures
SaaS	Data is present on the external boundaries	Data theft may occur	Strong encryption technique should be used and use fine grained access
PaaS	During building applications on platform coding may intermix on cloud	Wrong code execution	keep eye on type of attack and avoid visibility of code
IaaS	Any problem in hardware may lead to late delivery of packets	Working of System may slow down	Strong security management so only hardware related threats may occur

4 CONCLUSION

As described in the paper, though there are extreme advantages in using a cloud-based system, there are yet many practical problems which have to be solved. Cloud computing is a disruptive technology with profound implications not only for Internet services but also for the IT sector as a whole. Still, several outstanding issues exist, particularly related security and privacy. As described in the paper, currently security has lot of loose ends which scares away a lot of potential users. Until a proper security module is not in place, potential users will not be able to leverage the advantages of this technology. In this paper, we presented a selection of issues of Cloud Computing security. We investigated ongoing issues with application of XML Signature and the Web Services security frameworks, discussed the importance and capabilities of browser security in the Cloud Computing context (SaaS), data security issues in SaaS, security issues in PaaS and we suggested some countermeasures to avoid the data loss and for making the cloud computing more secure.

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Potential climate change impacts on water resources in the Buyo Lake Basin (Southwest of Ivory Coast)

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ABSTRACT: The sensitivity of subtropical African river basins to possible future climate change is a matter of some concern. In Ivory Coast, previous works on climate change impacts predict a decrease in annual average water resource by the 2080s between 6.9% and 8.4%. This is a potentially serious issue because of a series of historical resource management decisions that have increased dependence upon water use, such as through major dam building schemes. This paper focuses upon the Buyo Lake catchment, a central resource for the Ivorian people with the aim of providing future water resource scenarios, under climate change so as to develop appropriate adaptation policies. The study applied simulations from the UKMO climate model, HadGEM1 from the ENSEMBLES project 2009, with the A1B emissions scenario in continuous simulation. Daily climate data such as rainfall, temperature, wind speed and relative humidity were input to the SWAT hydrological model. The simulations were performed after model calibration. Analysis focuses on the periods 1950-1979 (baseline), 2035-2064 (2050 horizon) and 2064-2093 (2080 horizon). The results showed that the entire basin of Buyo could experience a serious temperature elevation of +1.34°C by the 2050s and +3.87°C by the 2080s. A reduction in the available water resource is therefore projected. Thus precipitation is forecast to fall by c. 10.3 % in the 2050s and 14.9 % in the 2080s as compared to the baseline period. Evapotranspiration is expected to increase by 3.6% and 3.4% respectively for the 2050s and 2080s. Runoff is forecast to decrease about 27.7 % for the 2050s and 40.0% in the 2080s. Recharge to groundwater is also forecast to fall by 34.2 % to the 2050s and 45.8% to the 2080s. This could lead to the drying up of groundwater aquifers. These changes are potentially serious and emphasise the need to develop adaptation strategies to prepare for future climate change.

KEYWORDS: Climate change, Water, Modeling, Simulation, Buyo, Ivory Coast, Watershed.

1 INTRODUCTION

Water is one of the main current and future challenges facing Africa. The water supply from rivers, lakes and rainfall is not equally accessible, the natural geographical distribution is uneven and water consumption cannot be called sustainable. Climate change is likely to impose additional constraints on the availability and accessibility of water in terms of quantity and quality. In West Africa, the first simulations let glimpse a small variation in rainfall compared to the current rainfall. This decrease in rainfall greatly depending on the latitude, varies from 0.5 to 40% of the annual rainfall over the period 1961-1990. A downward trend in rainfall was observed from the late 1960s/early 1970s until the early 1990s [1], [2], [3], [4]. Deficits were estimated at 16% for tropical Africa, 16% in 1980s and 7% in the 1970s. The mean temperature and climate

variability are projected to increase, due to climate change. However, for the changes in mean rainfall, climate models do not yet provide consistent results [5]. There is evidence from meteorological observations and modeling that the total annual rainfall may decrease in the sub-humid regions in West Africa within the next decades. This applies also to the small West-African country Ivory Coast. In the 2080-2099 horizons, flows in West Africa, calculated based on the A1B emission scenario could fall to 50% [5]. According to [6], although forecasts regarding runoff and groundwater recharge vary greatly regionally following the anticipated changes in precipitation and materials according to climate models, most climate change scenarios indicate the decrease in flow and groundwater recharge in arid and semi-arid areas of West Africa. Thus, the river flows will decrease in proportions varying between 5 and 34% depending on the time horizons and countries [6]. The most vulnerable regions are mainly countries bordering the Gulf of Guinea [7]. It is important to note that these predictions have not 100% accurate, but give a coherent plausible future, with the choice of emission scenarios. However, recently studies using IPCC models on West Africa [8] by comparing the annual cycle and the trends observed and simulated precipitation and average monthly temperatures, we conclude that six (6) models best simulate observations of rainfall and temperature: CGCM3.1, GFDL-CM2.0, GISS-EH, GISS-ER and UKMO-HadGEM1. In Ivory Coast, research has highlighted the impacts of climate variability on water and the environment [9], [10], [11], [4], [12], [13], [14]. Thus, a gap of 21 % was observed in the rain [4]. The decrease in runoff can reach above 20% [5]. Specifically, the flow regime in the 2075 horizon of Sassandra at Piébly and Kahin (Western Ivory Coast) could decrease by 8.4% and 6.9% [15], [16]. These variations have negative effects on the hydrological cycle, and so upon environment and socio-economic activities. One of the major issues raised by research on a complex phenomenon such as climate change is to quantify its impact upon the hydrological cycle and water resources. Thus, in this study, it was discussed to assess the possible future impacts of climate change on water resources in Buyo Lake watershed with the SWAT model, using data from UKMO HadGEM1-A1B climate scenarios from IPCC ENSEMBLES project. UKMO HadGEM1 climate model has never been applied especially to Buyo Lake basin. This study is the first trial to evaluate possible impacts of climate change upon water balance under A1B emission scenario.

2 MATERIALS AND METHODS

2.1 STUDY AREA

The study area is located in the South-western Ivory Coast between latitude 5°57' and 8°26' North and longitudes 6°45' and 7°51' West (Figure 1). The basin is located in the Guinean climate zone and its surface is estimated at about 24,560 km². This zone has two equatorial rainfall maxima (June and September) and belongs to the whole Sassandra River watershed. On average, this watershed has between 2,000 to 2,500 mm of precipitation per year [17]. The main geological groups are composed of amphibolite, anorthosite, gneiss, granitoid, itabirite, metasediments, migmatite, metavulcanite and schists. The basin is composed of four (4) main soil types: brown soils, lateritic soils highly desaturated, hydromorphic lateritic soils and lateritic soils moderately desaturated [18]. These types of soils favor the development of agriculture.

2.2 MATERIALS

The first data to use was the Digital Elevation Model (DEM) (Figure 2). The DEM is from the UTM projection, Zone 30, Northern Hemisphere resolution of 93 meters. It is obtained by downloading from the internet web site: <http://srtm.csi.cgiar.org/SELECTION/inputCoord.asp>. It is used to delineate the basin, to subdivide the basin into subbasins and to extract the hydrographic network. The land use map used in this study is for the year 2000 at the scale 1/200 000 (Figure 3), was provided by the CCT (Centre for Mapping and Remote Sensing), a specialized Ivorian Establishment in the map design. Eight major classes are so identified. The dominant classes are Agricultural land (42.30%), Range-Brush (29%) and Forest-Mixed (17.22%) [19]. The soil map (figure 4) was obtained mainly from the Harmonized World Soil Database (HWSD) developed by the Food and Agriculture Organization of the United Nations (FAO-UN) [20]. Twenty three units of soil are then extracted and completed by additional informations from literature and national soil documents. The hydro meteorological data used in this study are the maximum and minimum temperature, precipitation, relative humidity, solar radiation and wind speeds with a daily time step both for the SWAT calibration model and the prospective simulation by using the UKMO-HadGEM1 climate model. The SWAT calibration data were obtained throughout the <http://globalweather.tamu.edu/SWAT> web site (Figure 5). These data cover the period 1980-2010. The data for the prospective simulation with 1.875° x 1.25° as resolution, were obtained from the website: <http://cera-www.dkrz.de/WDCC> and were calculated by using the UKMO-HadGEM1 climate model. The periods are: the baseline period (1950-1979), 30 years, representing the past climate and periods representing future climate over the medium term (2035-2064) and long term (2064-2093). From a strictly global view, the scientific community has identified the period 1961-1990 as baseline period. This choice is based primarily on the fact that climatic conditions during this period are relatively stable. In hydrology, we do not find such a consensus on the choice of a baseline period. In the literature, climate and hydrological conditions of the present time are calculated for a

range of reference periods [21]. As daily data observations of temperature and rainfall were available for 1950-1979, we chose this period as the baseline.

2.3 METHODOLOGY

The method employed is based on the SWAT hydrologic model that uses data from climate model UKMO-HadGEM1 as input. The hydrological model SWAT (Soil and Water Assessment Tool), developed by the "United States Department of Agriculture (USDA), Agricultural Research Service" is a tool for water management in the watershed. It is a semi-distributed, semi-physical and semi-empirical model, which operates at a daily time step [22]. SWAT allows: (1) integrated water management (quantity and quality), (2) management of agricultural practices, (3) simulation of large, heterogeneous watersheds, (4) management of surface water and groundwater and (5) modeling processes related to sediment, nutrients and pesticides. SWAT is used worldwide and is supported by a broad scientific community. It is coupled with a GIS (Geographical Information System) with ArcView GIS 3.2a or Arcgis 9.x of ESRI, which allows:

- Easy access to variables and parameters, as spatio-temporal data can be pretreated; design input files and visualization of spatial outputs;
- A spatial emissions and transfers of pollutants, enabling prioritization of areas according to a sensitivity criterion or a degree of action priority. In addition, its source code is freely available.

SWAT includes a hydrological component based on the water balance equation (1):

$$SW_t = SW_0 + \sum (R_{day} - Q_{surq} - E_a - W_{seep} - Q_{gw}) \quad (1)$$

With, SW_t = final quantity of water in the ground (mm), SW_0 = initial amount of water in the soil (in mm), R_{day} = total precipitation (mm), Q_{surq} = total runoff (mm), E_a = Total evapotranspiration (mm), W_{seep} = amount of water within the soil unsaturated area (mm), Q_{gw} = amount of water returning to the ground (mm)

The methodology used in this study can be summarized in (2) major steps: **(1) SWAT hydrological model calibration; (2) SWAT hydrological model projection with HadGEM1-A1B climate model:** (a) data preparation for the prospective simulation; (b) correction of bias in the climate model UKMO-HadGEM1; (c) preparation of the SWAT hydrological model projection database; (d) simulation with model calibrated parameters; and (e) analysis of the potential impacts of climate change upon water resources.

2.3.1 SWAT HYDROLOGICAL MODEL CALIBRATION

To run SWAT model, we need daily maximal and minimal temperature, precipitations, relative humidity, wind speed and solar radiation. The calibration was done with the SWAT-CUP (SWAT-Calibration Uncertainty Program). The Calibration parameters is automated by SUFI2 (Sequential Uncertainty Fitting version 2) from [23], an integrated method in SWAT-CUP program. Sixteen (16) parameters were then used in this study taking into account the literature on the use of SWAT model in the tropics [24]. The parameters used concern those related to flow. These parameters are: CN2 (curve number 2) ALPHA_BF, GW_DELAY, GW_QMN, GW_REVAP, ESCO, CH_N2, CH_K2, ALPHA_BNK, SOL_AWC, SOL_K, SOL_BD, SURLAG, SLSUBBSN, EPCO and REVAPMN:

- CN2: the SCS curve number is a function of soil permeability, land use and historical soil water status. SCS defines three antecedent moisture conditions: I-dry (wilting point), II-average moisture, and III-wet (field capacity on the ground). CN2 is the moisture condition II (medium moisture);
- ALPHA_BF: base flow factor in days: constant base flow recession, α_{gw} is a direct index of the response of the groundwater flow in the evolution of recharge [25];
- GW_DELAY: Groundwater delay in days. This time cannot be directly measured. It is estimated by simulation comparing simulated and observed variations in groundwater;
- GW_QMN: Threshold depth of water in the shallow aquifer required for the resurgence of flow (mm);
- GW_REVAP: Evaporation Coefficient of groundwater;
- ESCO: Soil evaporation compensation factor: that coefficient has been incorporated to allow the user to modify the depth distribution; it is used to compensate the evaporation of soil application and take into account the effect of capillarity, scabs and cracks;
- CH_N2: Manning coefficient for the main channel;
- CH_K2: Effective hydraulic conductivity in main alluvium channel;

- ALPHA_BNK: coefficient of depletion in the rivers banks;
- SOL_AWC: available water capacity of the soil layer;
- SOL_K: soil hydraulic conductivity at saturation;
- SOL_BD: soil wet density;
- SURLAG: response time of the watershed
- SLSUBBSN: Average slope length (m);
- EPCO: evapotranspiration compensation factor for plant uptake as a function of depth;
- REVAPMN: Threshold evaporation from groundwater (mm)

SUFI2 is a method whose implementation in the field of hydrological modeling involves several steps (Figure 6):

Step 1: In the first step, an objective function is defined. SUFI2 gives us the possibility of using the objective function of our choice between R^2 , Chi2, NS, R^2 multiplied by the line regression coefficient b, bR^2 , SSQR (sum of squared errors) coefficients. In this study we chose the NS and R^2 coefficients. NS has allowed us to assess the strength of the model predictions and R^2 indicates the correlation between the model simulations and observed values. Two other factors have also been used, R factor and d factor to analyze uncertainties in the simulations;

Step 2: It is to choose the physically meaningful values of the parameters to be optimized, between a minimum and maximum value. There is no theoretical basis for the exclusion of a particular distribution. However, due to the lack of information, we assume that all parameters are uniformly distributed in a region bounded by the minimum and maximum values, they must be as wide as possible, but physically significant (2):

$$bj: b_{j, \text{abs_min}} \leq bj \leq b_{j, \text{abs_max}} = 1 \dots m, \quad (2)$$

where b_j is the j^{th} parameter and m is the number of parameters to be estimated.

Step 3: Following step 2, the Latin Hypercube sampling method [26] is carried out, leading to the desired combination of n simulations. This number must be relatively large (about 500-1500). The simulation program is then executed n times and the simulated output variables of interest, corresponding to the measurements are recorded.

Step 4: In this step, the objective function, g, is calculated.

Step 5: here, is calculated the overall sensitivity of each parameter in each simulation. First, the sensitivity matrix J, of g (b) is calculated using:

$$J_{ij} = \frac{\Delta g_i}{\Delta b_j} \quad i=1, \dots, C_2^n, \quad j=1, \dots, m \quad (3)$$

Where C_2^n is the number of lines of the sensitivity matrix (equal to all possible combinations of two simulations) and j is the number of columns (number of parameters).

Then, the equivalent of a Hessian matrix, H is calculated according to the Gauss-Newton and neglecting higher order derivatives as:

$$H = J^T J \quad (4)$$

Based on the Cramer-Rao theorem [27], an estimate of the lower bound of the parameters covariance matrix, C, is calculated from:

$$C = S_g^2 (J^T J)^{-1} \quad (5)$$

Where S_g^2 is the variance of the values from the objective function resulting from n simulations.

The sensitivities of the parameters were calculated according to the system of multiple regressions, which regresses the parameters generated by the "Latin Hypercube" sampling against the values of the objective function:

$$g = \alpha + \sum_{i=1}^m \beta_i b_i \quad (6)$$

A statistical test is then used from the relation (6) to identify the relative importance of each parameter b_i which is the sensitivity parameter.

Step 6: In this step, measures assessing uncertainties are calculated. The calculations are concerning the d factor and R factors. They are calculated at 2.5% (Xl) and 97.5% (Xu) percentile of the cumulative distribution of each point simulated. The goodness of fit is assessed by the uncertainty measurement calculated from the percentage of measured data framed by the minimum and maximum values of the '95PPU (95 percent prediction uncertainty which represents the d factor)', and the average distance between the top and bottom of 95PPU determined from:

$$dx = \frac{1}{k} \sum_{i=1}^k (Xu - Xl) \quad (7), \text{ where } k \text{ is the number of observed data points.}$$

The best result is that 100% of the measurements are covered by 95PPU, and close to zero. However, due to measurement errors and uncertainties in the model, the ideal values are generally not achieved. A reasonable measure of d factor, based on our experience, is calculated by the R factor expressed as:

$$R\text{factor} = \frac{dx}{\sigma_x} \quad (8), \text{ where } \sigma_x \text{ is the standard deviation of the measured d.}$$

A value less than 1 is a desirable measure for the R factor. The calibration was done on the period from 1985 to 1988, about four years. The overall application of the SUFI2 algorithm can be summarized as in figure 6.

To use the calibrated model to estimate the impact of climate change on the flow, the model was validated by trying to reproduce monthly flows observed over a period which has not been used for calibration. The periods chosen for validation are 1989-1992 for the wet period, and 1994-1999 for dry period. The performance of SWAT was evaluated using statistical and stochastic measures to determine the quality and reliability of predictions compared to observed values. Statistical measures used are R^2 (relation 9) and the Nash-Sutcliffe (NS) coefficients (relation 10). To these coefficients were added stochastic parameters (uncertainty) associated with random events such as rain. These parameters are the d factor and the R factor. A model is said to be perfect if the values of R^2 and NS are 1. However, because of errors due to uncertainties in the measurements, it is impossible to reach this value. Thus, some authors [28], [29] consider that NS and R^2 values above 0.5 are acceptable. The theoretical values of the d factor are between 0 and 100%, while those of the R factor are between 0 and infinity. A d factor of 1 and an R factor of zero indicate that the simulation exactly corresponds to the measured data. The degree to which we are far from these figures can be used to assess the robustness of our calibration. A larger d factor can be achieved against a bigger R factor. Thus, often, a balance must be struck between the two so that the simulation is acceptable [23].

$$R^2 = \frac{\left(\sum_{i=1}^n (Y_o - Y_m)(Y_s - Y_{sm}) \right)^2}{\sum_{i=1}^n (Y_o - Y_m)^2 \sum_{i=1}^n (Y_s - Y_{sm})^2} \quad (9)$$

Y_o : observed value

Y_m : observed mean value

Y_s : simulated value

Y_{sm} : average simulated value

$$NS = \frac{\sum_{i=1}^n (Y_o - Y_m)^2 - \sum_{i=1}^n (Y_s - Y_m)^2}{\sum_{i=1}^n (Y_o - Y_m)^2} \quad (10)$$

2.3.2 SWAT HYDROLOGICAL MODEL PROJECTION WITH HADGEM1-A1B CLIMATE MODEL

Data (minimum and maximum temperature, precipitation, wind speed, daily relative humidity) from the UKMO-HadGEM1 model were available with a $1.875^\circ \times 1.25^\circ$ resolution (figure7). These netcdf formats data were converted to .dbf using the tool "Multidimension Tool" of ArcGIS.

Climate models contain bias (Figure 8). Then, these biases were corrected following [30]:

$$T_{d,m}^{scen} = T_{d,m}^{obs} + (T_m^{GCMscen} - \bar{T}_m^{GCMcon}) \quad (11)$$

$$P_{d,m}^{scen} = P_{d,m}^{obs} \cdot \left(\frac{\bar{P}_m^{GCMscen}}{\bar{P}_m^{GCMcon}} \right) \quad (12)$$

$T_{d,m}^{obs}$ and $P_{d,m}^{obs}$ are daily observed temperatures and precipitation, \bar{T}_m^{GCMcon} and \bar{P}_m^{GCMcon} are the average monthly temperature and rainfall from climate model in the baseline period, $T_m^{GCMscen}$ and $P_m^{GCMscen}$ are the average monthly temperature and rainfall from climate model in the future, $T_{d,m}^{scen}$ and $P_{d,m}^{scen}$ are respectively the scenario daily temperatures and precipitation after correction.

After bias correction, the next step of the study was the preparation of the database required to run the SWAT prospective model for the periods 1950-1979 (baseline), 2035-2064 (2050 horizon) and 2064-2093 (2080 horizon). The new database prepared, helped to reconfigure the watershed; and the SWAT prospective model was run one time on the three periods above, using the calibrated parameters from SWAT hydrological calibration (table 1) to assess the possible impacts of the climate change upon the water resources. This section concerned the analysis of potential impacts of climate change on the main components of the water balance *i.e.* precipitation, actual evapotranspiration, runoff and infiltration in the watershed. Indeed, once the simulation is completed, annual and interannual average outputs of these components were exported to Excel to build graphs needed to interpret the results. The analysis focused on interannual averages of the main water balance components listed above.

Table 1. Rank and optimal values of calibrated SWAT parameters

Rank	Parameter	Parameter Name	Lower bound	Upper bound	Optimal value given by SWAT
1	CH_N2	Manning's "n" value for the main channel	-0.01	0.3	0.0653
2	SURLAG	Surface runoff flag time	0.05	24	0.476
3	CN2	SCS runoff curve number	35	98	37.47
4	REVAPMN	Threshold evaporation from groundwater (mm)	0	500	0.0519
5	ALPHA_BNK	Baseflow alpha factor for bank storage	0	1	0.062
6	CH_K2	Effective hydraulic conductivity in main channel alluvium.	-0.01	500	19.356
7	GW_REVAP	Groundwater "revap" coefficient	0.02	0.2	0.0675
8	SLSUBBSN	Average slope length	10	150	10.285
9	SOL_K	Saturated hydraulic conductivity	0	2000	0.5139
10	ESCO	Soil evaporation compensation factor	0	1	0.8102
11	EPCO	Moist bulk density	0	1	0.6065
12	GWQMN	Treshold depth of water in the shallow aquifer required for return flow to occur (mm)	0	5000	0.4364
13	SOL_AWC	Available water capacity of the soil layer	0	1	0.3531
14	ALPHA_BF	Baseflow alpha factor (days)	0	1	0.0448
15	SOL_BD	Moist bulk density	0.9	2.5	1.5635
16	GW_Delay	Groundwater delay (days)	0	500	415.20

3 RESULTS

3.1 SWAT HYDROLOGICAL MODEL CALIBRATION

A sensitivity analysis was first applied to the sixteen parameters. The results of the sensitivity analysis showed that the most sensitive for the swat model station N'Zo Kahin parameters are: the manning coefficient for the main channel (CH_N2), the response time of the watershed (SURLAG), the scs curve number (CN2) (figure 9a). at piébli station, the most sensitive parameters are the CH_N2, the SURLAG, CN2 (figure 9b). we note from these two graphs figures that the CH_N2, SURLAG and CN2 parameters are most sensitive to flow at the both stations. Thus, the flow is more dependent on hydraulic characteristics of the catchment area. Against by, the GW_Delay, ALPHA_BF, SOL_AWC and GWQMN parameters that govern groundwater flow are less sensitive and influence very little water flow. Once the most sensitive parameters identified, the calibration was performed. The calibration model was performed with 1500 iterations. Then the calibration parameters were used to calibrate the model. The result of the calibration of monthly flow at N'zo Kahin station over the period (1985-1988) shows a correlation coefficient R^2 of 0.89, a Nash coefficient equal to 0.87 (Figure 10), a R factor equal to 0.37 and a d factor of 0.32 . At Piébli station, the result of calibration in the same period indicated a Nash of 0.80 and a correlation coefficient R^2 of 0.82 with R factor and d factor, respectively equal to 0.46 and 0.34 (figure 11). At the wet validation period (1989-1992) (Figure 12), the results obtained at N'zo Kahin station indicates Nash 0.79, an R^2 coefficient of 0.80, with an R factor of 0.39 and 0.21 as d factor. The validation of the hydrological model at Piébli station in wet period gave Nash coefficient of 0.40 and a correlation coefficient R^2 of 0.46 (Figure 13). The measurement uncertainties were evaluated using the R factor and the d factor respectively equal to 0.31 and 0.50. Then the hydrological model was validated on the dry period (1994-1999) to show the ability of SWAT to simulate the climate variability. The result of the validation of the hydrological model in dry period (1994-1999) (Figure 14) gave at N'zo Kahin station a Nash of 0.63 and a correlation coefficient R^2 of 0.65. The evaluation of

uncertainties in model predictions gave a d factor of 0.40 and an R factor of 0.64. Statistical and stochastic (uncertainty) evaluation of the model is summarized in Table 2. Statistics have shown that there is generally a good correlation between the observed and simulated monthly flow during the calibration and the validation. At Piébli station, Nash and R^2 coefficients are greater than 0.50 in calibration; but during validation, they are slightly lower than 0.50. However, overall, the results could be acceptable and used for planning and protection of water resources of the basin. Indeed, we can say that the SWAT model has been successfully applied in the basin of Buyo Lake in terms of flow calibration.

Table 2. Summary of evaluation criteria

Stations			N'ZoKahin				Piébli			
	N'Zo Kahin	Piébli	NS	R^2	d Factor	R Factor	NS	R^2	d Factor	R Factor
Calibration	1985-1988	1985-1988	0.89	0.87	0.32	0.37	0.80	0.82	0.34	0.46
Validation (wet period)	1989-1992	1989-1991	0.79	0.80	0.21	0.39	0.40	0.46	0.31	0.50
Validation (dry period)	1994-1999	-	0.63	0.65	0.40	0.64	-	-	-	-

3.2 SWAT HYDROLOGICAL MODEL PROJECTION WITH HADGEM1-A1B CLIMATE MODEL

The temperature changes in the Buyo basin was also treated and gives an overview of the monthly cycle variations of temperature over the 2035-2064 and 2064-2093 horizons (Figures 15 and 16). Indeed, the 2035-2064 horizon, the differences between the average monthly temperatures and those of 1950-1979 are between 25 and 27.2°C, a change from 0 to 1.34°C. The estimated monthly temperature is up to 27.2 °C. The most significant variations are observed in January (1.19°C), March (1.21°C) and December with 1.34°C.

In the 2064-2093 horizon, temperatures estimated by the SWAT model are between 27 and 28.5°C. The variations could be between 0.83 and 3.87°C. The largest variation is in the month of September, which is also the hottest month with an average monthly temperature of 28.5°C. The estimation of the water balance was made for the entire watershed of Buyo Lake. The main parameters namely precipitation (P), actual evapotranspiration (ETR), runoff (R) and infiltration (I) were taken into account. The results of the evolution of the interannual average parameters in the basin for the baseline (1950-1979), 2050 and 2080 horizons are presented in Figure 17. The figure shows that overall, rain, runoff and infiltration decrease for the 2050s and 2080s. In terms of rain, there is a progressive decrease from 1449 mm for the reference period to 1300 mm for the 2050s and 1233 mm for the 2080s, 10.3% and 14.9% respectively. For both of the 2050s and the 2080s, there is an increase in evapotranspiration, rising by 3.6% to the 2050s and 3.4% to the 2080s. The latter is surprising, but it suggests that by the 2080s, the forcing of evapotranspiration rates by temperature rise becomes limited by the availability of precipitation and suggesting a fundamental shift in the hydrology of the basin by the end of the period. The net result is a progressive rise in the percentage of rainfall lost by the basin through evapotranspiration from 59.3% in the baseline period to 68.5% on the 2050s and 72.1% in the 2080s. Given this increase loss by evapotranspiration, it is not surprising the Figure 17 shows systematic reductions in both runoff and groundwater recharge (Figure 17), which decreases from an average of 339.8 mm in the reference period to 245.6 mm in the 2050s and to 204.0 mm in the 2080s. Similarly, groundwater recharge decreases markedly from 249.9 mm in the baseline period to 164.5 mm in the 2050s and 135.4 mm in the 2080s. The focus on mean changes in Figure 17 overlooks interannual variability which may be more important in terms of climate change adaptation. Figure 18 shows the frequency distribution for the baseline, 2050s and 2080s. The graph shows an important distinction between the 2050s and 2080s. By the 2080s, there is a systematic shift in the frequency distribution: that is all years have less rainfall. But, for the 2050s, it is mainly the drier years that become drier, with the wetter years experiencing less change and the most extreme, wettest years, not changing at all. The frequency distribution for evapotranspiration shows that the major changes in evapotranspiration occur between the baseline period and the 2080s but that also the increases in evapotranspiration tend to be greater at frequencies where the evapotranspiration is lower. This confirms that the years with the most extreme evapotranspiration do not see increases in evapotranspiration because these are already limited by available precipitation. The frequency distribution for runoff clearly reflects the changes in precipitation. It shows that between the baseline period and the 2050s, there is an increase in the inter-annual variability of runoff: that is, there is an increase in the number of years with very low runoff. But, it is still possible to have years with relatively high runoff. By the 2080s, runoff in all years has decreased such that the inter-annual variability has returned to levels typical of the baseline period. It should be emphasized that this change is important in terms of water resources. It is possible that for the 2050s, adaptation to those years when there is runoff reduction compared to normal is possible because there remains the possibility that there will be more normal wetter years that follow. However, by the 2080s, all years experienced substantial runoff reduction with approaching 60% of years in the 2080s having less runoff than the year with the smallest runoff in the

baseline period. Groundwater recharge has similar results to those for runoff: there is an initial increase in inter-annual recharge variability to the 2050s, associated with more years when there is less recharge. This then falls to the 2080s as all years show a decrease in recharge. Given that groundwater stocks are slowly replenished, groundwater systems can commonly average out interannual variability, which means that the changes to the 2050s may be less serious than the 2080s when a systematic decrease in groundwater recharge is forecast for all years.

4 DISCUSSION

The analysis of the temperature under the A1B scenario gave variations between 0 and +1.34°C for the period 2035-2064 and +0.83 to +3.87°C in the period 2064-2093. The monthly average temperatures could be affected rising to reach 29°C. This result shows that the watershed could be warm. The temperature variations obtained under 2050s horizon remain well below those of the 2080s horizon. The results of this study confirm those from [7] on the Comoé watershed (Ivory Coast) using the A1B scenario. Thus, according to this author, the 2091-2100 horizon, the expected changes in temperature would be more marked. Indeed, the average monthly differences between the horizon 2091-2100 and the period 1991-2000 will be higher than the 2031-2040 horizon and will be all above 2.8°C. Maximum variations (4.8°C) could be reached. The average annual variation in this horizon is 3.6°C. In addition, the temperature increases calculated in this study are consistent with those provided by [5] and [31] through climate models that global temperature could increase up 1.4 to 5.8°C by 2100s. Most alarmist projections even announce that these increases could reach up to 6.4°C by 2100 [5]. The analysis of potential impacts of climate change on the water balance for the 2050s and 2080s was conducted using the emission scenario A1B climate model UKMO-HadGEM1. The results of this study showed that the entire watershed of Buoy Lake could experience a serious change in available water resources. The clearest driver behind this is the forecast precipitation decrease in a basin that due to its geographical location has a very high evapotranspiration rate. Whilst the evapotranspiration rate is forecast to increase, it becomes limited by the declining precipitation in the 2080s scenario. These results are consistent with those from previous work. Indeed, in the domain of major rivers flows, a decrease is observed. By the 2080s, flows in West Africa, calculated based on the A1B emission scenario could fall to 50% of baseline levels [5]. The most vulnerable regions are mainly countries bordering the Gulf of Guinea [7]. The modeled decrease is consistent with the results from [32] in the Senegal for the Gambia and Sassandra watersheds, and [16] in the Bandaman (Ivory Coast) watershed and [7] for the Comoé watershed (Ivory Coast).

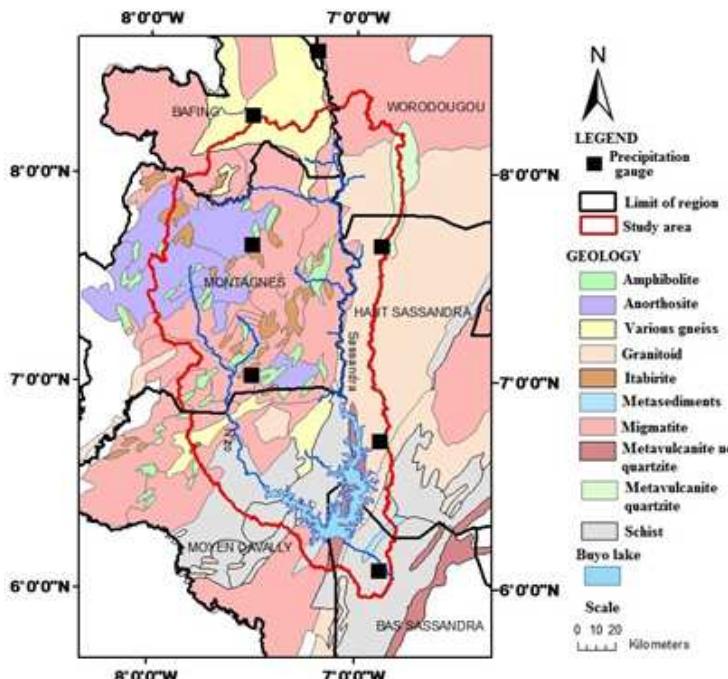


Fig. 1 Buoy Lake Basin

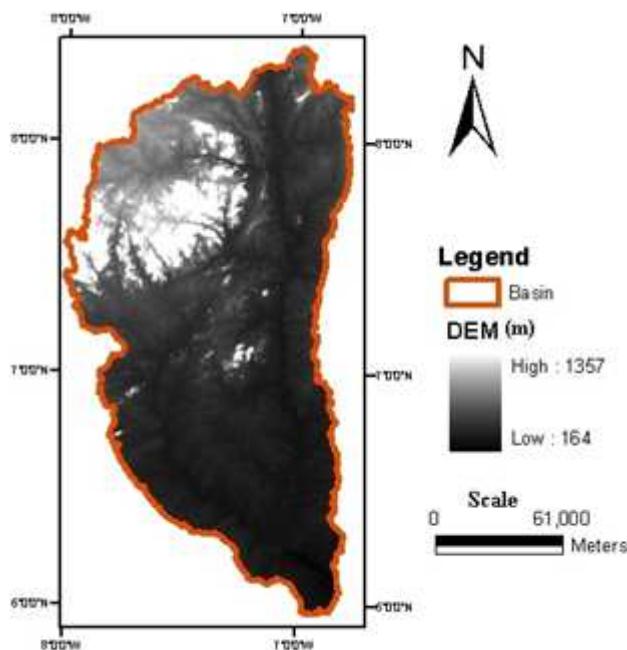


Fig. 2 Digital Elevation Model (DEM) of the watershed

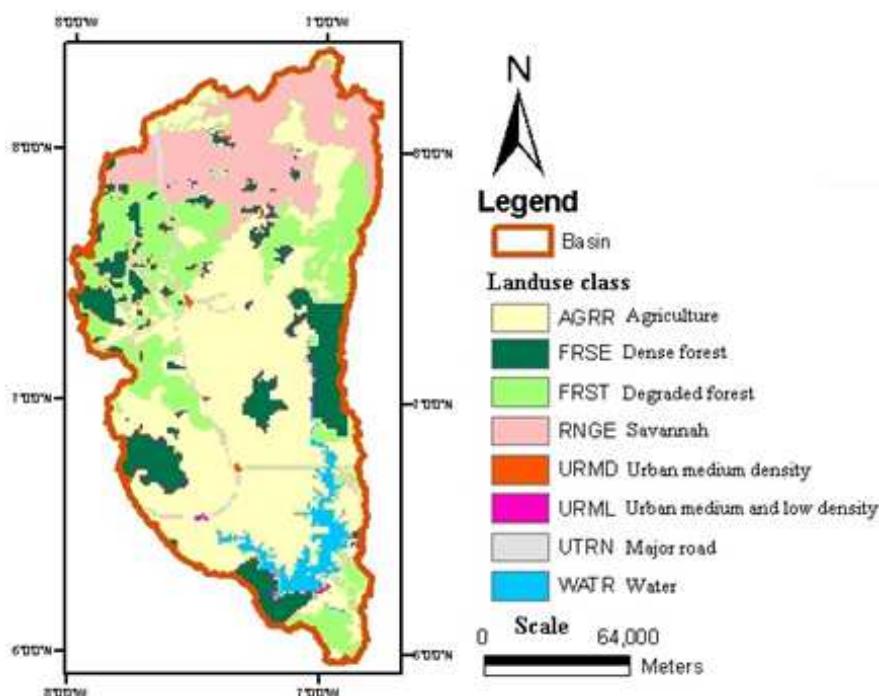


Fig. 3 Land use map of the Buoy Lake watershed

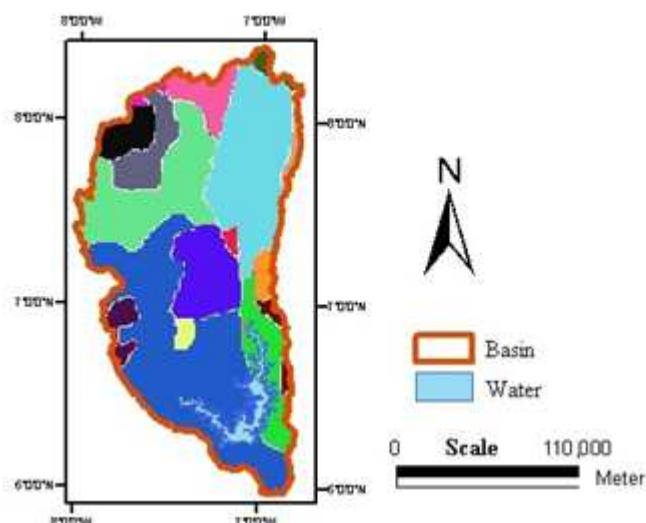


Fig. 4 Soil map of the study area

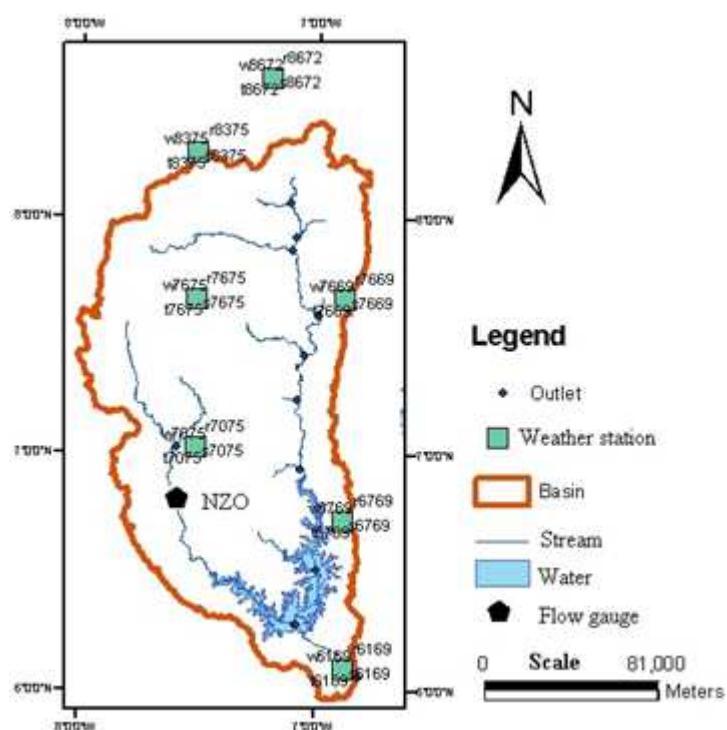


Fig. 5 Location of weather station and flow gauge



Fig. 6 calibration procedures using the method in the interface SUFI2 SWAT-CUP (Modified Abbaspour, 2011)

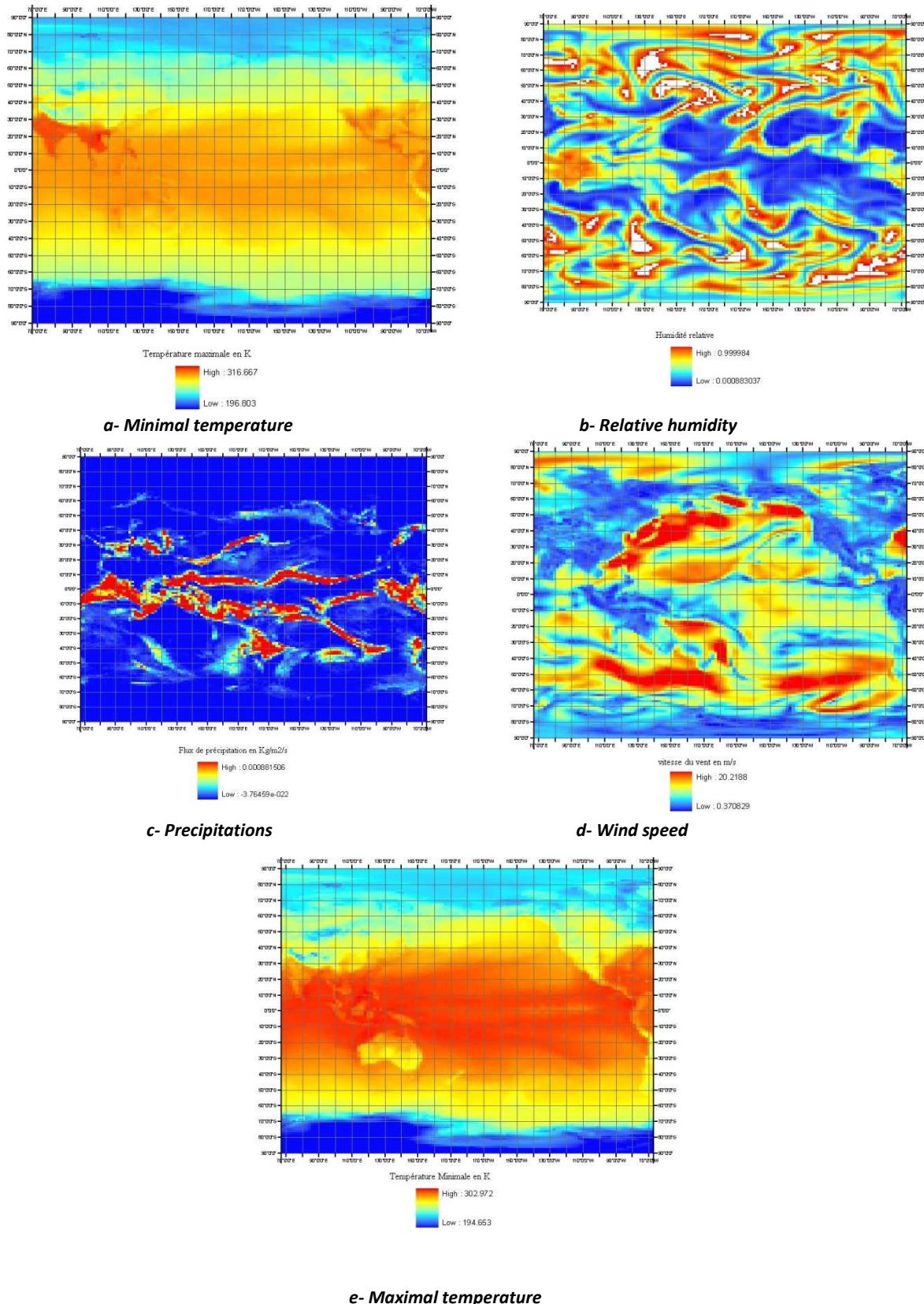
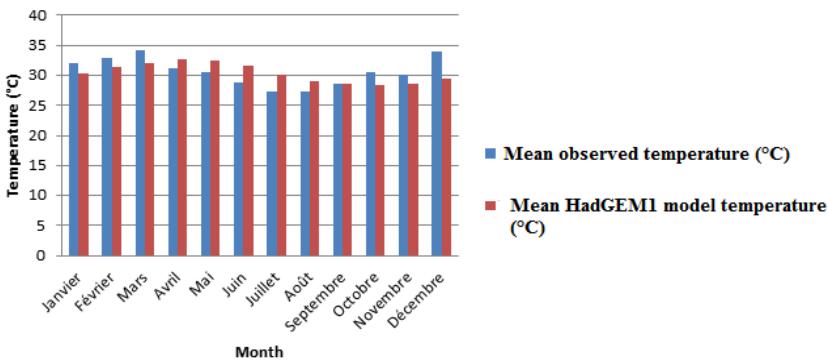
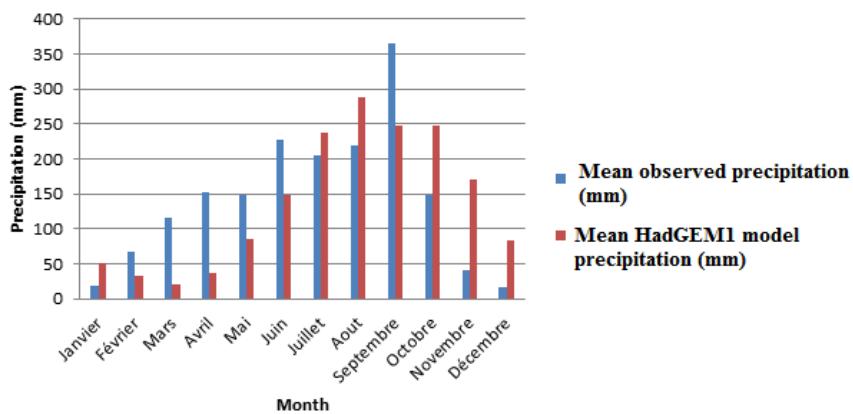


Fig. 7 Climate Data to NetCDF from climate model UKMO-HadGEM1

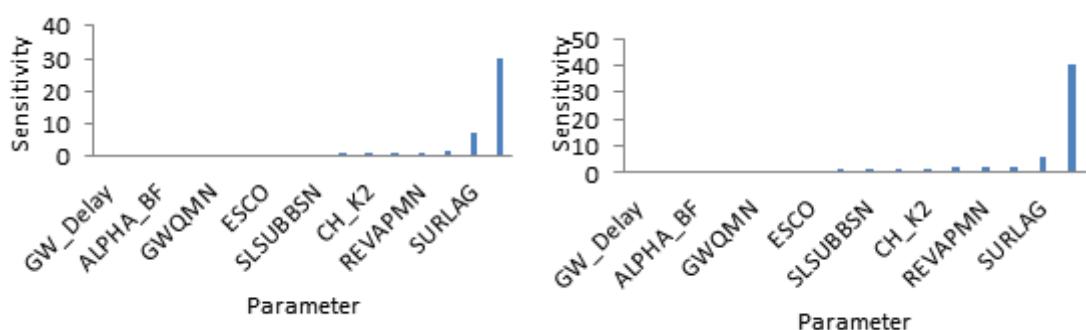


a- Comparison between temperature values from the model and those HadGEM1 observation Watershed Lake Buyo



b- Comparison between rainfall values from the model and those HadGEM1 observation Watershed Lake Buyo

Fig. 8 Highlighting HadGEM1climate model bias in the watershed of Lake Buyo



a. Sensitivity parameters to the station N'zo Kahin b. Sensitivity parameters to the station Piébli

Figure 9 Sensitivity of flow parameters

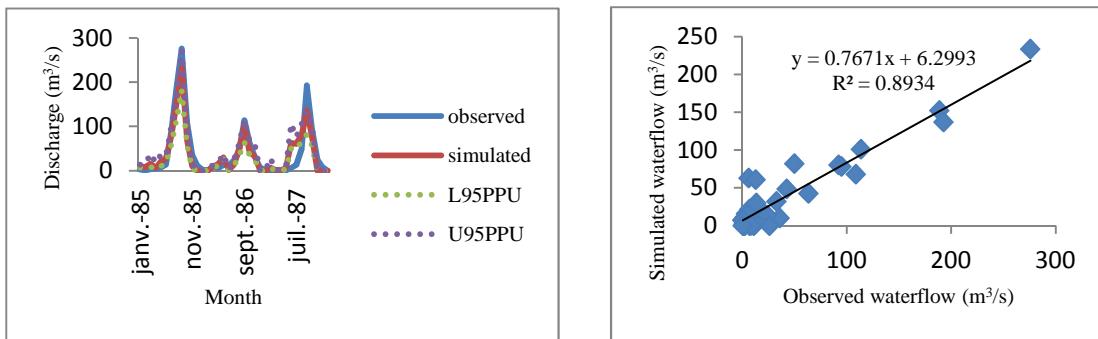


Fig. 10 Calibration of the monthly flow at the gauging station N'Zo Kahin

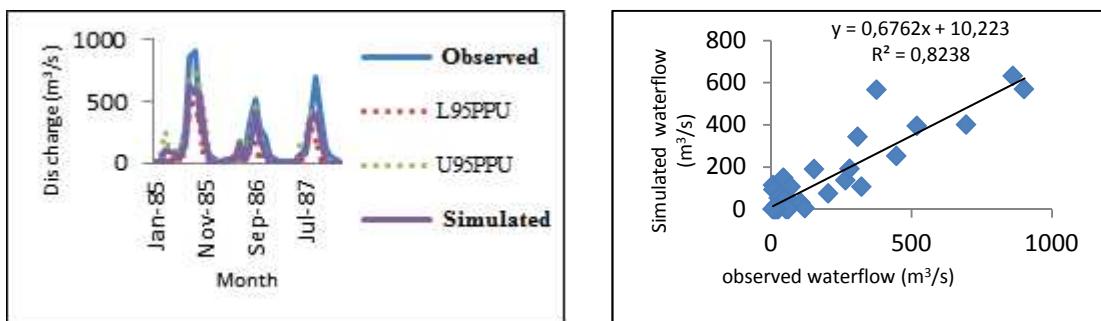


Fig. 11 Calibration of the monthly flow at the gauging station Piébli

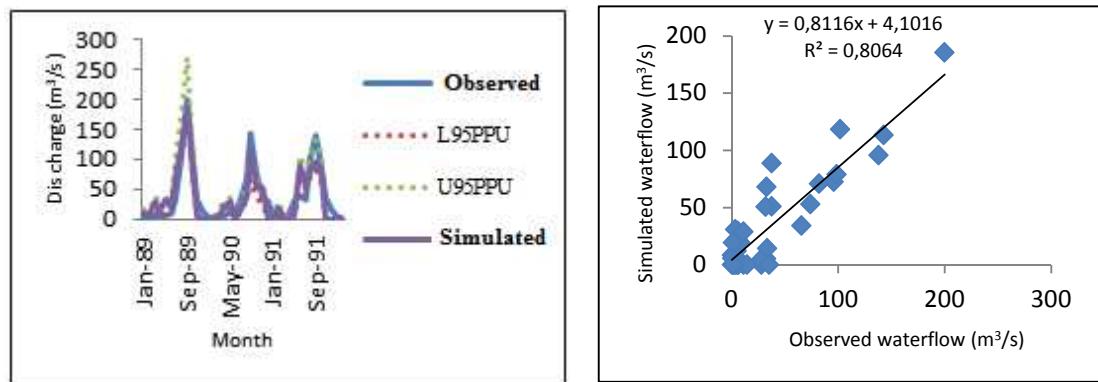


Fig. 12 Validation of the monthly flow at the gauging station N'Zo Kahin wet period (1989-1992)

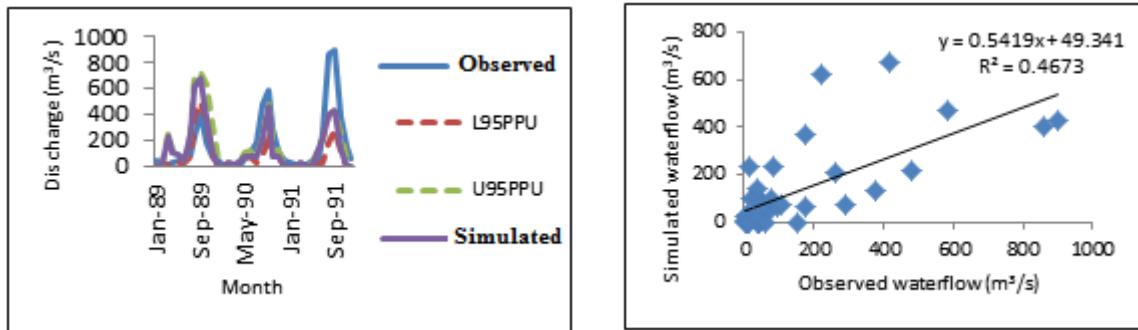


Fig. 13 Validation of the monthly flow gauging station Piébli wet period (1989-1992)

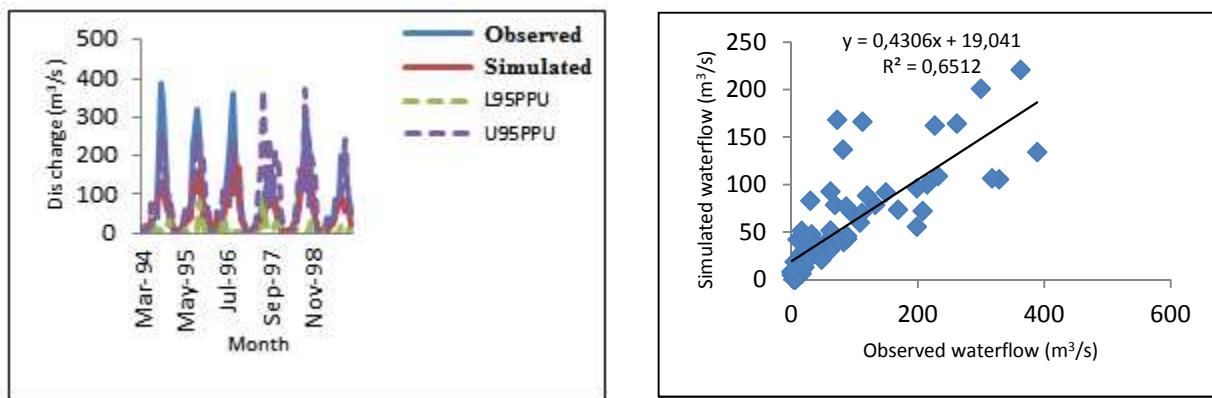


Fig. 14 Validation of the monthly flow gauging station N'Zo dry period (1994-1999)

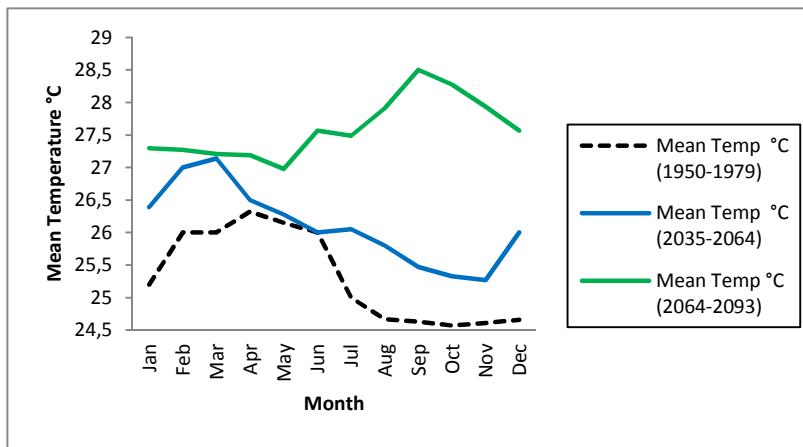


Fig. 15 Evolutions average monthly temperatures in the watershed of Lake Buyo over the period from 2035 to 2064 and from 2064 to 2093

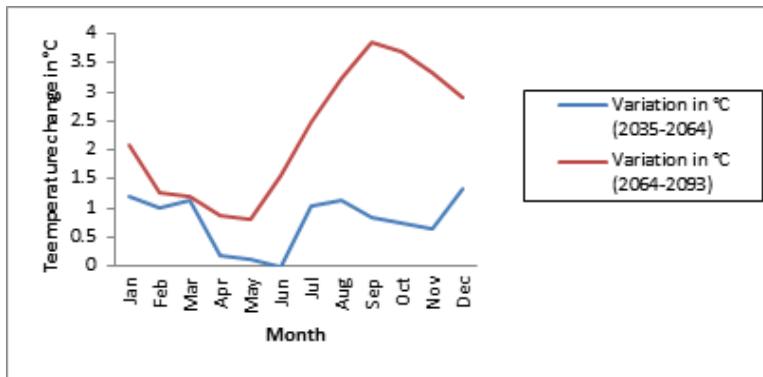
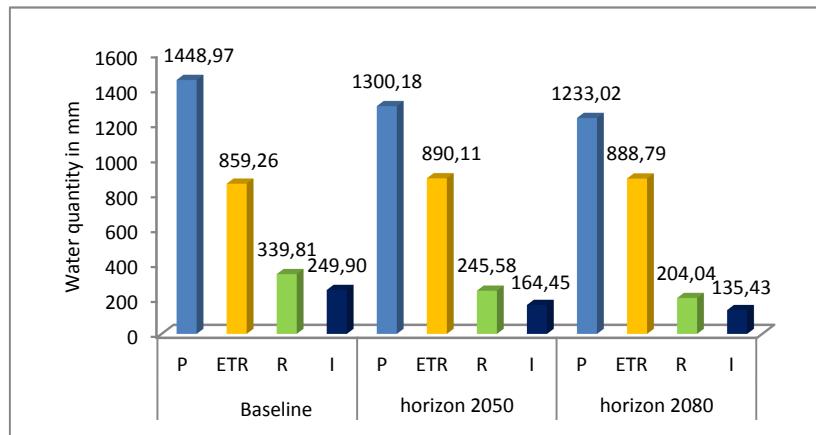
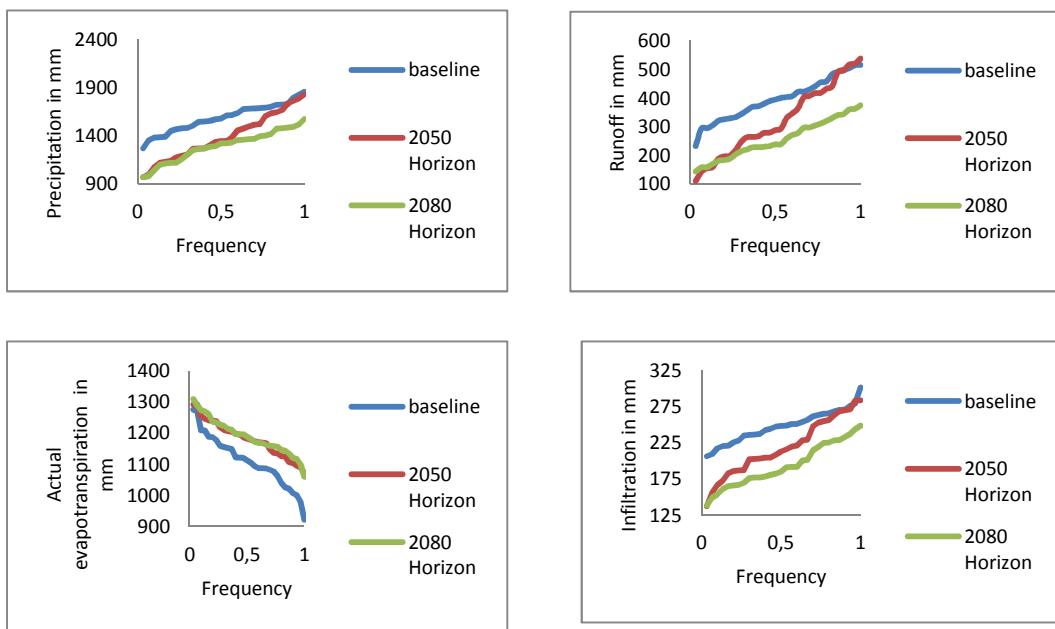


Fig. 16 Changes in average monthly temperatures on the periods 2035-2064 and 2064-2093

**Fig. 17 Changes in the parameters of the water balance in the Buoy Lake watershed****Fig. 18 Possible changes of water balance in the Buoy Lake watershed during the 2050s and 2080s**

5 CONCLUSIONS

This study focused on the potential impacts of climate change on water resources showed that the watershed of Buoy Lake is vulnerable to climate change. Indeed, compared to the reference period 1950-1979, the scenario used provides variations in monthly temperatures between 0 and +1.34°C for the period 2035-2064 and +0.83 to +3.87°C for the period 2064-2093. These circumstances would lead the watershed to be warmer. A lower annual rainfall of 10.27% in 2050 (2035-2064) and 14.90% in 2080 (2064-2093) is estimated. Unlike precipitation, annual average actual evapotranspiration (ETR) could increase to 3.59% in the 2050s and to 3.44% in the 2080s. In terms of average annual runoff in this century, the expected deficits are more important than precipitation. Variations of -27.73% (339.81 mm / year to 245.58 mm / year) in 2050 and of -39.95% (339.81 mm / year to 204.04 mm / year) in the 2064-2093 period are provided. Water infiltration to groundwater would also suffer of reducing. Indeed, one could go from 249.90 to 164.45 mm water infiltrated in the 2050s, with a change of -34.19% over this period. In 2080s, a decrease of 45.81% is also planned. These decreases can cause a drying up of some hydraulic structures capturing groundwater during dry periods of the year. The study of potential impacts of climate change on water resources in the basin of Lake Buoy has highlighted the increasing climate variability directly influencing the water cycle. These changes pose a real threat to the livelihoods of the most disadvantaged populations. Thus, strategies for adaptation to climate change must take into account this reality and focus on improving the sustainable

exploitation of natural resources, in order to increase the resilience of ecosystems and reduce their vulnerability to risks and dangers. The results of this study allow getting an idea of the evolution of the parameters of the water balance of the whole watershed. These results provide a valid working hypothesis it would be necessary to refine progressively as performances of climate model will improve

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Eco Innovation efforts: A review of dynamic eco innovation practices and new research agenda towards sustainability development

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ABSTRACT: The automotive industry is a backbone for nation development and approved as one of the dynamic sector with rapid change of technology capability, customer preferences, and complex management for the auto components. As part of the initiatives to support the ability of current generations to meet their needs without compromising the ability of future generations to meet theirs, firm starting to implement eco innovation in terms of producing an eco product and implementing green process in their manufacturing activities. However, there are low evidence of literature underlines firms capabilities to enable eco innovation as scholars tend to discuss factors from Macro and Meso level. Thus, this paper provide an insight for new paradigm of eco innovation research by introducing dynamic eco innovation practices as an antecedent for eco innovation efforts and indirectly supporting eco performance in triple bottom line effect. Four main factors identified as the heart of dynamic eco innovation practice namely; technology collaboration, green human resource, eco innovation culture and environmental management system strategy. Furthermore, this paper shed light on new research imperatives by proposing a research model with hypothesis development to be tested mainly in the automotive industries and particularly development countries as the background setting.

KEYWORDS: Eco Innovation, Dynamic eco innovation practices, sustainability, automotive industry.

1 INTRODUCTION

Malaysia, as part of ASEAN countries renown as one's of developing countries in this region who are success on transforming the economy through Foreign direct investment (FDI). The introduction of FDI strategy is not only success on attracting investors, but also spurring the economic growth by the establishment of the manufacturing sectors to develop varies types of product. Due to the outstanding strategies, resulted on the increment of the export earnings since 1970's and rapid globalizations by the manufacturing industries as in [1]. As part of it, the automotive industries have significant contribution in nation development through employment (more than 550,000 employees before and after market) and economic growth (3%-4% GDP per year) via manufacturing and marketing activities [2],[3].This industries steadily growth since 1985 in technology transfer and product development while highly protected by the government [4] because the industries encompass growing number of company (up to 570 manufacturer and 35,000 aftermarket business) and build up from numerous components and suppliers in different industries such as metal, plastic, rubber, Electric & Electronics and others [5],[6].

The increasing of attention and global competition in a sustainability development has forcing the local automakers and suppliers to shift their paradigm in green production. The pressure to eco innovative impetus on worsen of air quality, response to the Global trends of producing hybrid and electric vehicles originated from Japanese, Chinese, and Indian countries [7], [8] and competition with the traditional competitor which are Thailand and Indonesia as in [9]. Therefore, the priority in New Automotive Policy (NAP) released on 20th January 2014 emphasizes on the sustainability implementation in producing auto product; car and motorcycles driven by the alternatives energy resources and emphasizing of green automotive life cycle through 3R concept (Reuse, Reduce, Remanufacturer) as in [8]. The new trend of sustainability development embraces on growing research attention for the effective management of eco innovation efforts.

2 LITERATURE REVIEW

2.1 NEW RESEARCH IMPERATIVE: DYNAMIC ECO INNOVATION PRACTICE

Sustainability becomes a mantra for corporate business in 21st century and new edge of global competition relies on triple bottom line effect [10] specially manufacturing industry [11]. According to [12], eco innovation efforts echoes to the sustainability development through different target; product, process, marketing institutional and organizational. Eco innovation terminology refers as an ecological, environmental, green and sustainable innovation [13], [14] and this topic is new for scholars and provide a fertile ground to groom. Research under the umbrella of eco innovation central in developed countries such as Netherlands, Italy and Germany since 1990 [14] under Macro and Meso level which is focusing in the industry and national policy levels as in [15]. However, lack of growing scholars emphasized on Micro level as in [16],[14],[15] to determine firm capabilities towards green initiatives. As recommended by [17], it is critical to review critically the dynamic capabilities construct based on local context factors specially in Asia and developing countries as reported by [18]. Dynamics capabilities approaches merely used to describe how the firm managers utilized the resources in attempts to win the battles in high technology industries and grounded by the creative destruction. By referring to [19], dynamic define as firms capacity to renew its own competence in order to adapt with the rapid changing in internal and external environment. While, capabilities describe as key role of firm strategic management in adapting, integrating and reconfiguring internal and external skills, resources and competencies to achieve sustainable advantage. Amass findings from the previous researchers from each domains namely new product development [20], [21], [22], innovation management [23], [24], [25] and lastly, eco/green innovation [26],[27] echo to the establishment of dynamic eco innovation practices in four main pillars namely technology collaboration, green human resources, eco innovation strategies, and environmental management system (EMS) strategy.

3 PROPOSED RESEARCH MODEL

3.1 TECHNOLOGY COLLABORATION

Technology capabilities acknowledge as part and parcel to drive innovation activities, thus firm with higher technology know how in turn enable firm to stimulate economic growth as in[28]. As reported by [29], strategic capabilities, internal capabilities and external capabilities considered as the heart of technology capabilities for competitive edge. However, [30] mentioned that an external capabilities is giving a substantial impact compared the other factors to encourage technology transfer [31] particularly in the automotive industry as in [32]. Furthermore, [17] discovered that inter firms relationship resulted on the higher commitment towards environmental management practices and life cycle analysis (LCA) [33].Closed relationships between supplier and customer are pivotal to pursuing environmental initiatives through joint R&D activities or knowledge dissemination [34], [35] [30] and environmental regulation as in [36],[37]. Therefore, the technology collaboration between supplier-customers is critical and essential to encourages eco innovation efforts as proposed in the following hypotheses:

H1: The technology collaboration practices is positively relates to the eco innovation efforts

Automotive industry considered as the complex and complicated sectors as the process of developing a new car consist an efficient management of time, people and environment as in [38]. Therefore, at the heart of the technology collaboration, an effective customer-suppliers relationship towards improving eco innovation performance is crucial mainly in the automotive industries. As reported in [30], the enforcement of EMS regulations within automotive suppliers have a positive relationship on environmental performance in triple line; environmental product design, reduction of material usage and managerial aspect namely advanced prevention and safety systems at work. In line with the previous agreement, [34] in study of customer-suppliers collaboration between Chinese and UK automotive industries confirmed that strong co-operation between both parties directly effect to the environmental, economy, and operational performance. The benefits of collaboration through understandings customer demands and environmental information indirectly will improved firm's environmental image and return on investment as discover by [33]. Then, the corresponding hypothesis postulate as below:

H5: Technology collaboration practice will lead to positive relationship to the eco innovation performance

3.2 GREEN HUMAN RESOURCE

Despite of technology collaboration, human resource acknowledge as a backbone to describe firm's dynamic capabilities [20],[39] and sustainable advantage [40]. The important of human resources in supporting strategic innovation [41] and

organizational innovation[42] vastly explored in literature while little systematic research and empirical study on green human resource management [43] specially in the Asian based countries as in [18]. Under the umbrella of green human resource management, there are three main themes prompted in supporting eco design efforts such as product life cycle activities (LCA) [27] and design for environment [33]. Training considered as the heart of green initiatives by many scholars [44], [45],[18] relative to performance base rewards [46], [45],[43], [47] ,[18] and green team [27], [33], [44],[45],[48]. Thus, a green human resource practice offers fertile ground for research to explain its relationship with the eco innovation efforts. Due to that, the proposed hypotheses explain as below:

H2: The green human resource practice is positively related to the eco innovation efforts

As mentioned in the former paragraph, human resource plays an important role for supporting green technology innovation [47] and sustainable development [49]. Even though there is limited knowledge initiate to measure the relationship between green human resource practices with eco innovation effort, but the bold of reality is much evidence established on measuring the impact between green human resources with its performance. Several scholars examines the direct effects from the green human resources practices towards environmental performance as indicated in [47], [50]–[53]. As proposed by [46] and [54], human resource is important to improved firms commitment for the environmental innovation and initiatives [47]. Meanwhile, [50] mentioned that employee training is important to reduce production waste and consumption of hazardous materials. More than that, green human resource is significant to increase employee eco initiatives [55], firm's capability on investigating an alternate technologies and procedures and product quality [51],[52] and improved supplier commitment on environmental certification [53]. Pertaining to mentioned information, the following hypothesis proposed as below:

H6: Green human resource practice will lead to positive relationship to the eco innovation performance

3.3 ECO INNOVATION CULTURE

Organization culture recognized as a shared value and believes of the organizations and providing guidance to the employee's perceptions, attitude and behaviour. Culture is considered as the heart of main construct for the dynamic capabilities to enable external absorption and internal integration in new product development [20], [21],[22], innovation management [23],[24],[25]and lastly, eco innovation [26],[27]. [43] in journal titled "*State-of-the-art and future directions for green human resource management: Introduction to the special issue*" discovered that organization culture complement green human resources practices is in order to support environmental management programs [56] and employees eco initiatives [54],[46]. There is a rich stream of literature which is discussing the relationships of eco innovation culture, green human resource and employees green improvement as initiate by [54],[46], also the dimensions of eco innovation culture by [57],[58],[55], but this dimensions lack of empirical evidence [56] to describe managerial cultural factors [33],[59] to support firm eco innovation efforts and performance. Therefore, the hypotheses draw as below:

H3: The eco innovation culture practice is positively related to the eco innovation efforts

H7: Eco innovation culture practice will lead to positive relationship to the eco innovation performance

3.4 ENVIRONMENTAL MANAGEMENT SYSTEM (EMS) STRATEGY

The aforementioned findings on the critical elements derived from the dynamic capabilities are lies on the complementary items between green human resource and eco innovation culture. However, as proposed by several scholars [55],[54],[46], to ensure the effective employee eco initiatives, the adoption of simultaneous practices as such Environmental Management System is vital for any firms. The arena of business competition is no longer on profit oriented, but relies on the sustainable advantage in economy, ecology and social development. Therefore, the introduction of EMS as one of integrated approach towards improving environmental performance is vital to establish firm environment responsible management as in [60]. The adoption of Environmental Management System (EMS) approved as a critical strategy to bridge firm's environmental innovation [37],[61] and as a motivation to implement environmental product design, reduction of material usage, and management aspect mainly in the automotive industry as in [30].Thus, the next hypotheses proposed as below:

H4: The environmental management strategy practice is positively related to the eco innovation efforts

The implementation of Environmental Management System by firm is not only reflected on the environmental innovation, but also associated with operational performance. As confirmed by [62] in journal tittles "*Effects of Environmental Management Systems on Environmental Management Practices and Operations*", the operations

measurement consist of reducing both waste and cost in the production process while improving on designing better product and improved quality. Furthermore, as captured by [60], the practices as such written and documented EMS procedure with the integration of consistent environmental performance is important on reducing overall cost, lead time while increasing product quality. The importance of written environmental management system and environmental performance management review by top management is widely discuss by scholars and approved as a crucial factors for zero waste and emission [55] and zero defects [63]. Thus, the other hypotheses drawing as below:

H8: Environmental management strategy practice will lead to the positive relationship to the eco innovation performance

3.5 ECO INNOVATION EFFORTS

Eco innovation recognizes as state of the art for the sustainable development and in turn stimulates growth underline in triple bottom line dimensions; economy, ecology and social. There are many drivers as such external and internal captured under the umbrella of eco product innovation efforts proposed by many authors [30],[64],[36],[30]. The common drivers rest on strict regulation, economic in return, competitive advantage and opportunity awareness. In the another hand, some scholars believed that green commitment rest on the company's initiatives and capabilities as pointed out by [16],[65],[66]. Technology collaboration, Green Human resource is part of firm's best practices in managing companies' resources related to enables eco innovation efforts and sustainable development. "Eco innovation cultures" defines as shared values and beliefs of the organization and providing guidance to the employee's perceptions, attitude and behaviour in their daily work and Environmental management system Strategy acknowledge as the heart of firm best practice and described as companies specific planning and vision to be realized. Thus, the development of dynamic capabilities theory served a steady stream of framework for empirical evidence, therefore, the following hypothesis draw as below

H9: Eco innovation efforts through dynamic eco innovation practice will lead to positive eco innovation performance

Furthermore, there is some empirical evidence of literature which is discusses the role of eco innovations efforts to mediate the relationship between dynamic eco innovation practice and eco innovation performance. Although a mass findings proposed the significant roles of eco innovations to mediate both relationships, however, little systematic research and empirical study to tested the construct of dynamic capabilities as most of the construct tested in isolation as investigated in [36],[67],[62],[68]. The researchers conducted by [36],[62] confirmed that eco innovations practices mediated the relationship between external drivers as such customer pressure, government regulation and environmental performance outcomes, meanwhile the internal driver as such environmental management system (EMS) and operational performance respectively. Furthermore, having eco innovation in terms of organizational, product and process mediates the relationship between innovation strategy and firm performance [68]. Due the provided findings, supported to the establishment of the next hypothesis as follow

H 10: Eco innovation efforts significantly mediate the relationship between dynamic eco innovation practice and eco innovation performance

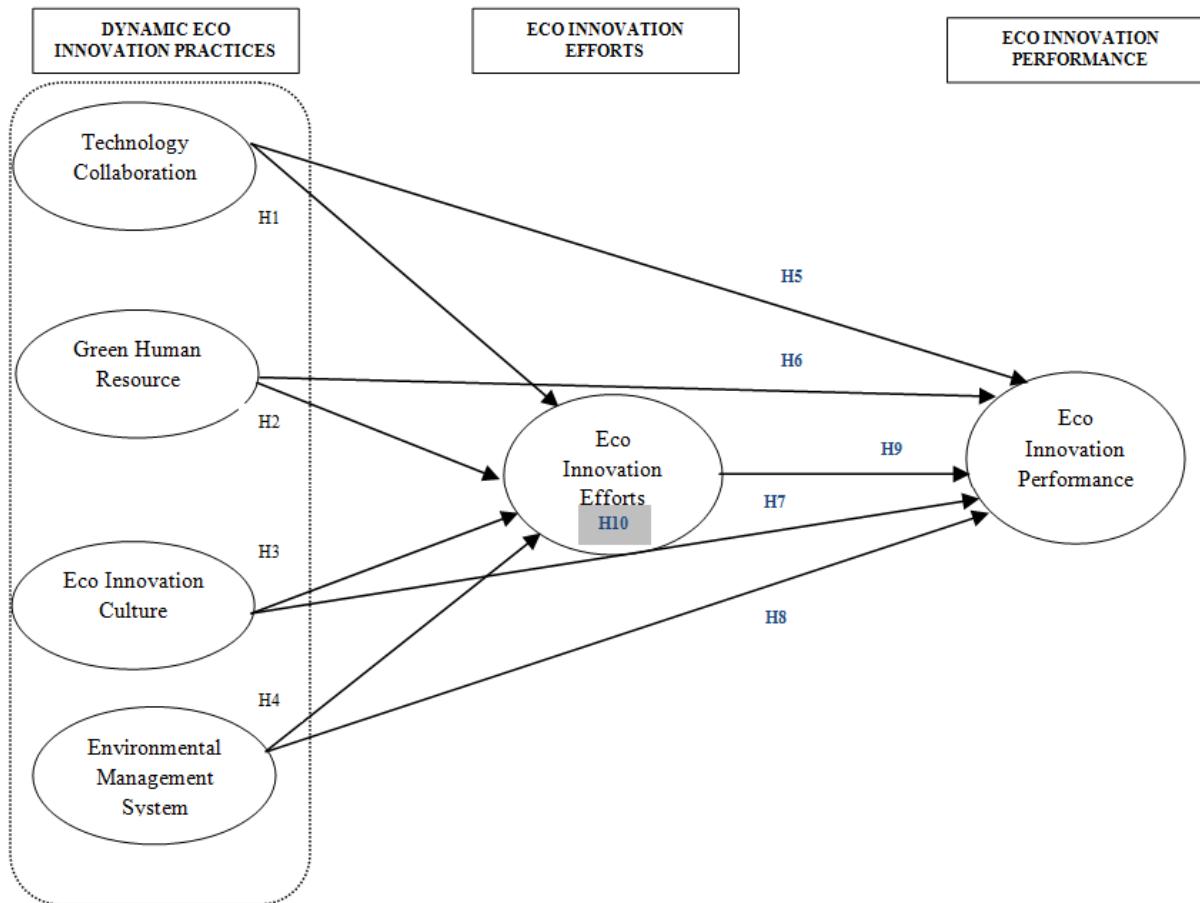


Figure 1: Proposed Model of study

4 CONCLUSION

The ground of competitive edge in the 21st centuries for the automaker relies on greening the industries as initiate by the European automakers and followed by others countries. In the automotive industry, the performance is based on technical advancement in producing better vehicles in efficiency and reliability in the areas of safety, reducing green effects and accessories advancement based on customer demand as in [69]. The introduction of NAP 2014 by YB Dato' Sri Mustapa Mohamed represented a serious involvement in greening the industries to upgrade Malaysian product and as a strategic weapons to overcomes competitive edge. Thus, it is beneficial to reveals the antecedents of eco innovation efforts based on dynamic capabilities theory.[70] highlighted the important to study dynamic capability for the new coming research agendas to help managers improve the source of firm sustainability by answering "what dynamic capabilities look like in organizations, how they are deployed, and how context may impact upon them?" as in [71]. In a similar vein, scholars and managers are keen to learn about the relationship between dynamic eco innovation practices with eco innovation efforts and its performance as proposed in the figure 1. Furthermore, dynamic capabilities perspective only found in a single study and isolate with each variables to measure eco innovation as the theory come from the "nascent form" and required for the further empirical evidence to refine the model as in[72].

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The Influence of Indian Culture on Pakistani Society: A Case Study of Layyah City

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ABSTRACT: Each community has its own culture and culture represent the identity of a specific community. Culture is a way of living of the people of any community. The culture of Pakistani is pure Islamic culture and Islam is official religion of Pakistan. The present study is conducted to explore the influence of Indian culture on Pakistani society in Layyah because Indian entertainment channels are most popular in Pakistani society. Main aim of this study was to explore the impact of Indian TV dramas and movies on the Pakistani cultural norms and values. Using multistage sampling technique 120 viewers were selected from Layyah city. Findings of this study show that Indian dramas and movies are directly influencing the Pakistani culture. In this way cable TV network is main source to promote the Indian culture in Pakistan.

KEYWORDS: Culture, Media, Indian Media, Society and TV Dramas.

INTRODUCTION

Each human society in the globe has its own particular culture because it is the identity of a particular society. In sub continent Muslim society is mostly influenced by the Hindu culture due to living to gather (Murtaza, 2007). Culture of any society deals with basic elements of culture which includes language, social norms and values, attitude and belief system which are mostly practiced by the individuals of a given society (Lane and Ersson, 2007). The term culture refers to various meaning which is stated that it is the way of living and way of interaction of individuals with each others. According to some researchers culture is an education for the individuals because culture inform the people that how to live in the society and how to practice the particular values in the society. Culture creates possibilities for the survival of peoples. But to the globalization of media culture is changing in the under developing nations (Tylor, 1920).

Culture highlights the each angle of human life such as way of living, and interaction with others. In reality our thinking is also the depiction of our culture because culture teaches us everything. Due to media culture of different societies is changing and culture is also share by the members of a social system (CIL, Canada 2005). Culture has two distinct kinds which deal with material and non material culture. Material refers to such things which have physical existence and non

material culture deals with such things which have no physical existence, as media has power and it is also influencing the both types of culture (Dash, 2004).

Pakistan is a Islamic country, Pakistani culture represent the pure Islamic culture and the all cultural norms and values of pakistan are based on Islamic teachings. Islam in Pakistan is a complete code of ethics and Islam is a complete religion which teach the Muslims that how to spend their life and how to interact with others. As media in Pakistan is free and there are number of foreign TV channels which has landing rights in Pakistan. The foreign channels are promoting modernization which is replacing the Islamic culture of our home land Pakistan. Indian entertainment channels are most popular among Pakistani viewers and these channels are promoting their own Hindu culture in Pakistan. Now Pakistani viewers practice these Hindu customs during their own festivals (Batool, 2007). Impact of Indian culture on Pakistani cu can be clearly observed during the celebration of different festivals. Marriage traditions and jaheez culture in Pakistan is also the product of Indian culture (Anonymous, 2010).

It is observed that Pakistani youth prefer to use the ring tune of Indian songs in their mobile phone. Indian TV dramas and films are playing their vital role to merge the Pakistani national language Urdu into Hindi (Flangan, 2005). Different traditions and customs which are celebrated in Pakistan are not the part of Pakistani culture but due to popularity of Indian media in pakistan these customs has become the part of Pakistani culture and has replaced the other traditions of Pakistan (Mahmood, 2000). It is observed from the Pakistani that due exposure from Indian TV channels, people involve them self to practice the Indian traditions which may be directly or indirectly such as basant is a cultural festival of India but it is highly celebrated by pakistani youth . Advertisements and Pakistani TV dramas are also following the contents of Indian dramas and are projecting the Indian culture at the behalf of Pakistani culture. Due exposure to Indian mass media now our young generation feel no shame to view the vulgar contents of media and they pay maximum attention on watching vulgar contents of media (Afzal , 2010). There is a vital role of cable operator in the promotion of Indian culture in Pakistani society because they mostly play the Indian movies on cable (Nisar, 2002).

RESEARCH METHODOLOGY

Smith (2000) stated that "Methodology is usually an instruction for solving a problem, with specific components such as phases, tasks, methods, techniques and tools. A comprehensive data collection plan whose purpose is to answer research question and test hypothesis is named as methodology". Current study was conducted in Layyah city to investigate the influence of Indian culture on Pakistani Culture. Layyah consist of 24 towns. Total 120 respondents were selected conveniently to document their responses by using multistage stage sampling. In the start one town (Mandi town) was selected out of 4 towns selected randomly. Then from total 24 union councils of Mandi town , 4 union councils UC 1, UC 7, UC 14, UC 18,UC 20 and UC 24 were selected randomly .During third stage 120 respondents which equally consist 30 from each UC were selected by utilizing "convenient sampling technique". In this study responses of the target people was documented by interviews and surveys methods. Before data collection pre test was conducted to overcome the mistakes and weakness.

ANALYSIS AND CONCLUSIONS

In the present study total respondents were male and mostly 58% target people were married. Nearly 31 % respondents were those who have belonged to age group of 22- 29 years and 29 % were from the age group of 32 – 39 years. Most of the respondents 37% have intermediate education level. The 84% of the overall respondents indicated that Indian culture is promoting in our Pakistani society and our traditional Pakistani culture is replaced due to popularity of Indian media in Pakistan. As mass media is the mirror of the society and it work as important element of the society. Findings indicated that it is the view of 94 % respondents that media is replacing the Pakistani culture from Pakistani society by presenting the Indian culture in TV dramas and in other entertainment programms. Further it was observed by the findings that 86% respondents are agree that cable television is playing important role in the promotion of Indian culture in our pakistani Islamic society. Any cannot refuse the reality that Pakistani media is also following the Indian because Pakistani TV dramas are based like the contentment of Indian dramas and in this way it is perception of 90% respondents that pakistani media is also promoting the Indian culture in the pakistani society. Sheher et al (2003) stated that Pakistani culture is widely influenced by foreign media contents and the Pakistani society is totally changed due to the popularity of foreign channels in Pakistan. Fatama (2003) also investigated that Indian TV dramas are most among Pakistani viewers and people prefer to practice the Indian custom in their daily life interactions. She also indicated that popularity of Indian in Pakistani is a great threat to Pakistani national culture.

Table 1. Socio economic characteristic of the respondents Age (in years)

	Frequency	Percentage	Mean	Standard Deviation
15 -30	48	40.0	24.91	4.33
31-45	54	45.0	36.90	4.61
46 and above	18	15.0	53.00	3.69
Total	120	100.0	34.52	10.50
Marital status		Frequency	Percentage	
Married	70		58.3	
Unmarried	50		41.7	
Total	120		100.0	

Family type		
Nuclear	56	46.7
Joint	50	41.7
Extended	14	11.7
Total	120	100.0
Home set up		
Patriarchal	84	70.0
Matriarchal	4	3.3
Democratic	32	26.7
Total	120	100.0

Total	120	100.0		
Mean = 10.28 Std. Dev. = 4.44				
Monthly income (Rs.)	Frequency	Percentage	Mean	Standard Deviation
Up to 15000	20	16.7	9300.00	2921.78
15001-30000	30	25.0	20800.00	3438.12
Above 30000	70	58.3	30828.57	4239.12
Total	120	100.0	24733.33	8969.35

Educational level		
Illiterate	13	10.8
Primary	8	6.7
Middle	11	9.2
Matriculation	13	10.8
Intermediate	44	36.7
Graduation	24	20.0
Post Graduation	7	5.8

It is observed that majority of respondents has cable television at their home. 87 % respondents express their views that cable operator are playing their vital role in the promotion of Indian culture in Pakistan because mostly display the Indian dramas and movies. Nazar (2002) investigated that cable operator has power to promote the Pakistani culture at national and international level. He further stated that cable operators are working as major factor in replacing the Pakistani values from Pakistani society. It is the perception of 96% respondents that Indian dramas and movies are extremely influencing our national language Urdu, because it is observed that due to exposure to Indian media the people use mostly Hindi words in their daily life communication and interaction with others. Zia (2007) investigated that cable network is highly influencing our youth and it is replacing our particular cultural identity .She further stated that our young generation is blindly following the Indian customs and traditions. Ansari (2005) conducted a study on the impact of cable television on youth and he indicated that cable network is most popular among youth and due cable TV our social ties are going to weakness and aggressive behavior is also promoting among the youth. He further stated that Indian language is extensively use by the young generation and Indian dress are most popular among the viewers. Mostly 90% respondents stated that due to Indian media sexual behavior is promoting among youth which is future of our beloved homeland. Kunkel (1999) also supported the present study because he stated that sexual talks and short dress of female in the dramas attract the youth toward sex and to satisfy their sexual needs they use different illegal ways. It is observed that 62 % has cell tune of Indian songs which is the strong support to that study how much the Indian media is influencing our society while only 29 % has Islamic tune on their

mobile phone. Majority of the Pakistani people are the fond of Indian music as Flanagan (2005) researched that 71 million cell phone in Pakistan has Indian songs

Table 2. Distribution along with mean and standard deviation regarding the understanding of Indian culture

perception categories	Strongly agree	Agree	Disagree	Strongly Disagree	Mean	Std. De.
Indian culture is spoiling the indigenous culture of Pakistan	83.3	16.7	0	0	3.83	.37
Indian culture is affecting the life style of Pakistani people	80	20	0	0	3.80	.40
People to adopt Indian culture in their way of life	1.7	13.3	28.3	56.7	1.60	.78
Indian channels/movies are increasing sexual behavior among youth	89.7	7.7	2.6	0	3.88	.40
Indian culture is affecting the immature mind of children	90.3	6.7	3	0	3.87	.43

It was investigated that 87% target people satisfied that they are following the Indian traditions such as celebration of mehndi, dancing and other traditions of wedding .This situation indicate the extremely high threat to Pakistani culture which is adopted due to Indian TV dramas and Indian movies. Mona (2009) investigated that majority of the urban cable TV viewers are involved in the Indian customs and traditions. She stated that adoption level of foreign culture in Pakistan is at peak in Pakistani Urban areas .Our wedding celebration totally depicts the Indian traditions and we perform all those functions which are performed by Hindus during their wedding celebrations. According to Tariq (2004) 93% respondents of Lahore city Indian wedding traditions are most attractive and they are much impressed by the hair style, dress, jewellery and life style of Indian. 25 % indicated that wedding trends in the Indian dramas are for the elite class but these are creating problems for middle class. 98% of the target people documented their views that Indian culture is influencing the traditional art and culture of Pakistan with great extent.

Table 3. Distribution along with mean and standard deviation regarding influence of Indian culture on Pakistani society.

	To a great extent	To a some extent	Not at all	Mean	Std. De.
"mass media is spoiling the real picture of Pakistani culture"	95.0	5.0	0	2.95	0.22
"Pakistani mass media is promoting and reflecting Indian culture"	91.7	6.7	1.6	2.90	0.35
"Cable operators are responsible for promoting Indian culture in Pakistan"	86.7	11.7	1.6	2.85	0.40
"our nation n Our national language Urdu is being blended with Hindi after watching Indian movies"	95.0	5.0	0	2.95	0.22
"we are performing Indian traditions/customs at our weddings"	86.7	13.3	0	2.87	0.34
"Indian culture is influencing our (Pakistani) performing art i.e. dance music, drama and theatre"	96.7	3.3	0	2.97	0.18
"Pakistani people have an impacts of Indian style of dressing i.e. Sari, Patiala Shalwar and Choori Pajama"	88.3	11.7	0	2.88	0.32
"Hijab/veil concept in females is declining due to the influence of Indian culture"	85.0	10	5	2.80	0.51
"Pakistani people are abundantly using wine due to impact of Indian culture"	75	21.7	3.3	2.72	0.52

Table 4. Distribution along with mean and standard deviation regarding access toward electronic media

	Frequently	Rarely	Never	Mean	Std. De.
Visiting cinema and theatre	3.3	50	46.7	1.55	0.55
Watching Cable TV Programmes	41.7	50	8.3	2.33	0.63

An astonishing part of the respondents 91% are agreed that Indian culture is imposing negative impact on our mind and on our children. Findings of the present study have support from Rizvi (2006) who indicated that Indian dramas are effecting on our Islamic way of interaction like Muslims say slam but mostly young people use Namaste during their daily life interactions. He also stated that love marriage culture also promoting in our Pakistani society due to Indian media which is against the Islamic teachings. As entertainment is a function of mass media which should be enjoyed in the boundaries of law. At the name of entertainment there should be no vulgar content which create the problem for society and due to cable television people has huge access to different entertainment based TV channels. Nearly 12 % respondents viewed that there

is positive impact of cable TV on our society but 88 % indicated that cable TV has negative impact on our society and it has created new problems for the people. It is clear from the findings that Indian customs and tradition are influencing the Pakistani society. Nearly 34% expressed their views that due Indian media we are refusing Islam and are following the Hindu culture. About 46% people stated that our Pakistanis are following the Indian culture and 21 % stated that Indian media is promoting vulgarity in our society and it is detracting our young generation. Dress of Muslim society is designed in such way that cover the whole body and Islam give no permission to show the naked part of human body. 89% documented their views that Indian dresses are adopted by Pakistani people with great extent. It is stated by the viewers that now mostly people feel shame by using Islamic dress like veil. But veil culture among Pakistani is replacing with short dresses of India. As Ansari (2005) conducted a study on the impact of star plus dramas and he investigated that star plus dramas are totally projecting the customs which are against the Islamic culture and the culture of Pakistan but Pakistani girls are blindly adopting the new cultural trends which are presented in the star plus dramas. Due star plus dramas love marriage culture is promoting in the Pakistani girls and they are tending toward sexual behavior. Some drinks which are not permitted in Islamic culture such as wine, but is extensively used in Indian culture and Pakistani young generation also adopting the wine culture in the wedding celebrations.

Table 5. Distribution of the respondents according to the type of incoming caller tune they like to set in their mobile phones

Type of incoming caller tune	Frequency	Percentage
"Pakistani songs"	4	3.3
"Indian songs"	74	61.7
"Islamic verses and Naat"	10	8.3
"Normal Tune(Ringing)"	32	26.7
Total	120	100.0

SUMMARY

Analysis of the study indicated that adoption level of Indian culture in pakistan is increasing day by day because Indian media is presenting such contents which attract the people of pakistan. Cable television network is randomly spreading in the Pakistani society which is a great threat to our national culture because cable operators are presenting such contents which are against the culture of Islam and Pakistani culture. These contents of Indian media are replacing values of Pakistani culture. To compete with Indian media, Pakistani media is also following the Indian media are presenting such contents which are supportive to Indian culture. In this way Indian media is not only disturbing our social norms and values but it is also promoting the sexual behavior among youth. Mostly people are against the Indian media because they stated that Indian media has negative influence on our society. Findings of the study indicated that most of the respondents are the follower of Indian customs and they prefer to the Indian dressing style and use of Hindi words in their daily life conversation. Findings further indicated that new cultural trends of Indian media have created many problems lower and middle class. These trends force the viewers to adopt them and their adoption is expensive such as wedding traditions of Indian media which are blindly followed by Pakistani society. But our Islamic culture never permits to celebrate these trends. It is the view of respondents that contents of Pakistani media are not gratifying their needs because many Pakistani film and drama stars have migrated to India. By concluding the above discussion we should promote our Pakistani cultural identity and we should not follow the Indian tradition because these new cultural trends are anti Islam and we should adopt the Islamic way of life instead of Hindu way of life. In this way Pakistani media should play its vital role to promote the Pakistani culture at national and international level.

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COMBATING DOWRY VIOLENCE AGAINST WOMEN IN BANGLADESH: A CRITICAL STUDY

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ABSTRACT: In Bangladesh the most important event in a women's life is marriage which is surrounded by the various financial transactions including primarily the religiously sanctioned dower. Added to the dower, the practice of dowry popularly known as 'Joutuk', demands made by the groom's side to the bride's side, have in the last few decades become a widespread practice in the society supported neither by state law nor personal laws, but apparently designed to strengthen traditional patriarchal assumptions and with the expansion of capitalist relations that help capital accumulation by men in Bangladesh. The dangerous scenario is that every year a number of women become the victims of violence for non fulfillment of dowry demand, which is caused the threatened to their lives as the law cannot eradicate the menace of dowry due to lack of proper enforcement. This paper is an attempt to indicate the severity of the dowry violence including the analysis of legal strategies to put on curb the dowry violence in Bangladesh.

KEYWORDS: Bangladesh, Bride, Dowry, Groom, Law, Violence.

INTRODUCTION

In contemporary Bangladesh violence against women appears in a myriad of forms. Dowry violence especially beating wives for dowry by husbands has been common in Bangladesh society for a long time. Newspaper reports clearly indicate that the prevalence of dowry-related violence against women is very high as daily papers are full of the news of violence against women specially the dowry violence. Zahan(1994) states that most of the violence caused against women are due to non payment or inadequate payment of dowry. The violence is increasing rapidly although here are several laws in Bangladesh to prevent dowry and violence relating to it. The anti-dowry criminal statutes firstly enacted in 1980 and subsequently modified in 1982, 1984 and 1986 and newly adopted Nari O Shishu Nirjatan Daman Ain, 2000 with the support of women advocates have not provided a dramatic protective effect. Instead, they have been implemented narrowly. The result is to de-emphasize the systematic subordination of women that was at the root of the original attack on dowry violence. Although this may generally be a problem of legal reformist efforts, it is specially a problem of reliance on criminal law where we must rely on enforcement by a limited cast of both the specialized institutional actors and preexisting systems of criminal justice. In the adversarial justice delivery system, it takes a long time to dispose a dowry violence case. Moreover, women have no easy access to justice system as the judicial system in Bangladesh is patriarchal.

Dowry related violence has been proved to be highly complicated in Bangladesh. Zaman and Aziz, (2009) asserts that due to dowry related violence many women have been killed and the rest victimized to physical and mental abuse. Sometimes

husbands alone or collaborated with other members of the family tortures or kills wife for failure to pay the demand of dowry. Dowry completely demolishes the dignity of women and makes them very helpless in their so-called homes. Dowry-related violence affects the lives of many women in Bangladesh. This is also a determinant of male dominated patriarchal society and poor enforcement of the anti-dowry laws.

CONCEPT AND NATURE OF DOWRY

Dowry means the transmission of large sums of money, jewellery, cash and other goods from the bride's family to the groom's family (Srinivas: 1984). In the Encyclopedia Britannica dowry is defined as a term denoting the property the 'property, whether realty or personal, that a wife brings to her husband on marriage (Encyclopedia Britannica: 1970). Similarly, the Encyclopedia Americana defines dowry as 'the property that the bride's family gives to the groom or his family upon marriage (Encyclopedia Americana: 1969). So, whatever property a husband gains from his wife or wife's family through marriage is dowry. The extended meaning of dowry includes anything exchanged in consideration of marriage according to Bangladesh law related to dowry.

The modern phenomenon of Dowry in South Asia is that it is an abuse. It takes the form of inducement for a man to marry a woman. There is a common tendency to consider dowry as groom price. It is differentiated from *kanyadan* or bride wealth. At present the bride's family sends large sums of money, jewelry, cash and other goods to the groom's family.

In rural areas, among the poor, money, ornaments or household articles are often demanded as dowry. In urban areas similar demands are made in matured forms. Some families even demand luxury goods such as a car, television, furniture, or even a job abroad or building a house for the groom. The miseries of the bride's parents do not end with their giving a dowry at the time of marriage. The custom demands a perennial flow of gifts from parents of the girl to the boy's family on all festivals. If we look at the upper class families, there may not be any dowry negotiations apparently but the monetary expectation of the groom's family is properly addressed in different form. Dowry appears here in disguise of gifts. When matrimonial baggage is not up to the mark according to the expectation of the groom's family it turns to be a mental abuse for the bride. (Monsoor: 1999) states that even if to meet the expectations of groom's family it is needed to face economic hardship or even to run for a loan, they would do it. They would not like to think of not marrying their daughter. Nusrat Ameen writes: "In several cases they (bride's family) continue to fulfill the demands of their daughter's in-laws forgetting that a woman cannot buy peace, not to speak of affection, by meeting monetary demands of her in-laws. The demands may lead to constant nagging and bullying which is even more damaging to the human spirit. Sometimes dowries are demanded after the wedding ceremony. The refusal to pay could result in the daughter being divorced or even oppression causing the death of the bride".

VIOLENCE CAUSED BY DOWRY

Beginning from the early 1970s and up to the present, dowry demands are cited as a major cause of violence against women, as well as suicides by the women themselves. During 1980-1982, dowry was allegedly the major cause of suicide of women (Jahan: 1994). *The Daily Star* showed that in Jhenidhah district, the majority of suicides reported between 1991-1995 were attributed to dowry demands. In 2004 alone, 18 women were forced to commit suicide due to dowry while 371 cases of dowry related violence were reported in that year, taking a variety of forms and reports of death and violence due to dowry continue to fill the newspapers (BNWLA: 2004). It has been widely accepted that acid violence, murder by burning and other types of violence towards women are to a great extent due to demands for dowry. Non-payment or inadequate payment of dowry is a common cause for harassment and divorce (Agarwal: 1994). *The Daily Star* reported from the Natore district of Bangladesh that thousands of divorce cases have been registered in different courts of the district during the last five years', attributing dowry as the main cause. The demand for dowry underlines most forms of mental torture within marriage, in particular the threat of divorce (Roy: 1992).

The demands often continue after marriage, and the wife may be forced to suffer physical and mental torture for the inability of her parents to fulfill additional and continuing demands. This may cause the marriage end in divorce or the husband may marry again in order to procure more dowries. A news item on 20 March 1989 in the *Ananda Bazar Patrika* reported that, according to the National Association of Marriage Registrars, dowry was responsible for the break-up of 200, 000 marriages in Bangladesh each year (Ghose: 1989). It may be too simplistic to blame dowry as the only cause of violence against women in Bangladesh. However, it cannot be denied that dowry demands and disagreements over dowry 'are a significant source of violence against women and can have powerful influence on a woman's relationship with her original family and her new one (Scheffer: 1986).

In one report of *The Daily Star* observed: "It is an evil prevalent in the society and despite efforts by some activists and women's rights organization to eliminate this malaise, the numbers have continued to climb. In villages marriage was once considered a very sanctified bond united in the worst or best of times, in sickness or in health through the vicissitudes of life. But dowry related deaths have shattered that bond of peaceful and happy relationship.

According to a report on human rights violations in Bangladesh by the human rights organization Odhikar: "267 women including one child were victimized due to dowry related matters. Among them, 165 were killed, 77 tortured by acid violence and one was divorced and 11 committed suicide due to incessant dowry demands." These figures were collected by Odhikar from newspaper reports on dowry related violence published throughout 2004.

In a report on violence against women in Bangladesh in 2006, *The Daily Star* writes: "In the last five year two month women were the most vulnerable groups in Bangladesh that witnessed an alarming increase in human rights violations. From 1 January 2001 to 28 February 2006... a total of 1575 women found to be victimized of dowry related violence. Of them 1009 women were killed, 420 were brutally tortured, 55 found acid burns, 8 committed suicide and 7 were divorced due to dowry.

Hong Kong –based Asian Legal Resource Centre (ALRC) provides data on dowry violence in Bangladesh: "In the first half of 2009, 119 cases of dowry-related violence, including 78 deaths, were reported, said Ain O Salish Kendra (ASK), a local NGO working for human rights. In 2008, 172 women were killed and the figure for 2007 was 187, ASK said, adding that there were at least five reported cases of women committing suicide in the first half of this year when dowries went unpaid.

Recently, in an article in *The Financial Express* on 23 April, 2011 M. Mizanur Rahman mentioned: "A report of Bangladesh Society for the Enforcement of Human Rights (BSEHR) says that 249 women were killed in 2010 in dowry related violence, which is more than double the number of 109 deaths for the same reason in 2009. In 2008, the number of dowry victims was 114 and in 2007 it was 145. Reports say, in the month of March this year about 18 women were tortured to death. Even, many of these incidents are not reported only for the pressure of the male counterpart.

LEGAL STRATEGIES FOR COMBATING DOWRY VIOLENCE

The dowry system increases the vulnerability of women in Bangladesh. To assume logically, it appears to turning the women into liabilities for their family. It is often maintained that the problem of dowry during the post-independence era of Bangladesh became so widespread that women activists demanded legislation to eradicate this social evil. Daulatunnessa Khatun introduced a Dowry Prohibition Bill in parliament, and, under pressure, the government passed it as the *Dowry Prohibition Act of 1980* (Begum: 2006). The Act makes giving and taking or demanding dowry a punishable offence. According to the Section of this Act, dowry means 'any property or valuable security given or agreed to be given either directly or indirectly

- (a) by one party to a marriage to the other party to the marriage or
- (b) by the parents of either party to a marriage or by any other person to either party to the marriage or to any other person.

The Dowry Prohibition (Amendment) Ordinance 1984 extended the definition of dowry to 'any property or valuable security given at the time of marriage or at any time' that substituted the earlier words 'at, before or after the marriage'. It states that [at the time of marriage or at any time] before or after the marriage as consideration for the marriage of the said parties, but does not include dower or mehr in the case of persons to whom the Muslim Personal Law (Shariat) applies.

Section 3 of the Act provides the punishment for giving or taking dowry: If any person, after the commencement of this Act, gives or takes or abets the giving or taking of dowry, he shall be punishable with imprisonment which may extend to [five years and shall not be less than one year, or with fine, or with both].

Section 4 of the Act sets out the punishment for demanding dowry: If any person, after the commencement of this Act, demands, directly or indirectly, from the parents or guardian of a bride or bridegroom, as the case may be, any dowry, he shall be punishable with imprisonment which may extend to [five years and shall not be less than one year, or with fine, or with both].

In acknowledgement of dowry-related violence against women in Bangladesh, *the Cruelty to Women (Deterrent Punishment) Ordinance of 1983* was enacted, but was then repealed by *the Women and Child Repression (Special Provision) Act of 1995*. The 1995 Act provided severe penalties for crimes committed against women and children, including those related to dowry, stipulating the death penalty in section 10(1) for causing death for dowry and life imprisonment for attempting to cause death. Section 11 laid down the penalty for causing grievous hurt to a woman in connection with dowry as life imprisonment or 14 years of rigorous imprisonment (which would not be less than five years), and the perpetrator was also required to pay additional monetary compensation. A still more stringent law to combat violence against women and

children was enacted when *the Nari O Shishu Nirjatan Daman Ain 2000 (Women and Children Repression Prevention Act 2000)* repealed the 1995 Act. Special Tribunals have now been set up in every district to try cases under this Act. But despite deterrent punishments, dowry violence continues unabated.

Critics of the law point out that instead of protecting women as intended, these laws are widely used to harass people, including women of the husband's family. In many cases, in order to bring an offence of domestic violence that is not related to dowry demands within the law of 2000; false allegations of such demands are made. Laws alone cannot purge society of the dowry system. Any official state law has definite limits in the face of opposition from society and its unofficial laws (Menski: 1998). Great difficulty lies in devising ways to prevent and punish an offence which to the perpetrators is an offence only because the law says it is, but which is supported by far stronger village custom. To stop practice of dowry we must look forward to the enforcement of the existing laws which is really big hurdle as most of the villagers of our country cannot get access to legal protection because of illiteracy and economic constraints.

In 2011, Bangladesh government has introduced "*Jatio Nari Unnyan Niti 2011*" (National Women Development Policy 2011) with an aim to establish equality between man and woman according to the Constitution, women empowerment, women entrepreneurship, women rehabilitation that means proper development of women in our country and to protect women from all sorts of oppression, in other words this policy desires to ensure women's safety in every stage. In the second part of this policy in clause 19.1, it has been mentioned that the policy aims to stop all sorts of violence against women such as social and domestic violence, sexual abuse or mental harassment, rape, dowry, acid throwing. But just after the declaration of this policy we saw reaction from a particular section of our society who opposed such noble venture of the government on the ground of misinterpreted religious law. These religious bigots are not at all ready to accept women's equality. So this national women policy will have to face challenges from a corner of our own society. Time will say how far this policy succeeds in protecting women from violence especially domestic tortures related to dowry.

PROBLEMS OF IMPLEMENTATION OF LAWS

While appropriate legislation is an important step towards providing protection against dowry-related violence, law reform alone does not guarantee implementation. Indeed, the implementation of anti-dowry provisions in Bangladesh has been disappointing, hampered greatly by the attitude and operation of enforcement agencies: the police, the administrative machinery and the judiciary.

The role of the police is more central in this regard. By emphasizing the criminal nature of dowry-related violence, the legislature itself has recognized the central role of the police in responding to it. Legal strategies encourage police intervention at various levels, placing upon them a heavy responsibility for effective and unbiased enforcement. In practice, however, the situation is grim (Menski: 1998). The paradoxical picture of governmental activism on the one hand and general policy apathy on the other finds reflection in the establishment and functioning of violence against women cell. But this cell is run by staff inadequately trained in the dynamics of dowry violence and available legal alternatives and services. Understandably such cell has assumed a mediatory role, seeking to affect reconciliation rather than pursuing the matter under prescribed criminal law. The absence of gender sensitization may result in dangerous assumptions regarding the inferior status of women, which are carried over to the place of work. Thus a woman who is trying to make a complaint about dowry harassment finds herself unwillingly dragged into a process of negotiations which she neither wants nor understands, receiving virtually no information or advice different from what her family or society would have given her. In cases of reconciliation the follow up procedure is the least efficient part of the process. Summons for effective monitoring are either not sent or, if they are and couples do report back, they are summarily dismissed without allowing the woman a chance to voice her opinion (Vanita: 1987).

The police frequently hesitate to intervene in what is perceived as a family matter. It is only after intense pressure from the aggrieved party or social organizations that a case is registered, which in the event of a dowry death is usually registered as a suicide, changed only after much persuasion into murder (Jha and Pujari: 1996). This follows a lapse in ordinary procedural duties of providing the complainant a copy of the First Information Report (FIR) informing her of her legal rights and further judicial procedure.

The Bangladeshi criminal justice system is evidence-based and requires adequate incriminating material for prosecution. Instances often indicate that the policy may be guilty of collusion and gross misconduct. Relevant evidence may be completely ignored or tampered with so that it fails to build a good case admissible in law, defeating the ends of justice. Courts have often lamented the callous and almost prejudiced stance of the investigating officers, reprimanding them for exonerating culprits despite clear evidence of their guilt. Police malfunctioning and apathy has taken many forms; among them undue influence in recording dying declarations, delay in sending the body for post-mortem, intimidation of prime

witnesses and exploitation of the legal ignorance of both parties to extort money as a price to build a good case in their favor.

Along with the corruption, deliberate lapses of duty and the pre-conceived mind-set of the police, frequent transfers of the functionaries add to the piecemeal preparation of the case. As the case file goes through the many hands, the seriousness of the situation is lost on the officers, permitting a thoughtless and disinterested mechanical approach. All such factors combine to make it difficult to generate a fair and just approach from machinery turned corrupt, apathetic and gender-biased causing disillusionment among the victims, preventing them from reporting violence in the home and so reinforcing the fact that such violence so often goes unreported.

The role of the administrative machinery in the implementation of the anti-dowry law is equally to be found wanting. As administrative agents, government doctors, prosecutors and other relevant agencies play an integral role in the enforcement process of the legal provisions pertaining to dowry. Practice reveals that agents of this tardy administrative machinery are increasingly guilty of professional misconduct.

Studies have shown that doctors, too, can fall prey to greed and become manipulative. Collusion with the interested party is not unusual. It is quite common for wrong fitness certificates to be given to fabricate dying declarations in favour of the accused. Postmortem reports are similarly skewed. Vital evidence is thus destroyed, killing the prosecution even before the case has begun. Counsellors, both public and private, commonly exhibit a mercenary attitude that cuts across professional obligation and, instead protecting the interests of the client, extends to colluding with the defence for personal gain. Moreover, the propensity to shun dowry cases as being unprofitable leaves victims with little hope of achieving justice, even after withstanding untold pressures not to approach the court.

Although an increase in the number of dowry death cases is evident, only a tiny proportion are reported, of which fewer still reach trial and judgment. On being asked about possible explanations, a sample of judicial magistrates and judges interviewed opined that the courts were at the mercy of the evidence placed before them. Faulty and fabricated evidence or a complete lack of it, circumstantial evidence which might prove to be inadequate, lack of proof and corroborative evidence, prime witnesses turning hostile and hesitating to depose, plus the self-contradictory nature of the legal provisions, were cited as major difficulties faced by the court in arriving at a fair and just verdict. Apart from procedural inadequacies, the attitude of the judiciary towards gender equality which stems from the values of the patriarchal society of which they are a part may be seen as an important component in preventing a truly impartial appraisal of dowry offences and crimes against women.

Moreover, the dowry system and dowry-related violence are issues which cannot be addressed in isolation. Any discussion of the subject must be placed within the socio-economic and cultural framework of the complex Bangladeshi society, if effective answers are to be found to the unabated dowry crimes and lack of commensurate prosecution under law. Dowry crimes may be linked to socially structured and highly distorted traditional expectations about dowry giving, engineered to foster the inferior status of the woman. Strong societal and religious dictates continue to demand the marriage of a girl to a man of appropriate caste and class, subjecting her family to grave censure and disgrace if they fail to perform this religio-cultural duty. As Monsoor (1999) discussed in her research that most parents are not opposed to giving a dowry to their daughter, seeing it essentially as the maximum price a family is willing to pay to settle her in matrimony and also to safeguard their social standing, creating in the process a dangerous asymmetry between the two parties to the transaction. Associated with this belief is the general consensus that divorce and separation are a disaster for women, who should go to great lengths to avoid them.

In fact, the natal family's attitude towards recurring dowry-related violence is seen largely to determine whether the girl would opt out of a bad marriage and seek legal recourse to bring dowry offenders to book. Studies show that all the women who refused to return to violent husbands were those whose families concurred in the decision. All those who returned to continuing violence which could ultimately result in a dowry death were women whose parents were willing to humiliate themselves and concede to the unreasonable demands of the husband, if he would only agree to take her back (Vanita: 1987). A woman finds herself under pressure from her family to return to a violent marriage and adjust to the ways of her real home, reinforcing the concept that her natal home is no longer her home. Negotiations are usually kept within the family for fear of social disgrace or even defiance to the husband.

CONCLUSION

Dowry is a social reality in Bangladesh. Despite anti-dowry laws and government's legal and other interventions to address dowry and dowry-related violence against women, agitation and protests and actions by government and nongovernment organizations at national and international area, the evil persists and is aggravating. Over the last two

decades, violence against women has become one of the most visible and articulated social issues and dowry multiplied the issue in Bangladesh. Dowry related violence occurs at individual level, in the family within the general community. Today all sections of the society are concerned about the issue and anti-dowry movement, and legal reforms are being made against women oppression and violence.

In the society of patriarchy, the subordinate status of women, illiteracy, ignorance, prejudice, and limitations of law and criminal justice system might be the underlying causes. Women of bridegroom's family are demanding dowry and committing violence against women of another family. Even the women themselves also are not able to realize situation. They sometimes accept violence against them as usual. In Bangladesh it is difficult to change anything by the government initiatives alone due to resource scarcity. So there is the need for collaborative efforts of GOs and NGOs that can stop dowry prohibition and reduce dowry related violence and others violence against women. Based on the study of the problem of dowry and related violence against women, it appears that there is a dire need of a comprehensive national policy on all forms of violence against women. The proper implementation of the dowry prohibition laws and fair justice must be ensured provided that the perpetrators do not get escape from the trial process with excuse of evidence or proof. Awareness raising measures through mass media in the society against cruel crime like domestic violence must be undertaken by the government and the NGOs. Educational programs with special focus on girl's education, legal aid education, illiteracy eradication etc. at family level needs to be paid attention. Government should activate violence monitoring cell so that they function as per the set goals. Anti-dowry monitoring cell should be established at union and upazila levels. Legal aid and support services must be expanded for the victims and quick trial of cases must be done and the perpetrators must be brought under punishment. Finally, to eradicate the violence relating to dowry, the women themselves must wake up to their conscience. They have to realize that the inferiority imposed on them is not their destiny rather their deprivation. Such deprivation can be removed only if the women become empowered and enlightened.

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Child Abuse and NGO's Initiatives in Bangladesh: A Critical Review

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ABSTRACT: This paper aims to improve our understanding about the prevalence and determinants of child abuse in Bangladesh. Another thing is to focus on the activities that are taken by the NGOs in this perspective, which is trying to improve the “**abusive**” condition & give the children who are directly or indirectly affected by the various abusive conditions a path of better future. The information was collected from 36 children aged 08-15 years is given sheltered by the NGO named “**APARAJEYO BANGLADESH**”. Findings revealed that a large number of the children are in the labor force, although the country laws prohibited child labor. The prevalence of child abuse and exploitation was widespread in all over Bangladesh. The incidence of physical assault is much higher among younger children although the probability of other types of abuse was higher among older children. Boys are more exposed than girls to abuse of any kind. Poverty is also significantly associates with child abuse. The out-of-school and the illiterate children, landless and unskilled laborers are more likely to be abused than others when age and sex of children are controlled. In this review it is highlighted on the causes of child abuse & given some recommendation to improve their (Children) condition with public awareness.

KEYWORDS: Child abuse, NGO, Bangladesh, Legal framework, Interventions.

1 INTRODUCTION

An estimated 300 million children worldwide are subjected to violence, exploitation and abuse including the worst forms of child labor in communities, schools and institutions; during armed conflict; and to harmful practices such as female genital mutilation cutting and child marriage. Millions more, not yet victims, also remain without adequate protection.

Today's Children are the architect of the golden future of any nation. For the establishment of a strong welfare nation it is necessary that they should be grown up by a sound & perfect environment as well as providing them every needs of life, the environment where they can live in sound health with mental, physical, moral & social privileges. But scenario is quite different in Bangladesh. Though it (Bangladesh) is called developing country but the reality doesn't support so. Like other developing countries we have a common problem of over-population. Children are not apart from this. As a result of over-population & various crises children are often facing lots of problems, they are abusing in various forms in different sectors .Millions of Bangladeshi children face a childhood that is starkly and brutally different from the ideals that were adopted in The Millennium Declaration, in 2000, by all countries, as a blueprint for building a better world in the 21st century. Poverty is denying children their dignity, endangering their lives and limiting their potentials. Abuse, exploitation and violence against them rob of a secure family life, which every child has a right to enjoy. It is a positive sign that many NGO's have extended their hands towards the helpless or the victims out of child abuse.

2 SOME PERTINENT LITERATURE

2.1 WHAT IS CHILD ABUSE?

Child abuse can be defined as causing or permitting any harmful or offensive contact on a child's body and any communication or transaction of any kind which humiliates, shames, or frightens the child. Some child development experts go a bit further, and define child abuse as any act or omission, which fails to nurture or in the upbringing of the children.

2.2 FORMS OF CHILD ABUSE

Child maltreatment refers to four types of victimization against children; they are:

- Physical Abuse
- Emotional Abuse
- Sexual Abuse
- Neglect

Physical Child Abuse:

Physical abuse is the non-accidental infliction of physical injury to a child. The abuser is usually a family member or other caretaker and is more likely to be male. Many physically abusive parents or the people doing abuse insist that their actions are simply forms of discipline, ways to make children learn to behave. Physical abuse can include striking a child with the hand, fist, or foot or with an object, burning, shaking, pushing, or throwing a child; pinching or biting the child, pulling a child by the hair or cutting off a child's air.

Emotional Child Abuse:

Emotional abuse is the rejecting, ignoring, criticizing, isolating, or terrorizing of children, all of which have the effect of eroding their self-esteem. Emotional abuse usually expresses itself in verbal attacks involving rejection, scapegoat, belittlement, and so forth. Because it often accompanies other types of abuse and is difficult to prove, it is rarely reported. Emotional child abuse may seem invisible.

Sexual Child Abuse:

Sexual abuse, defined as any sexual act between an adult and a child, has components of both physical and emotional abuse. Sexual abuse can be physical, such as inappropriate fondling, touching and actual sexual penetration. It can also be emotionally abusive, as in cases where a child is forced to undress or exposing a child to adult sexuality. Apart from the physical damage that sexual abuse can cause, the emotional component is powerful and far reaching. The layer of shame that accompanies sexual abuse makes the behavior doubly traumatizing. They may believe that the abuse is their fault, and the shame is devastating and can cause lifelong effects.

Child prostitution and exploitation of teenage children, in various forms, are common in Bangladeshi society although this is not readily admitted. Prostitution is a flourishing business in the country, as many children under the age of 18 are driven to prostitution as a means of day-to-day survival and lack of opportunity, and unknown numbers of underage girls are forced to accept prostitution as a profession every day. They suffer acute social exclusion, as they are unable to re-enter mainstream society, and are thus condemned to work that confirms and reinforces their marginalization.

Child Neglect:

Child neglect is the most frequent form of child abuse. Neglect is an approach of failing to provide for a child's basic needs, endangering a child's physical and psychological well-being. Child neglect is not always deliberate. Sometimes, a caregiver or the person responsible for the children becomes physically or mentally unable to care for a child, such as in untreated depression or anxiety. Other times, alcohol or drug abuse may seriously impair judgment and the ability to keep a child safe. The end result, however, is a child who is not getting their physical and or emotional needs met child neglect.

2.3 CHILD ABUSE IN BANGLADESH:

2.3.1 REASONS FOR CHILD ABUSE IN BANGLADESH:

Emotional and physical abuse against children is probably one of the oldest issues in the history of human civilization. Children were never fully safe from adults, despite the nice words about children such as, children are pure like flower;

children are innocent like angels; children are the future of the nation etc. Rather, the extent of violence against children has increased over time. The main reason for child abuse could be the conflict of interest and power between adults and children. Adults always tend to impose their choices on children without taking into consideration children's expectations. If children do not want to follow adult's decision they are likely to have abusive behavior, physical punishment and other forms of cruelty from adults. Lack of awareness about child rights among most of the adults could also be considered as one of the contributing factors towards the incidents of violence against children. Some other specific reasons are given below:

(a) Lack of Awareness about Child Rights among Adults and Children:

Although children are very much expected in our personal and family life, most of the adults do not have the adequate knowledge about the rights of the children. As a result, in most cases, adult's behavior towards children is not always supportive to the welfare and overall development of the children. Children also can not protest against the violation of their rights as they are not fully equipped to do the same.

(b) Adults Negative Attitude towards Children:

Adults do not usually see children as human being. Rather they consider children as some kind of special species, who are fully dependent on others. Adults are used to forget about the potential that children have and their special need as children.

(c) Lack of Opportunity for Children to Express Opinions:

Right to express opinions is one of the fundamental rights of the children recognized by the national and international instrument. However, in reality, children usually do not get the opportunity to share their own feelings on matters that have a direct or indirect effect on their lives. Adults have a general feeling that children are not capable to form their opinions regarding good and bad things and thus impose decisions on children, which sometimes turn to an act child abuse.

(d) Lack of Proper Implementation of the Laws Relating to Children:

The children of Bangladesh are seemed to be lucky in a sense that a Children Act was enacted in 1974 in Bangladesh, which was quite early in comparison with the emergence of the UNCRC in 1990. The Children Act 1974 provided almost all necessary rules and regulations in order to protect the rights of the children of Bangladesh. However, it is really unfortunate that all those good things are yet to be fully materialized.

(e) Non-availability of Children's Own Organizations:

There is no strong and effective children's organization in Bangladesh, especially in the rural areas through which children could mobilize themselves in order to protest against violent activities on children. There is also a lack of coordination among the existing children's organizations.

(f) Poverty:

Most of the people of Bangladesh live their lives with poverty. Due to the poor economic condition at family level many children used to suffer abusive behavior and physical torture by their parents. In some cases, failing to provide basic necessities parents force their children to do income earning activities at a very early age which in turn exposed children to various violent situation.

2.3.2 LEGAL FRAMEWORK FOR PREVENTION OF CHILD ABUSE IN BANGLADESH:

Law Relevant for Children in Bangladesh: The spirit of CRC is neither new nor alien to Bangladesh not only in traditions, belief systems and social but also in the realm of law. Thus, there are both Constitutional as well as individual legal enactments on children in Bangladesh. These are given below:-

A) Constitutional Provision Relevant for Children Rights in Bangladesh:

- ❖ Directive principles of State Policy - Articles 15, 17 and 25 (1).
- ❖ Fundamental Rights - Article 27, 28 (1), (3), 31, 32, 39 (1) and 39 (2).
- ❖ Power of Judicial Review - Article 26 (1), 26 (2).
- ❖ In particular, Article 27, 28 & 31 of the Constitution lay down the general principles regarding the protection of children and others from of all forms of discrimination. Article 27 of the Constitution declares that 'all citizens are equal before law and are entitled to equal protection of law.'

Article 28 of the Constitution provides that:

- 1) The state shall not discriminate only on ground of religion, race, caste, sex or place of birth,
- 2) No citizen shall only on ground of religion, race, caste, sex or place of birth, be subjected to any disability, liability, restriction or condition with regard to access to any public entertainment or resort or admission to any educational institution.

Article 31 specifies the right to protection by law. It states that 'to enjoy protection by law and to be treated in accordance with the law'.

B) Laws Relating to Children Rights in Bangladesh:

- 1) The Divorce Act, 1869 deals with the custody, maintenance and education of minor children while their parents are engaged in law suit for separation. The court may order the maintenance, custody and education of children.
- 2) The Guardian and Wards Act, 1890 empowers a designated court, if it is satisfied that it is on the welfare of minors to appoint a guardian.
- 3) The Suppression of Immoral Traffic Act, 1933 provides for punishment for forcing a girl under 18 years of age into prostitution. Abetting any one having custody or charge of the girls is also a crime. However, this provision has now been incorporated in the Act vii of 2000.
- 4) The employment of children Act, 1938 regulates the employment of children in specified industries and occupation provides for punishment of employers contravening the provision of the act.
- 5) The cruelty to Women and Children (special provision) Act, 1995 provides for severe punishment, for rape, trafficking and kidnapping of children and for dowry related deaths. This has now been repealed and replaced by Act viii of 2000.
- 6) The vagrancy act of 1943 deals with handling of people over 14 years of age who lives on alms.
- 7) Repression of Women and Children Act of 2000 (amended in 2002), provides the prohibitions for the trafficking of women and children for the purpose of commercial exploitation or involuntary servitude.
- 8) The penal code, 1860, section-372 & 373 prohibits the selling and buying of a child under the age of 18 for prostitutions.
- 9) Section-374 of penal code 1860, prohibits forced labors.

From above brief description of the child related laws of Bangladesh, it can be easily seen that most of these are concerned with protection rights.

2.4 LIMITATION WITH THE EXISTING LAWS, POLICIES AND THEIR IMPLEMENTATIONS:

1. The definition of a child in the existing laws is not only inconsistent with that of CRC but these laws also contradict one another.
2. Child abuse is not defined by any existing laws of Bangladesh.
3. Preventive aspects regarding Child abuse is absent in Bangladeshi laws. Such as prevention of poverty, discriminative Economic, Social, Cultural system, family conflicts, physical and sexual abuse is absent.
4. Rehabilitation steps taken by Ministry of social welfare are too less then present necessities. There are no reformatory steps for the crime-going children in the Bangladeshi laws.
5. Children Act-1974 does not protect a male child from the sentence of whipping. Also pro-children provisions are not at all adequately implemented owing to insufficient infrastructural facilities, lack of motivation and callous attitudes of the enforcing agencies. The mere fact the law still allow whipping encourage the use of physical violence against children instead of seeking other human ways of guiding them into a more positive behavior.
6. The guardians and Wards Act-1840 has a provision which allows court to terminate guardianship in case of incapacity, ill-treatment and neglect on the part of the guardians. There are several problems with the existing adoption procedure that it is slow, complicated and costly. And there are not many competent organizations to link up abandoned/orphaned babies with genuine foster parents.
7. There is nothing in the laws against the use of children as Agricultural and construction workers, although some of these may be more hazardous than factory work. Again there is no law against hazardous child labor in Bangladesh.

8. In Bangladesh there are no laws dealing with incest and sexual abuse or exploitation.
9. Penal Code 1890 prohibits forced labor, but the prescribed penalties of imprisonment up to 1 year or a fine are not sufficient stringent to deter the offence.

2.5 NGO INTERVENTIONS IN BANGLADESH REGARDING CHILD ABUSE:

2.5.1 ROLE OF THE NGOs IN BANGLADESH

Bangladesh has a large and most dynamic NGOs sector. It is most probably the largest activities of NGOs in Bangladesh. A number of NGOs are already engaged in organizing & offering services for the welfare & development of disadvantaged children. The passage and adoption by the General Assembly of the United Nations Convention on the Rights of the Children (UNCRC) gave the impetus to the concerned NGOs in Bangladesh to focus their attention on ensuring the rights of the children.

Bangladesh has been perhaps the most important hearth on the glove for Nongovernmental Organizations (NGOs). Some estimates place the number of NGOs Bangladesh excess of 20000.

There are many types of NGOs in the country, but most focus on development or poverty alleviation. NGOs have taken many programs to help vulnerable, less privileged, undeveloped people. Our main finding how they are working for abusive children. There are many NGOs who are working in this field but some of them can't concentrate on the main issue. Some NGOs are working excellent job.

Our Social Welfare Ministry can't implement the project specifically for the abusive & disadvantaged children because it doesn't have enough manpower & skilled persons to utilize this type of project. Many foreign organizations are funding to Bangladesh Government to improve the conditions of vulnerable children. But Bangladesh doesn't have proper plan & resource to utilize this fund. That is why they divert this fund to NGOs. One of them is PECAR project which has been diverted to **Aporageyo Bangladesh** (a NGO).

I visited two of the NGOs named "**Save the Children, UK**" and "**Aporageyo Bangladesh**" who are working for the vulnerable children. It is to be mentioned that "**Aporageyo Bangladesh**" have four existing programmes in Chittagong Metropolitan area. They are as follows:-

- APARAJEYO BANGLADESH (Bot-toly)
- APARAJEYO BANGLADESH (Laldighi)
- APARAJEYO BANGLADESH (Sholoshahar)
- APARAJEYO BANGLADESH (Bahaddarhat).

As I visited the NGOs named "Save the Children UK, Bangladesh Programme" I found the information that as they are working for vulnerable children but their programmes or project depends on the country studies. They are working for children education, nutrition, safety, giving relief in the emergency period.

The information I got from the named "Save the Children UK" that at presently they have project in area of Rangpur, Myemensing, Sylhet, Rajshahi, Tongi, Dhaka, Comilla, Jessshore, Khulna, Barishal, Chittagong & Cox'sbazar.

Other NGOs like-

- * YPSA (Chandgaon C/A Branch)
- * YPSA (Mehedibag Branch)
- * YPSA (Khulshi Branch)
- * BITA
- * UCEP

are also involve in this sector. UCEP only giving them education and YPSA is giving service in the health sector. But APARAJEYO BANGLADESH rehabilitates the street children or the children victims of child abuse.

2.5.2 FOCUSING ON TWO NGOs WORKING FOR CHILDREN IN BANGLADESH

(1) APARAJEYO BANGLADESH:

Aparajeyo-Bangladesh (AB) is a national child rights organization. It was founded in 1996 when Terre des hommes Foundation (Tdh), Lausanne, Switzerland wanted to localize their Dhaka child rights programs. The program was launched in 1976 to work with children living in and around the slums of the Dhaka city. Its goal was to reduce their unbearable poverty, distress and vulnerability caused by the harshness of slum life. In 1989, another program started to serve the children who live on the city's streets. Over the years, AB has expanded its support to promote and protect the rights of other socially excluded children. Aparajeyo-Bangladesh is a non-government and non-profit organization that was founded with the sole purpose of serving socially deprived children in the urban settings in Bangladesh. Through its programs and projects, AB gives rights-based services to children through a holistic approach.

AB complies with the **United Nations Child Rights Convention**. It believes that childhood means much more than the space between birth and the attainment of adulthood. Childhood refers to the state and condition of a child's life - the quality of those years.

AB recognizes that children are the holders of their own rights. They are not just passive recipients of charity, but active participants in their life-skill development programs. Our programs just create opportunities for them to act.

In Chittagong, AB has 4 shelter-homes where about 800 children are getting the facilities provided by the AB. Here facilities like shelter, Food, recreation, primary medical treatment, Education, motivation, counseling, skill training are providing to the children live in this shelter-homes.

When I visited there on my report purpose, I asked the manager of APARAJEYO BANGLADESH, Chittagong office, various questions. From his reply we found that AB preparing the children for the future by providing them safety, education, training, job placement etc. Generally AB provides the facilities to the children of age of 7-18 years.

AB- how Collect those Children?

In four ways, these are-

- 1) Field visit,
- 2) Child to child Contact,
- 3) Reference from Stakeholders
- 4) By Children Themselves

AB's Priorities

- Recognize the child as the subject of fundamental and inalienable rights.
- Give children a primary role in their own development, according them dignity as interlocutors and encouraging their participation in the adoption of plans and in the implementation of measures of relevance to them.
- Respect the principle of every child's right to have her/his own, cultural, family and community roots.
- Consider investment in children to be a sustainable factor.
- Consider children as a fundamental resource for the development of the country and an important indicator of its overall condition.
- Protect and empower children in street situations by addressing their needs against all forms of discrimination, abuse and exploitation.
- Prevent the exploitation of child labor, with particular attention to the most hazardous forms of child labor.
- Prevent the commercial sexual exploitation of children relative to street and brothel-based sex work and sex tourism.
- Regard trafficking and the sale of children as an intolerable form of exploitation.
- Protect child victims in contact/conflict with the law.
- Provide psychological and physical protection of the child's integrity against all forms of violence, abuse, exploitation and torture.

(2) Save the Children UK:

Save the Children UK worked in Bangladesh since 1970, providing relief during and after the war for independence from Pakistan together with local partner organizations. It has been working to protect children from violence, abuse and exploitation. In particular, it's helping children to avoid the situations in which they're most vulnerable: at work and in prison. It also helps more children get a good quality basic education.

Save the Children UK, Bangladesh

Making sure young offenders get better treatment

Improving the lives of working children

Helping children from minority ethnic groups get a good start in life

Plans for the Future

The reach of Save the Children in Bangladesh is wide — it is estimated that its programs impact almost one-third of the country's population. It plans to maintain the momentum of existing responses and introduce new initiatives as appropriate, including the following:

- Diversify its geographic presence by expanding programs in the Meherpur, Barisal and Sylhet areas;
- Build its child-focused response through stronger links with the Bangladeshi Ministry of Health and Family Welfare;
- Remain a national leader in the fight against HIV/AIDS;
- Invest in training to ensure that its food security interventions remain strong; and
- Strengthen its emergency preparedness and response capacities

Save the Children UK's program or project is taken by the country studies. As they are working for the children they are concerned about the children's education, nutrition, safety, giving relief in the emergency period (like flood, cyclone or other natural calamities).

3 OBJECTIVES OF THE STUDY

The specific objectives of our study are as follows:

1. To determine the forms and reasons of Child abuse,
2. Consequences arise out of child abuse,
3. To focus on NGOs activities in this specific arena,
4. To notify the national & international instrument which are related to reduce or abolish child abuse,
5. To draw attention along with raising awareness for child abuse to the people of our society,
6. Recommendation for successful abilities to the Government & NGOs for abolishing the Child abuse from Bangladesh as well.

4 METHODOLOGY OF THE STUDY

The methodology of the study is descriptive. Methods followed to achieve the objectives are mainly based on secondary data (*i.e.*, from the books, law journals, Acts, articles, news papers, various law reports as mentioned in the references) as well as on direct field observation.

4.1 GEOGRAPHIC COVERAGE OF THE STUDY

For the field survey we choose the Chittagong Metropolitan area. The APARAJEYO BANGLADESH (NGO) has four shelter-homes in this Chittagong metropolitan area where almost 800 children are sheltered. For finding out the present condition of the child abuse we have questioned 36 children of them who were collected from the various abusive situations. In our query session they were asked a set of selective questions formally & informally from which we have sorted out necessary information.

5 LIMITATIONS AND CONSTRAINTS

Though, present study has been accomplished with high sincerity & pre-planning but not in a large context. It has not possible to cover child abuse as a whole in Bangladesh. For that there is need of longtime initiative & favorable environment. For such limitation the study has been done on the basis of children sheltered in the 4 Shelter-home of AB (APARAJEYO BANGLADESH) in Chittagong Metropolitan area. Although, the 2 NGOs have co-operated with us but as they have their own policy they cannot go beyond it. For this reason we could not get the huge information. Another thing we observed that the children had hesitated to giving information. As they are victim of various abuses like sexual abuses which cannot be so easy for them to explain. Besides this, lack of proper education, prejudice & present social values they have common tendency of hiding information. Last but not least, it is to be mentioned here that the information from the parents of the children could not be collected.

6 FINDINGS AND RECOMMENDATIONS

6.1 KEY FINDINGS

A large number of Children victimize by various forms of abuse almost every year in Bangladesh. While physical injuries may or may not be immediately visible, the impact of child abuse and neglect is often discussed in terms of physical, psychological, behavioral, and societal consequences. In reality, however, it is impossible to separate them completely. Physical consequences, such as damage to a child's growing brain, can have psychological implications such as cognitive delays or emotional difficulties. Psychological problems often manifest as high-risk behaviors. Depression and anxiety, for example, may make a person more likely to smoke, abuse alcohol or illicit drugs, or overeat. High-risk behaviors, in turn, lead to long-term physical health problems such as sexually transmitted diseases, cancer, and obesity. Some children experience long-term consequences of abuse and neglect while others emerge relatively unscathed. The ability to cope, and even thrive, following a negative experience is sometimes referred to as "resilience." A number of protective and primitive factors may contribute to an abused or neglected child's resilience. These include individual characteristics, such as optimism, self-esteem, intelligence, creativity, humor, and independence, as well as the acceptance of peers and positive individual influences such as teachers, mentors, and role models. Other factors can include the child's social environment and the family's access to social supports.

From the review of secondary information and interviews, it appears that the shame and stigma of abuse and the tendency to blame both the child victims and survivors rather than bring the perpetrator to justice lead to silence and cover-up. This presents a serious obstacle to protecting the rights of children and combating the problem of child abuse and exploitation.

- In Bangladesh, sexual abuse and exploitation is amongst the most prevalent types of violence that affect child throughout their childhood and adolescence.
- Physical abuse is very common phenomenon. It starts in a very early age from the family. They can also physically abused by relatives, teachers, caregivers or friends.
- Emotional abuse & Neglect are often seen in our daily livings to the children.

It is very important to notice that all of this happened in a very early age & its effects is not temporary, it goes up to influence in future.

6.2 RECOMMENDATION

6.2.1 RECOMMENDATION TOWARDS THE GOVERNMENT

First of all, we think that Government should be more concern about the matter of child abuse. Because the Government is the highest institution of any country as well as it has the huge responsibilities towards the mob. So, it is too logical that to remove any problems from the society like child abuse Government should come forward first than the others.

Besides these I would like to draw attention to the Government to take into account the following recommendation:

- Government should promote programmes to raise public awareness about child abuse. By which all walks of lives would come forward to resolve child abuse in every sector of society.

- Building a protective environment for children is essential for reducing child abuse which will ensure that children are safe from any forms of abuse, harm & exploitation.
- Planning schools for children, in whatever locations & situations, should certainly include consultation with children about their daily habits, their definitions of educational needs & their personal likelihood of availing themselves of schooling opportunities.
- Programmes to remove children from high risk jobs in some of the more hazard ridden factories, shops & other occupations.
- Government should introduce programmes to make more conscious to the law enforcing agencies about child abuse.
- Provision of more strict punishment on child abuse should be established in existing laws that relates to children.

6.2.2 RECOMMENDATION TOWARDS THE NGOs

From our observation we found that the NGOs are doing excellent job on child affairs. As per our observation, the NGOs are mainly working on urban areas but the backward areas are still out of there functioning. So, we would like to mention here the NGOs should extend their functioning procedure in every knock & corner of our country.

However, as per our concern the NGOs ought to focus on those points given below:

- NGOs should introduce better project that promotes the rights of the children
- Medical facilities should be upgraded for those children who are facilitating by NGO's
- NGOs should be more emphasis on Education programmes
- Food & shelter facilities should be ensured to the children on the priority basis
- NGOs should have a special cell for close monitoring on the vulnerable child abusive areas
- NGOs should provide legal aid for the children who are victimized by sexual abuse & have no capacity to get the facility of legal opportunity
- Helpline service should be promote by NGOs

7 CONCLUSION

The children are probably the most neglected members of society and hardly have any voice, even within the home. They may experience abuse at homes, in leisure activities at school, in fact anywhere. The abuse is usually caused by someone the child knows and rarely by a stranger. It is also important to recognize that children can be abused by fellow mates. As a result, they are consistently becoming easy victims of all sorts of child abuse. Though a number of NGOs are already engaged in organizing & offering services for the welfare & development of the disadvantaged children, but it is not serving as per the demand of the situation. Abuse against children must stop and the judiciary, law enforcing agents and the parents and guardians of children themselves, must be sensitized to the provisions of the Convention on the Rights of the Child and the law protecting children in Bangladesh. Furthermore, children need to be protected from vested interest groups and acts of impunity towards children by those purporting to protect society must be dealt with seriously and in accordance with the law. Government should launched a general campaign to sensitized people to understand that physical punishment, beatings in schools, factories, shops & all places of employment are violations of child rights that creates child abuse. Children should include in the idea of having participate directly in the programmatic planning affecting their daily lives. A step-by-step approach to the implementation of the existing laws, including reformulation & repeal of the existing laws in the light of prevailing reality & the provision rights of CRC. NGOs should be persuaded by the Government to adopt a strict self-imposed code of conduct, the violation of which should lead to a strong disciplinary measure. There should be proper steps from the Government side for rehabilitation of abusive & reformations of the crime-going children. We believe one day will come when there would be no child abuse, no discrimination to the children & the children of Bangladesh will stand at the same ground. Every individual of the society should be aware of child abuse & its bad effect, because it can hamper the society as well as demolish the social system. Individual or family counseling can help by saying "Say Yes for the Children" and it should be implemented for the sake of establishing child rights on the society. Children should be treated in such a way that they can never feel themselves helpless.

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Socioeconomic Analysis of the Migrated Rickshaw Pullers in Comilla City of Bangladesh

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ABSTRACT: Rickshaw is very popular as a mode of transport in Bangladesh. Every year from different part of Bangladesh a large number of literate and illiterate people join the labour market. Because of the insufficient jobs in the labour market, most of these people try to find jobs in the informal sector like rickshaw pulling. This study is conducted to analyze the socioeconomic conditions of those people who are involved in the rickshaw pulling occupation in the city of Comilla, Bangladesh. The objectives of this study are to find out the causes of migration, asses the demographic status and the previous occupation and finally analysis the income-expenditure status and remitting behaviour of the migrated rickshaw pullers. 150 rickshaw pullers have been randomly selected for the study purposes. The findings of the study reveal that rickshaw pulling is an easy way of earning more money and employment but the social status of the rickshaw pullers are not satisfactory and it is not an economically sufficient way to earn the livelihood in the long run.

KEYWORDS: Earnings; expenditure; migration; remittance; seasonal variations.

1 INTRODUCTION

Bangladesh is one of the most populated countries in the world where 35.2 percent of the rural people live below the poverty line[1]. Lack of assets, limited employment opportunities, high illiteracy rate and high income inequalities force many rural people to migrate to urban area for better employment opportunities, improved livelihood and better amenities. However, due to lack of education and industrial skills, these migrated rural people cannot find employment in the formal sector and other related sectors. These migrated people mostly find jobs in different informal sectors such as hotel and restaurant, petty retail trade, transport, construction and domestic services. Among these informal sector activities rickshaw pulling attracts a greater number of migrated people. The people who earn their livelihood by pulling rickshaw are called the rickshaw puller. The cycle rickshaw as a local means of transportation are widely used in major cities of the South East-Asia and South Asia particularly in Bangladesh and India for the shorter distance[2]. In Bangladesh, it gets popularity because it is safe and convenient for the shorter distance as well as the cheapest means of transportation. Though rickshaw pulling bears a symbol of poverty but provide bread and livelihood for those people who are coming from economically backward area and largely depend on this profession[2]. Earlier studies [3,4] have analyzed different aspects of the rickshaw pullers in the Dhaka city but there is no existing research on the rickshaw pullers in Comilla city.

Rickshaw is widely used and very much popular for short distance in Comilla city. A large number of migrants initiated their urban career in this sector. But we have limited information about them. Who are these people? Where these people come from? What are the factors that push them to migrate? What are the reasons of choosing this occupation? So, the purpose of this study is to conduct a research to know the several aspects of the migrant rickshaw pullers. The study is conducted in Comilla city with the following specific objectives:

- i. To understand the demographic characteristics and previous occupations of the people who engaged in rickshaw pulling.
- ii. To find out the causes of migration of rickshaw pullers.
- iii. To analyze income-expenditure status and remitting behaviour of the migrant rickshaw pullers.

The remaining of the paper is organized in the following way. In section 2, the background of the study area is discussed. Section 3 presents the methodology of the study. We analyse and discuss the result and findings from the study in section 4 and section 5 concludes the paper.

2 BACKGROUND OF THE STUDY AREA

Comilla city is selected as study area which is located at 23.4583° N latitude and 91.1833° E longitude in the south eastern of Bangladesh. Comilla is about hundreds kilometers south-east of Dhaka city. It covers a total area of 11.47 square kilometers and had a population of 168378 where male 52.56% and female 47.44%. The literacy rate among the people was 55%. The city was connected by Grand Trunk road, railway and airport as well as it is the transit point between Dhaka-Chittagong highways. The city contains trade and cottage industries especially 'Khadi' textile, Bakhrabad Gas Field, Export Processing Zone (EPZ), and BARD which is well known for research on Rural Development. On the other hand Comilla is well known as a city for education having a Public University (Comilla University), Secondary and higher secondary education board, Medical College, Cadet College, Zilla School, Polytechnic institution and also a lot of educational institution.

3 METHODOLOGY

To achieve the objectives of the study, data has been collected using a structured questionnaire from 150 rickshaw pullers who have migrated from different parts of Bangladesh and currently active in Comilla city. In order to meet the objectives, the entire study is based on primary data and data have been collected through face-to-face interview in 2014. The city has been divided into five strata according to the following function, i.e. access to the city (Tiprabaazar, Cantonment), core of the city (Thomson Bridge), medical centre (Medical area), residential area (Doulotpur) and education centre (Kotbari). The reason behind the selection of the area has been the availability of a reasonable number of respondents and availability of easy communication to each the area. On the basis of stratified random sampling, 30 migrated rickshaw pullers from each stratum were randomly selected and the selected pullers were interviewed. After collecting data, it have been checked and verified to make sure that answer to each item had been properly recorded. Collected data have been tabulated and analyzed using descriptive statistics. Figures and diagrams are used to represent the findings of the present study.

4 RESULTS

4.1 SOCIO DEMOGRAPHIC STATUS OF THE RICKSHAW PULLERS

Demographic factors can be divided into age, education and marital status. For the socioeconomic analysis of the rickshaw pullers, it is important to estimate the demographic status of the rickshaw pullers. We discussed the results in the following subsection.

4.1.1 AGE DISTRIBUTION

From the survey it has been found that only 2% of the rickshaw pullers' age is below 20 years and the mean age of the rickshaw pullers is 35 years. Since this occupation requires more physical energy, the percentage of the aged rickshaw pullers is very low. Yet 6% of the aged rickshaw pullers who are above 49% are visible for pulling rickshaw. In this case most of them claim that their children do not want to take their responsibility. So they find no other way to earn their livelihood at this and are engaged in this occupation.

4.1.2 LEVEL OF EDUCATION

Education is one of the most important indicators to determine the status of a people in the society. The distribution of the respondents according to the education status is reported in table-1. Generally rickshaw pullers have come from the economically backward family, so the level of education among the rickshaw pullers is very poor. Illiteracy is very common among them (30%). The survey result shows that about 40% of the rickshaw pullers have completed their primary level of education. Around 24% of the rickshaw pullers have secondary education.

Table 1. Distribution of respondents according to educational levels

Education level	Frequency	Percentage
Illiterate	45	30
Primary level (class 1-5)	60	40
Secondary level (6-10)	35	23.33
SSC and above	10	6.67
Total	150	100

4.1.3 MARITAL STATUS

Marital status is one of the factors for the determination of migration. Among the married person the migration rate is high than the unmarried person. From the survey we have found that most of the migrated rickshaw pullers (82%) are married whereas 16% are unmarried and very few (2%) are widower/Divorced. High engagement of migrated married person in this profession implies that a married person has the responsibility to maintain his family and always have a tendency to earn better income to meet the daily needs of his family

4.2 PREVIOUS OCCUPATION OF THE RICKSHAW PULLERS

To know the socioeconomic conditions of the rickshaw pullers it is necessary to analysis the previous occupation. Table-2 shows that 64% of the rickshaw pullers were agricultural labourers and farmers where Construction labourers (6%), Hawkers (2%), Workers in hotel-restaurant (4%), Day labourer (6%), non-workers (4%) and other workers (14%).The reason is that Bangladesh is an agricultural country where a large part of the population earns their livelihood by working in the agriculture sector .But due to low wage, over-crowding, high input cost and lesser amount of output in the agriculture, sector they are forced to earn their supplement income by rickshaw pulling.

Table 2. Distribution of the respondents according to previous occupation

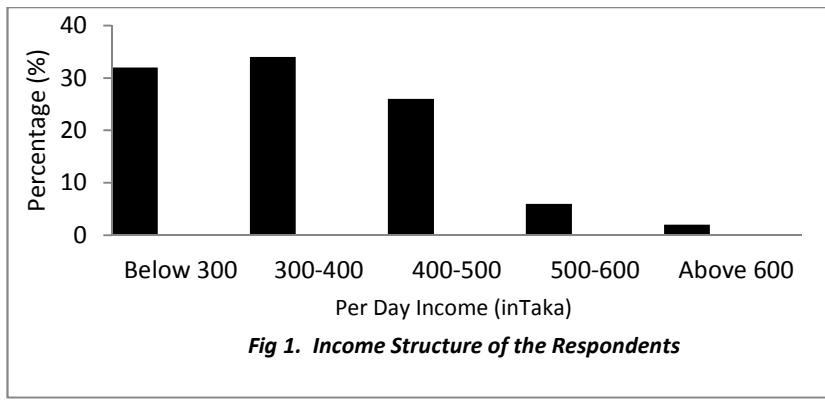
Occupation	Frequency	Percentage
Agricultural laborers	78	52
Farmers	18	12
Laborers in construction	09	6
Hawkers	03	2
Workers in Hotel-restaurant	06	4
Day labor	09	6
Non workers	06	4
Other workers	21	14
Total	150	100

4.3 SEASONAL VARIATION AND INCOME STRUCTURE OF THE RICKSHAW PULLERS

Compared to the other informal occupations, a rickshaw puller may earn a handsome amount of money and send a significant amount to their family. But their daily earnings are unpredictable and very much fluctuates depends on seasonal variation and distance. We present the statistics on seasonal variation of income of the rickshaw pullers in table-3. The survey result shows that due to the heat of the sun during summer most of the people prefer to use the rickshaw as transportation and about 36% of the pullers report this reason. However, 58% of the rickshaw pullers said that they earn more during the winter and suggest that during the winter they can demand higher rent. Finally 6% of the rickshaw pullers argue that they earn more during the rainy season. The earnings of the rickshaw pullers also vary because of the distance of the trip. For example, on an average rickshaw pullers charge TK.10 for the short distance, TK. 25 for the medium distance and TK. 50 for longer distance trips. Figure-1 depicts the per day income of the rickshaw pullers in Commilla city. The figure reveals that 32% of the rickshaw pullers earn less than TK. 300 per day. Earnings range for 34% rickshaw pullers is TK. 300-400 per day. Only 2% of the rickshaw pullers earn more than TK.600.

Table 3. Seasonal variation of in the earnings of rickshaw pullers

Season	Frequency	Percentage
Summer	54	36
Winter	87	58
Rainy season	9	6
Total	150	100



4.4 OWN EXPENDITURE OF THE RICKSHAW PULLERS

People who are engaged in rickshaw pulling come from rural areas and more or less poor. In order to meet the basic needs these poor people migrates to the area where they can earn more than expenditure. Since the livelihood of their family depends on their saving so they are very much conscious about their expenditure. However, rickshaw puller faces both direct and indirect cost like rickshaw maintenance, penalties and fines. Beside these rickshaw pullers also spend a part of their daily income on their daily essential items. For example, the survey results indicate that most of the rickshaw pullers' daily expenditure for food is Tk. 90, for cigarette and betel leaf is Tk. 15 and for rickshaw rent is Tk. 60.

4.5 REMITTANCE BEHAVIOUR OF THE RICKSHAW PULLERS

Most of the migrated rickshaw pullers report that they are the main income-earning person of their family. The livelihood of their family depends on their income. So, their aim is to earn more money and transfer it to their family members. Table-4 indicates that 52% of the rickshaw pullers transfer less than TK. 5000 per month to their family. For 26% rickshaw pullers this transferable range is TK. 5000-6000 per month. About 2% transfer in between TK. 8000-9000 per month and for 6% it is more than TK. 9000 per month. Frequency of money transfers is different among the rickshaw pullers. For instance, most of the rickshaw pullers (78%) transfer monthly while around 14% transfer weekly. In terms of the way of transferring money to the family survey result shows that most of the rickshaw pullers (86%) use bkash to transfer the money. A large proportion of the rickshaw pullers prefer to use bkash to transfer the money to their family members since is it quick and easily accessible. On the other hand, 12% of the rickshaw pullers prefer to use formal transfer systems such as post office and bank account for transferring money to their family.

Table 4. Distribution of respondents in terms of per month transfer of money to the family

Amount (TK.)	Frequency	Percentage
Below 5000	78	52
5000-6000	39	26
6000-7000	12	8
7000-8000	09	6
8000-9000	03	2
Above 9000	09	6
Total	150	100

4.6 REASONS FOR THE MIGRATION OF RICKSHAW PULLERS

According to the survey, most of the rickshaw pullers (92%) come from the northern part of Bangladesh and the rest of the rickshaw pullers (8%) come from other part of Bangladesh. Why a large number of people migrate from the northern part? People migrate from this region, which is very much affected by natural calamities and economic crisis [5]. From the survey, it is found that most of the rickshaw pullers (90%) claim that there are two factors i.e. natural factors (Flood and River bank erosion) and economic factors (poverty and unemployment) lead them to migrate. Table- 5 presents the distribution of the migrated rickshaw pullers according to the reasons for migration. They argue that Northern part of Bangladesh is affected monga, floods, river erosion, drought and cold waves, all of which occur more frequently and affects a large number of people who are directly involved in the agriculture activities. For this natural factors employment opportunity is very limited in this region. About 50% of the rickshaw puller state unemployment as their reason for migration to Comilla. Since they have no work so they have no scope to earn money to buy livelihood and poverty is very much common among them. So to remove the curse of poverty every year a large number of people from the northern region i.e. Gaibandha, Rangpur, Nelfhamary, kurigram, Dinajpur, Lalmonirhat and Panchgore are agreed to migrate to the place where employment opportunities are available.

Table 5. Distribution of the respondents according to the reasons of migration

Reasons	Frequency	Percentage
Poverty	48	32
Unemployment	75	50
Natural disasters	12	8
Others	15	10
Total	150	100

4.7 REASONS FOR CHOOSING COMILLA CITY

Rickshaw is the popular mode of transportation in Bangladesh. In Bangladesh, there are more than 800,000 rickshaw pullers. A large number of rickshaws are pulled in the Dhaka city which is known as the world's capital city of rickshaw. Monthly income of rickshaw pullers in the Dhaka city is up to tk. 14000 which is eight times higher than the basic minimum wage of a garments worker. In spite of higher income why people choose to pull the rickshaw in another part of Bangladesh rather than Dhaka city? In this regard they claim several reasons, i.e. political confusion, traffic jam, insecurity, rickshaw license fee , high rickshaw rent and high living cost. Most of the rickshaw pullers opine that they face many challenges during the unstable political situation. When the political party calls strike, they depend on their saving which they wish to send to their family. Some of the rickshaw pullers blame the rickshaw owners for sharing a large proportion of their income in Dhaka. For this reasons in recent time most of the rickshaw puller want to departure from the Dhaka city and choose to migrate those places where they feel save to pull the rickshaw or able to pull the rickshaw without rickshaw license, no traffic jam, income from pulling rickshaw is high but expenditure is low, low living and rickshaw rent cost, availability of various amenities and improved transport or communication system. In this regard although Comilla is far from northern region compared to Dhaka city, they consider above mentioned reasons to come to Comilla city for rickshaw pulling

4.8 REASONS OF CHOOSING RICKSHAW PULLING OCCUPATION

In the poor economic context of Bangladesh there is a surplus of labour force. In this case informal sector as well as rickshaw pulling is an effective source of employment in Bangladesh [6]. On the other hand, this occupation does not require any specialization and it is an easy way to get quick cash earning and employment [2]. From the survey (Fig. 2), it is found that 56% of the rickshaw pullers report that rickshaw pulling provides greater source of income and employment opportunities. The next most common reason is more freedom in this occupation (14%). About 4% of the rickshaw pullers mention that lack of job opportunity in his native village is the main reason of choosing this occupation.

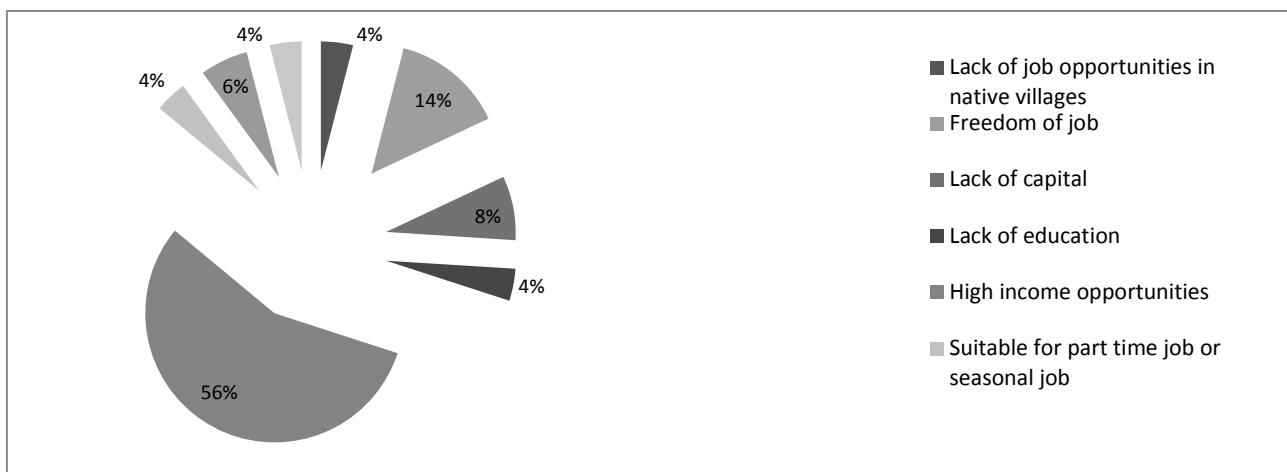


Fig. 2 Reasons for Choosing Rickshaw Pulling as a Profession

5 CONCLUSION

The findings of the study reveal that most of the rickshaw pullers have come from the rural poor society and it is an easy way for rural poor to escape themselves from extreme poverty. The cycle rickshaw as an informal activity has a significant effect on our national economy and it is a way of transferring money from the middle class to the poorest class. But the social stigma related to rickshaw puller makes the rickshaw pullers lives more miserable. This occupation does not make their life economically sufficient in long run. On the other hand, the contribution of this sector in generating income and employment has not been sufficiently appreciated. But if the government takes initiative to abolish the social stigma and given its positive role in the economy then the contribution of this sector will be significantly appreciated. So, government should take steps to improve this sector and make attention to those people who are involved in this sector to earn their live.

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Theoretical Sizing & Design of The Equipment of a 40 MMSCFD Natural Gas Processing Plant based on the operating condition of Titas Gas Field Location #A

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ABSTRACT: Natural gas processing is a complex industrial process designed to reduce impurities from raw natural gas by separation process to produce gas which is known as pipeline quality dry natural gas. In Titas Gas Field (Location #A), natural gas process plant is mainly designed to separate the water from the raw gas and make the gas transmittable to the consumer. Natural gas dehydration for Titas Gas Field mainly includes the separation of water from gas by Glycol Dehydration Process. Besides, a little amount of condensate is also separated during the dehydration process. Condensate of Titas Gas Field mainly contents hydrocarbon of C₃-C₄. As the absorbent, TEG (Tri-Ethylene Glycol) is the most preferable to use. In this paper, we represent the design of the equipment using in the glycol dehydration plant of Titas Gas Field, Location #A. Equipment sizing means calculating optimum height, diameter, number of tray, capacity, circulation rate etc. of each equipment. Calculation of height, diameter, number of tray capacity, circulating rate etc. of the equipment by using various tables, figures, charts, methods. In this paper we designed Inlet 3-phase separator, Glycol contactor tower, Lean-Rich glycol heat exchanger, Glycol circulation pump, Glycol flash separator (3-phase), Glycol regenerator (Re-boiler), Stripping still. It has to be mentioned that this is a theoretical design of the equipment for a glycol dehydration plant based on the operating condition of Titas Gas Field, Location #A which can be more efficient than the operating equipment.

KEYWORDS: Dehydration, Impurities, Absorbent, TEG, Separator and Operating Condition.

1 INTRODUCTION

This project study refers to size and design the equipment of a glycol dehydration plant based on the operating condition of Titas Gas Field (Location #A). This project work is mainly to establish a general way to design any glycol dehydration plant on several operating conditions based on the theory. This work will be a help to any further glycol dehydration plant design of several gas fields. Operating parameters are mainly the pressure, temperature, gas flow rate, water content in raw gas, desired amount of water content in processed gas, required amount of glycol to remove 1 lb water etc. There are total 18 gas wells in Titas Gas Field. Titas Gas Field (Location #A) is situated in Brahmanbaria includes well no-1, 3, 4, 5, 7. Well no-3 is known as dead well now, as it has stopped producing gas. At present, gas of well no-1, 4, 5, and 7 is processing in the glycol dehydration plant of Titas Gas Field (Location #A). We will consider a single well for simple calculation with a capacity of 40 MMSCFD. year.

2 OPERATING CONDITION OF TITAS GAS FIELD LOCATION #A

It is desired to process 40 MMSCFD natural gas (mainly CH₄) containing water and hydrocarbon condensate. To remove 1lb water content from the raw gas, 3-4 gallon TEG is needed for the dehydration process.

The conditions for the inlet and outlet of the process plant are described here.

Feed gas conditions for the plant:

Inlet pressure: 1400-1500 psi

Inlet temperature: 140-150°F
Flow rate: 35-40 MMSCFD
Water content in raw natural gas: 0.85 bbl/MMSCF
Condensate content: 0.80 bbl/MMSCF

The Dehydration plant should process the natural gas according to the following basis:

Outlet pressure: 1000 psi
Outlet temperature: 120°F
Maximum water content: 7 lb/MMSCF
Condensable hydrocarbon content: 2 US gallon/MMSCF (maximum)

3 SIZING OF THE EQUIPMENT

3.1 INLET 3-PHASE SEPARATOR

Liquid capacity of separator
= (1.65 bbl/MMSCF × 40 MMSCF/day) = 66 bbl/day.

The OD, height and settling volume of the separator can be determined [*from Appendix B, Table 1*] and given below:

Size of OD (outer diameter) = 16"
Shell height = 7.5'
Settling volume = 0.72 bbl

3.2 GLYCOL CONTACTOR

A Valve Tray type Glycol Contactor Tower will be designed under the operating condition.

A Glycol Contactor diameter is selected based on the operating pressure required with the approximate required gas capacity.

For 40 MMSCFD and 1000 psig working pressure, contactor size can be found. [*from Appendix B, table 4*]
Size of OD (outer diameter) = 48"

Gas capacity of contactor at standard condition, $q_s = 49.6 \text{ MMSCFD}$
(Standard condition means at 0.7 sp. gravity and 100°F)

Now, two correction factors are needed to be introduced.

C_t = Temperature correction factor

C_g = Sp. Gravity correction factor

Now, at 120°F and gas with specific gravity of 0.6.

We find, $C_t = 0.98$ and $C_g = 1.08$ [*from the Appendix B, Table 2 & 3*]

So, Gas capacity of contactor at operating condition, $q_o = q_s \times C_t \times C_g$

So, $q_o = 52.4 \cong 52 \text{ MMSCFD}$.

So, a 48 inch outer diameter contactor cannot handle up to 52 MMSCFD gas capacity.

So, the following data can be found. [*from Appendix B, Table 4*]

Size of OD = 54 inch

Gas inlet and outlet size = 6 inch

Glycol inlet and outlet size = 2 inch

Glycol Cooler Size = 6 inch × 8 inch

Shipping weight = 20200 lb

Calculation of number of trays in the contactor:

Gas flow rate = 40 MMSCFD
Gas sp. Gravity = 0.6
Operating Pressure = 1000 psig
Gas inlet temperature = 120°F
Gas outlet water content = 7 lb H₂O/MMSCF

The following data are listed below: [*From Appendix A, Figure 1*]

Table-1: Dew Point Depression and Water Content calculation

	Dew Point Temperature (°F)	Water Content (lb H ₂ O/MMSCF)
Inlet	120	100
Outlet	32	7
Dew Point Depression	88	93

Now, $C_{rich} = (0.995 \times 9.2) / (9.2 + 1 / 3.5) = 96.50\%$

Where, $C_{lean} = 99.5\%$, $L_w = 3.5 \text{ gal/lb H}_2\text{O removed}$

$P_{lean} = (1.103 \times 8.34) \text{ lb}_m \text{ TEG/gal}$ [from Appendix B, Table 11]

Now, Number of actual trays = 6.8 ≈ 7 [from Appendix A, Figure 14]

Here, the operating line points are given below:

Top of Column: 7 lb H₂O/MMSCF and 99.5% TEG

Bottom of Column: 100 lb H₂O/MMSCF and 96.55% TEG.

Table-2: Equilibrium line calculation

% TEG	Equilibrium dew point temp. at 120°F [from Appendix A, Figure 2]	Water content of natural gas at dew point temp. and 1000 psig from [Appendix A, Figure 1] (lb H ₂ O/MMSCF)
99.6	13	3.05
99	37	8.5
98	53	13.5
97	60	17.5
96	70	23
95	74	27.4

Now, to determine the triangulation, the following graph is plotted.

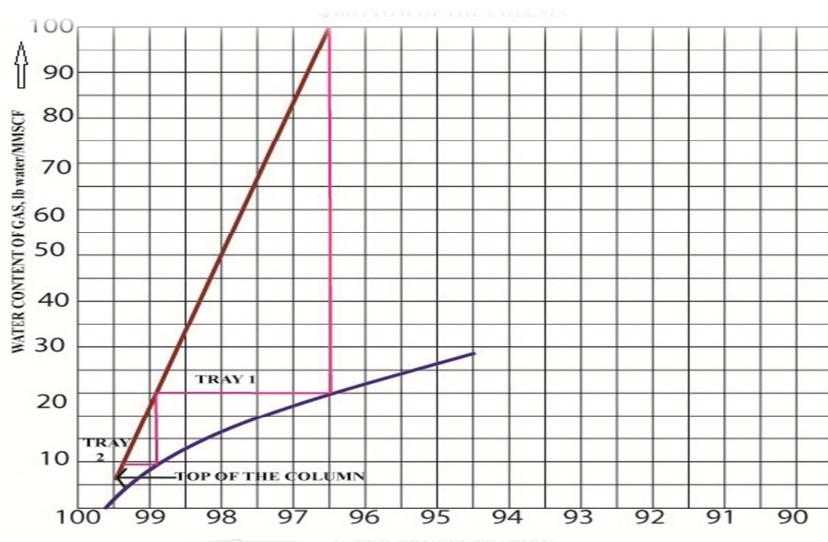


Fig-1: Modified McCabe Thiele Diagram

So, from Modified McCabe-Thiele diagram, theoretical number of trays required is 2.8.

Now, Number of actual trays = $2.8/0.33 = 8.48 \cong 9$ (assume, valve trays)

Standard field dehydration contactors normally have 24 inch spacing.

So, Number of actual trays = 9

3.3 LEAN-RICH HEAT EXCHANGER

Assume a 1-2 pass shell and tube heat exchanger where hot fluid flows in the shell and cold fluid flows in the tube.

Here, hot fluid is lean glycol and cold fluid is rich glycol.

Now, heat balance = 207383.68 Btu/hr

Amount of hot fluid = $(33.6 \times 150.17 + 1.41 \times 18) \text{ lb}_m/\text{hr} = 5071.09 \text{ lb}_m/\text{hr}$

Amount of cold fluid = $(33.6 \times 150.17 + 10.022 \times 18) \text{ lb}_m/\text{hr} = 5226.108 \text{ lb}_m/\text{hr}$

So, LMTD = 101.93°F

Correction of LMTD:

Temperature effectiveness = 0.43

Temperature difference ratio = 0.94

LMTD correction factor, $F_T = 0.94$ [from Appendix A, Figure 7]

So, Corrected LMTD = previous LMTD $\times F_T = 96^{\circ}\text{F}$

Now,

Sp. gravity of hot fluid (lean glycol) at 350°F is 1.005 $\cong 1.0$ [from Appendix A, Figure 6]

So, API⁰ = $141.5/1-131.5=10^0$ API

And,

sp. Gravity of cold fluid (rich glycol) at 175.95°F is 1.06 [from Appendix A, Figure 6]

So, API⁰ = $141.5/1.06-131.5=2^0$ API

If, the viscosities of both hot and cold fluid don't vary too much. Then the calorific temperature can be determined from the mean temperature. Though the both fluid is TEG, so the calorific temperature can be determined by following:

Calorific temperature of hot fluid. $T_c = 315^{\circ}\text{F}$

Calorific temperature of cold fluid, $t_c = 213^{\circ}\text{F}$

Assumption of U_D

Now, the viscosities at both calorific values are given here. [from Appendix A, Figure 5]

For 99.5% TEG, at 315°F ; viscosity of hot fluid, $\mu_h = 0.8 \text{ cp}$

For 96.5% TEG, at 213°F ; viscosity of cold fluid, $\mu_c = 3.10 \text{ cp}$

Now, the cold fluid passes in the tube. So, U_D will be assumed for the viscosity of cold fluid.

For, $\mu_c = 3.10 \text{ cp}$, the range of the $U_D = 10 \text{ to } 40 \text{ Btu}/\text{hr ft}^2 \text{ F}$. [from Appendix B, Table 5]

Selection of Tube length and Tube layout

A cost variation curve to select the length of tube is given here.

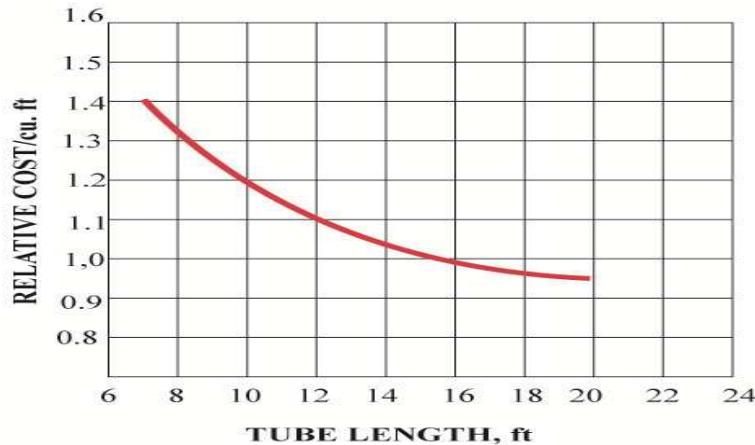


Fig-2: Cost of Tubular surface vs tube length [After D. Q. Kern, 1983]

From the figure, cost variation between the use of 12 ft, 16 ft and 20ft is not very great.

So, we assume the tube length is 12 ft

The advantage of a square pitch over triangular pitch is the tubes are accessible for external cleaning and cause a lower pressure drop when fluid flows in the direction.

A cost variation curve to select the tube OD is given here.

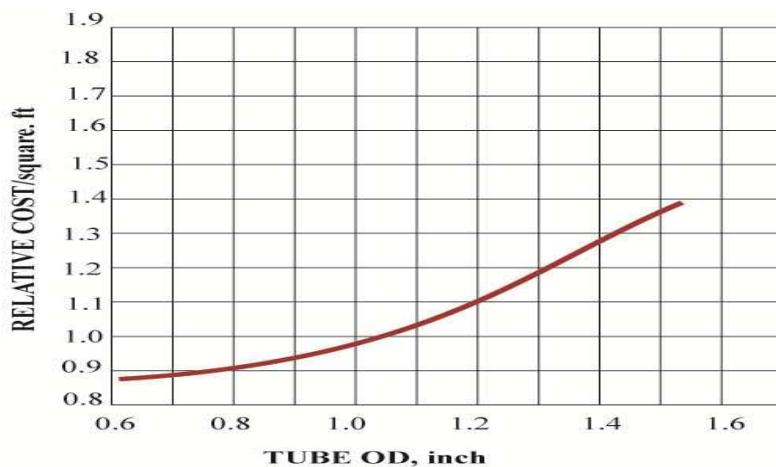


Fig-3: Cost of Tubular surface vs tube OD [After D. Q. Kern, 1983]

From the figure it is clear that the cost for $\frac{3}{4}$ inch OD is relatively low and feasible than the others. So, a OD of $\frac{3}{4}$ inch can be selected.

So. Square tube pitch selection is appreciable. Most commonly used pitches for square layout is $\frac{3}{4}$ inch. OD on 1 inch square pitch.

Generally, 10, 12, 14 or 16 BWG are available selection. We assume a 14 BWG for heat exchanger tube

Determining clean overall heat transfer co-efficient and dirt factor

Now, for a tube length of 12ft, $\frac{3}{4}$ inch. OD on 1 inch square pitch and 14 BWG we get following values. [from Appendix B, Table 7]

Tube ID = 0.584 in

Flow area per tube = 0.268 in^2

Surface per lin ft = 0.1963 in²

Tube Length = 12 ft

By Trial and error method for different U_D , clean overall heat transfer co-efficient is determined.

Methodology

- $A=Q/(U_D \Delta t)$
- Number of tubes= $A/(L \times a'')$,
- Select a nearest number of tubes. [from Appendix B, Table 7]
- Determine corrected U_D

Cold Fluid (Rich Glycol): Tube Side

- Obtain $\mu_{\text{cold actual}}$ at t_c [from Appendix A, Figure 5 & 8]
- Obtain sp. Gravity (API^0) at t_c [from Appendix A, Figure 6]
- $a_t (\text{ft}^2) = (N_t \times a'_t) / (144 \times n)$
- $G_t (\text{lb}/(\text{hr})(\text{ft}^2)) = W/a_t$
- $R_{et} = D G_t / \mu_{\text{cold actual}}$
- Obtain J_H for R_{et} and (L/D) [from Appendix A, Figure 9]
- Obtain $k((c\mu)/k)^{(1/3)}$ for $\mu_{\text{cold actual}}$ (cp) and sp. gravity (API^0) [from Appendix A, Figure 10]
- $H_{to} = J_H \times (1/D) \times k((c\mu)/k)^{(1/3)} \times \phi_t$
- $H_t = h_{so} \times ID/OD$

Hot Fluid (Lean Glycol): Shell Side

- Obtain $\mu_{\text{hot actual}}$ at T_c [from Appendix A, Figure 5 & 8]
- Obtain Sp. Gravity (API^0) at T_c [from Appendix A, Figure 6]
- $B = \text{Shell ID}/5$
- $a_s (\text{ft}^2) = (ID \times BC) / (144 \times P_T)$
- $G_t (\text{lb}/(\text{hr})(\text{ft}^2)) = W/a_s$
- Obtain D_e [from Appendix A, Figure 11]
- $R_{es} = D_e G_t / \mu_{\text{hot actual}}$
- Obtain J_H [from Appendix A, Figure 11]
- Obtain $k((c\mu)/k)^{(1/3)}$ for $\mu_{\text{hot actual}}$ (cp) and sp. gravity (API^0) [from Appendix A, Figure 10]
- $h_s = J_H \times (1/D_e) \times k((c\mu)/k)^{(1/3)} \times \phi_s$
- Clean Overall Heat Transfer Co-efficient,
- $U_C = (h_s \times h_t) / (h_s + h_t)$
- Trial and error method will continue until $U_C > U_D$

Overall Clean Heat Transfer Co-efficient is slightly lower than the range which is So, $U_C = 6.53 \text{ Btu/hr.}^0\text{F.ft}^2$ (at $U_D = 6 \text{ Btu/hr.}^0\text{F.ft}^2$ and corrected $U_D = 4.9 \text{ Btu/hr.}^0\text{F.ft}^2$)

Pressure Drop Calculation

Pressure drop can be calculated using the following method.

Cold Fluid (Rich Glycol): Tube Side

For $R_{et} = 173$, [from Appendix A, Figure 12]

Friction factor, $f = 0.0025$

Sp. Gravity, $s = 1.06$

So, Pressure Drop

$$\Delta P_t = f G_t^2 \ln(5.22 \times 10^{10} D_t s \phi_t)$$

$$= 0.0145 \text{ psi}$$

Hot Fluid (Lean Glycol): Shell Side

For $R_{es}=1600$, [from Appendix B, Figure 13]

Friction factor, $f = 0.003$

Sp. Gravity, $s = 1$

Now,

No. of crosses, $N+1=12L/B= 36$

$D_s = 19.25/12=1.604$

So, Pressure Drop

$$\Delta P_s = f G_s^2 D_s (N+1) / 5.22 \times 10^{10} D_{es}$$

$$=0.0637 \text{ psi}$$

Dirt Factor (R_d) Calculation:

$$R_d = (U_c - U_d) / (U_c U_d) = 0.0509 \text{ hr.}^0\text{F.ft}^2/\text{Btu}$$

So, dirt factor is $0.0509 \text{ hr.}^0\text{F.ft}^2/\text{Btu}$.

Table-3: Summary of the heat exchanger design

SHELL SIDE		TUBE SIDE
45.19	$H_{Outside}$	7.63
U_c		6.53
U_d		4.9
R_d Calculated		0.0509
0.0637	Δp Calculated	0.0145

Final selection of exchanger

Tube side:

Number of tubes = 220

BWG = 14

OD = $\frac{3}{4}$ inch

Length = 12 feet

Pitch: 1 inch square

Passes: 2

Shell side:

ID = 19.25 inch

Pass: 1

3.4 GLYCOL CIRCULATION PUMP

The required size of glycol circulation pump can be readily determined using the glycol circulation rate and maximum operating pressure of the contactor.

Water in flowing gas = 100 lb /MMSCF (at 120^0F and 1000psia)

Glycol circulation required = 3.5 gallon TEG/lbH₂O

$$\text{Circulation Rate} = (3.5 \text{ gal/TEG}/1 \text{ lb Water}) \times (100 \text{ lb Water}/1 \text{ MMScf}) \\ \times (1 \text{ day}/24 \text{ hr}) \times (1 \text{ hr}/60 \text{ min}) \times (40 \text{ MMScf}/1 \text{ day}) = 9.7 \text{ GPM}$$

Table-4: Comparison between Union Pump and KIMRAY Pump [Titas Gas Field data]

	Union Pump	Proposed KIMRAY Pump
Capacity (max.)	17.6 GPM	7.5 GPM
Speed (max)	50 SPM	28 SPM
Per Stroke	0.352 G	0.2678 G

So, to reduce the cost it is recommended to use the proposed KIMRAY pump even the capacity is lower than we needed. From Titas Gas field data, it is recommended to select KIMRAY Pump & model number is 45015 PV. [*Titas Gas Field (Location #A) Data*]

3.5 CONDENSATE FLASH SEPERATOR (3-PHASE)

A flash separator should be installed downstream from the glycol pump to remove any entrained hydrocarbon from the rich glycol. The separator is sized based on a liquid retention time in the vessel of at least 5 minutes.

The size can be calculated by following equation: [*After Sanjay Kumar, 1987, vol 4*]

$$V=Lt/60$$

Where,

V= Settling volume required in the separator, gal

t = Liquid retention time, min

$$V = 583.33 \times 5/60 = 48.61 \text{ gal} \times 1 \text{ bbl}/(42 \text{ gal}) = 1.15 \text{ bbl}$$

Now, the following values can be found. [*from Appendix B, Table 1*]

Size of OD = 20 inch

Shell height = 7.5 ft

3.6 GLYCOL REGENERATOR (RE-BOILER)

The glycol circulation rate in Gallons per Hour L, in the plant is given by following equation:

[*After Sanjay Kumar, 1987, Vol 4*]

$$L=L_w W_i (q/24)$$

$$L = 3.5 \times 100 \times (40/24) = 583.33 \text{ gal/hr}$$

An approximate calculation of the heat required in the re-boiler also called re-boiler heat load, Q in Btu/hr, can be made using the following empirical relationship:

$$Q = 2000L = 2000 \times 583.33 = 1166660 \text{ BTU/hr}$$

So, for the heat load of the re-boiler is 1166660BTU/hr, the design for the re-boiler can be found.

[*from Appendix C, Table 8*]

3.7 STRIPPING STILL

The diameter (or cross sectional area) of the packed stripping still for use with the glycol re-concentrator can be estimated, [*from Appendix A, Figure 3*] as a function of the glycol re-concentrator's glycol to water circulation rate gal TEG/lb water and the glycol circulation rate (gal/hr). The size of a stripping still is governed by vapor and liquid loading conditions at its bottom. The vapor load comprises vapor load and stripping gas flowing upwards through the still, whereas the liquid load

consists of rich glycol and the reflux flowing downwards. Generally stripping gas requirements, in the range of 2-10 ft³/gal TEG circulated. [Appendix A, Figure 3]

For a packed type design, a minimum of 4 feet packing height is provided, consisting generally of 1.5 inch ceramic, saddle type packing. This height should be increased with increasing glycol re-concentrator size, to a maximum of about 8 ft for a 1 MM BTU/hr. [After Sanjay Kumar, 1987, vol 4]

For a glycol circulation rate of 583.33 gal TEG/hr, re-boiler heat load of 1.167×10^6 Btu/hr and with intalox saddles (1.5 inch) type packing. Now, the size of the stripping still can be given following: [from Appendix B, Table 8]

Stripping column diameter = 16 inch

Stripping column height = 8 ft

The amount of stripping gas required to re-concentrate the glycol to a high percentage is 6 ft³/gal of glycol circulated i.e. the amount is 3499.98 ft³/hr

4 DISCUSSIONS & RECOMMENDATIONS

This paper work is based on the operating condition of Titas Gas Field (Location #A). Here operating conditions are the gas flow rate, wellhead temperature, pressure, gas composition, gas properties, water-content in raw gas etc. So, with the change of these conditions the total results can be changed also. This project work is mainly a model to design any glycol dehydration plant. The results we got in the overall paper are established on theoretical proof and some practical knowledge. So, the procedure to design any glycol dehydration plant will be similar as we have designed here but the results can be varied.

In the sizing of Inlet 3-phase separator the liquid capacity is 66 bbl/day. But, the OD and height of the separator is designed for the liquid capacity of maximum 100bbl/day to satisfy any overflow of gas. Though the operating condition is not the standard condition, so in the sizing of glycol contactor two correction factors of temperature and sp. gravity are introduced to determine gas capacity. And the contactor is designed for the maximum gas capacity of 52 MMSCFD. In the lean-rich heat exchanger, selection of tube length, tube layout, BWG can be varied which may affect the value of clean and dirt overall co efficient and pressure drop as well as the dirt factor. The glycol circulation rate generally exceeds the maximum circulation rate for the proposed KIMRAY pump of model number 45015PV. Theoretically this model is not recommended to use, but practically this pump is used for economic feasibility. For a general glycol regenerator, the maximum heat load is 1000000 Btu/hr. But, the heat load in the re-boiler we got in this process exceeds the maximum value. Still the re-boiler and stripping still is designed according to the maximum heat load of 1000000 Btu/hr.

This paper work is a model to design any glycol dehydration process plant. As, the project work is based on the operating condition of Titas Gas Field (Location #A) where the raw natural gas is sweet gas and water is the major impurity. So, this work is recommended to follow for those gas fields where the properties of raw natural gas are similar to the Titas Gas Field. The work is done for a single well of 40 MMSCFD and can be elaborated for multiple wells in a single process plant of higher capacity.

5 ACKNOWLEDGMENT

The authors are very grateful to Mr. Mohammad Shahedul Hossain, Assistant Professor, Petroleum & Mining Engineering, SUST, Bangladesh for his sedulous support and sufficient time. Besides, we are very thankful to Bangladesh gas Fields Company Limited (BGFCL) for giving us access to the Titas Gas Field Location #A (Glycol Dehydration Plant) and for supplying necessary data.

6 NOMENCLATURE

$^{\circ}\text{F}$ = Degree Fahrenheit

μ_c = Viscosity of Cold Fluid

$\mu_{\text{hot actual}}$ = Viscosity of hot fluid

$\mu_{\text{cold actual}}$ = Viscosity of cold fluid,

ϕ_s = Viscosity ratio for shell side

ϕ_t = Viscosity ratio for tube side

h_s = Heat transfer co-efficient for shell

h_t = Heat transfer co-efficient for tube

ID = Inner Diameter

J_H = Factor for heat transfer

k = Permeability

L = Glycol circulation rate, gal/hr

ΔT = Corrected LMTD, $^{\circ}\text{F}$
 ΔT = Temperature Difference, $^{\circ}\text{F}$
 a_s = Flow area
 a_t = Actual flow area
 A = Total Tube Area, ft^2
 a'_t = Flow area
 a'' = Surface Perlinft, in^2
 B = Maximum baffle spacing,
 bbl = Barrel
 C_g = Sp. Gravity correction factor
 C_p = Specific Heat, BTU/lb $^{\circ}\text{F}$
 C_t = Temperature Correction Factor
 C' = Clearance
 D_e = $d_e/12$, d_e = Equivalent diameter
 d_t = Tube ID
 D = Nominal OD, inch
 $D = d_t/12$,
Et al = Associates
Etc. = Etcetera
 F = Design Factor
 G_s = Mass velocity
 G_t = Mass velocity
 G_D = Dry gas

L_w = Glycol to water circulation rate, gal/lb H_2O
 L = Tube length, ft
LMTD = Logarithmic Mean Temperature Difference
 m = Amount of Glycol, lb_m/hr
MMSCF = Million Standard Cubic Feet
 n = Water content in glycol, lb_m/hr
 n = Number of tube pass
 N_t = Number of tubes
OD = Outer Diameter
 P_T = Number of shell pass
 P = Design Pressure, psi
 Q = Amount of Heat, Btu/hr
 q = Gas flow rate, MMSCFD
 q_o = Gas capacity of contactor, MMSCD
 R_{es} = Reynolds number
 R_{et} = Reynolds number
 t = Liquid retention time, min
 T = Temperature, $^{\circ}\text{F}$
 t = Wall Thickness, inch
 T_c = Calorific Temperature of Hot fluid, $^{\circ}\text{F}$
 t_c = Calorific Temperature of Cold fluid, $^{\circ}\text{F}$
 U_D = Overall Dirt Co-efficient, BTU/hr $^{\circ}\text{F}$ ft 2

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Effect of Mixing Speed and Time on Dyes Removal through Coagulation and Flocculation from Dyebath Effluent

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ABSTRACT: It is difficult to treat textile wastewater to a satisfactory degree because of high chemical oxygen demand COD, Biochemical oxygen Demand BOD, Suspended solids (SS), conductivity and highly intense colours. Colour removal from textile waste water has gained considerable attention these days. Coagulation-Flocculation is a frequently used physiochemical treatment method to decolorize textile effluents and reduce the total loads of suspensions. Jar Test apparatus is used to conduct the research work. The study focuses on determining the effect of coagulation and flocculation, optimum dosage and PH of coagulant and flocculant on the removal of reactive textile dyes from the dye bath effluent of a textile industry. In dye bath effluent two reactive dyes are present named Sumifix Supra Red E-XF gran. and Sumifix Supra Yellow E-XF gran. in ratio 0.55:0.45. Dye bath effluent has initial pH of 11. Alum is used as a primary Coagulant and two flocculants named Polymer A110 (anionic) and Polymer 202 As (cationic) are used as flocculant aids. Effect of mixing speed and mixing time is almost same for both flocculants. Maximum dyes removal is at 200 rpm for Polymer A110 which is 86% and for Polymer 202As is 72.4% which is at 180rpm. At maximum dyes removal is achieved when the mixing time is 18 min it is 85.6% and 72.5% for Polymer A110 and Polymer 202As respectively.

KEYWORDS: Dye bath effluent, Coagulation, flocculation, mixing speed, mixing time, color removal.

INTRODUCTION

Textile industry is the greatest source of liquid effluent pollution because large quantity of water is consumed in dyeing processes. 10,000 different types of dyes and pigments are being produced these days. Annual production of these dyes is estimated to be 7×10^5 tons. Annual worldwide discharge of textile dyes is estimated to be more than 280,000 ton [1, 2]. Dyes are classified according to their dissociation in aqueous solution as follows [3]. Cationic include basic dyes, anionic include acid, reactive and direct dyes while nonionic include disperse dyes. Increased demand of cellulosic fiber, requirement of better dyeing conditions and bright colours have increased the consumption of reactive dyes in recent years.

Synthesis of azo dyes is easy and economical; these are highly stable also a wide range of colours (3000 varieties) is available in azo dyes as compared to natural dyestuff so these are produced in large amounts [4]. 70% of the worldwide dyestuff constitutes azo dyes [5], so these are largest group of synthetic dyes released into environment. Reactive dyes are hydrolyzed in water in presence of alkali and this is the reason of large amounts of these dyes in dyebath waste streams. Because of hydrolysis, their fixation to fiber is less than expected. Only 50-80% of these dyes are fixed and rest is present in waste stream [6]. Release of dyes especially azo dyes in aqueous streams e.g. Rivers, lakes, cause aesthetic problems and reduces penetration of sunlight into water which results in photosynthesis reduction. Consequently there is reduction in

dissolved oxygen concentration, aquatics life and hence fish life is disturbed. Dye waste is also characterized by high BOD and COD. Further, dye waste is carcinogenic as well as mutagenic, and can cause dysfunctioning of some human organs e.g. Kidney [7, 8].

Except few simple structured dyes all azo dyes resist biodegradation using aerobic sewage plants [9]. Each treatment process has its associated advantage and disadvantages, e.g. adsorption is associated with problems like regeneration, and filtration and membrane separations have fouling problems. Although coagulation flocculation has high sludge production [10] but this process can be used before adsorption or other techniques to obtain 100% colour removal as no treatment alone can give 100% colour removal efficiencies.

Coagulation is to destabilize the charge of particles and this purpose is achieved by addition of oppositely charged colloids into solution containing impurities. After charge neutralization, colloids can stick together. This process leads to formation of slightly large particles called microflocs which cannot be seen by naked eye. If a large amount of coagulant is introduced into the system then charge reversal reduces the sedimentation and hence reduces the efficiency of the process [11]. It is also said that alum is precipitated in water in very complex form as $[Al_8(OH)_{20} 28H_2O]^{+4}$. When this large precipitate is settled down in water, it helps many colloids to be removed by enmeshment [12]. PH of solution to be treated is a major factor which plays a vital role in the removal of colloids. Usual flocculation contact time range from 15 -20 minutes to an hour [13].

Alum is used as primary coagulant with two flocculants, one is cationic with commercial name Polymer 202As and other is anionic with commercial name Polymer A110. Jar test Apparatus is employed to study coagulation flocculation on reactive dye solution. Dye bath waste from a local industry is collected which contains two reactive dyes Sumifix Supra Red E-XF gran. and Sumifix Supra Yellow E-XF gran. in the ratio Red E-XF/ Yellow E-XF = 55:45. Chemical structures of both dyes are not disclosed. The composition of dye Bath before dyeing was:

Sumifix Supra Red E-XF gran	=	2.34%
Sumifix Supra Yellow E-XF gran	=	1.88%
Salt	=	80 grams/litre
Soda ash	=	20 gm/litre
SARABID LDR (Leveling agent)	=	0.5g/litre
pH of waste	=	11

SARABID LDR is added in dye bath to improve the solubility of reactive dyes and in order to disperse them thoroughly.

LITERATURE REVIEW

Effect of coagulation alone on decolorization of some dyes was studied earlier. Effect of decolorization on some dispersed and reactive dyes was studied using Ferric Chloride coagulant. Jar test method was used to find dye removal, zeta potential distribution, suspended solids concentration, changes of the SCOD/TCOD. For dispersed blue 106 maximum removal efficiency was 97.7% at coagulant concentrations 0.93 mM ferric chloride at pH6. For dispersed yellow 54 maximum removal efficiency was 99.6% at coagulant concentrations 0.74 mM ferric chloride at pH5. For reactive blue 49 and reactive yellow 84 maximum removal efficiencies were 60.9% and 71.3% at coagulant concentrations of 2.78 mM and 1.85 mM ferric chloride at pH 7 and pH6 respectively. Conclusion was made that dispersed dye solutions are more easily decolorized as compared to reactive dye solutions using Chemical coagulation [14].

Further studies were done in order to consider the effect of coagulant along with adsorption on removal of reactive dyes. Work was done on removal of C.I. reactive red 45 and C.I. reactive green 8 using coagulation by aluminum chloride followed by adsorption by activated carbon method. It is shown that not only almost complete removal of both dyes from wastewater is obtained by combined coagulation and adsorption method but also 95.7% COD and 99.7 % TOC removal is obtained [15]. Later on experiments has been performed on waste mixtures of commercial dispersed and reactive dyes in different ratios using coagulation- flocculation method using Alum, $MgCl_2$, polyaluminium chloride and an anionic aid. Colour removal and chemical oxygen demand (COD) reduction is measured by changing initial pH of solution and coagulant type and their doses. It is evident that when percentage of reactive dyes in solution increases, demand for coagulant dose increases to obtain optimum colour removal and COD reduction. It is shown that polyaluminium chloride is more efficient in removing colour and COD, 99% and 96.3% respectively, as compared to both alum and magnesium chloride [16].

Effect of pH on polyaluminium chloride dose for reactive dyes is also studied later on. Experiments are performed on four reactive dyes namely turquoise DG, red DB-8, orange OGR and black DN. It is seen that dye removal depends strongly on pH. Maximum colour removal for turquoise DG is 99% at pH 3.5, for orange OGR 80% at pH 5, for black DN 81% between pH 4 and 5 and for red DB-8 64% at pH 5 [17]. Synthetic polymers prepared in laboratory are employed as flocculants. A synthetic

polymer from formaldehyde and cyanoguanidine prepared under acidic conditions is used for some reactive dyes and real waste water containing those dyes. It was proved that using coagulant i.e. alum and ferric salt only 20 to 40 % removal of colour was obtained while with the aid of synthetic polymer almost 99% colour removal was achieved [18]. Dye removal studies have also been performed with Polyamine flocculants. Synthesis of polyamine flocculants was done by polycondensation of dimethylamine and epichlorohydrin, organic amines e.g. 1,2-diaminoethane as modifying agent. Color removal from reactive yellow, reactive red and reactive blue is obtained as 96%, 96% and 97% respectively.COD removal is also studied and COD reduction of 90% is achieved from actual waste water [19].

Later on coagulation flocculation method has been applied to highly concentrated C.I. Acid Black 210 dye using alum and five different commercially available flocculants which include low, medium and high molecular weights Polyacrylamide Cationic and anionic Polymers as flocculants aid. Dye removal increment is taken as difference between percentage dye removal due to coagulant and flocculants and due to coagulant alone on acid black 210 dye solution. Poly-diallyl-dimethyl ammonium chloride ACCEPTA 2058 gives best dye removal increment 36.6% [20]. Coagulation /flocculation method was applied to remove colour from residual dyebath effluents of cotton/polyamide blends dyeing using reactive and acid dyes. It is found that aluminium sulfate combined with cationic organic flocculant provides almost complete decolorization. Also it reduced TOC, COD and BOD [21].

Flocculation process was used to remove Suspended solids (SS), total dissolved solids (TDS) and dyes from textile waste water using food grade polysaccharides (mucilage), which is obtained from Hibiscus and Trigonella foenum graceum commonly known as Okra and Fenugreek, as flocculant. Parameters to be studied are change in dose of flocculant, contact time, and PH for removal of pollutants from textile wastewater. Polysaccharides used in this study provided 94 % SS, 44% TDS and 35% dye with very low dose of flocculant [22]. A composite coagulant was prepared by mixing of polyferric chloride and polydimethyl diallyl ammonium chloride (PDMDAAC) and used it for decolorization of actual textile wastewater as well as for simulated dye solution. It is found that composite coagulant is far better than PFC and PDMDAAC alone and treatment with PFC followed by PDMDAAC. Composite coagulant gave 98% colour removal for dispersed blue dye and 86% colour removal using reactive blue dye [23].

EXPERIMENTAL SETUP

Jar test method was employed in this research for the removal of reactive dyes from dye bath effluent of a Textile Mill using Alum as primary coagulant and two commercially available flocculants, Polymer A110 (anionic Polyacrylamide) and Polymer 202 As (Cationic). Studying the effect of mixing speed and time on coagulant and flocculants performance of dyes removal. This research paper discusses the effect of mixing speed and time on dyes removal from dye bath effluent.



Fig 1: Jar Test Apparatus

EXPERIMENTAL METHODOLOGY

- Collection of dye bath waste water
- Alum Solution Preparation
- Flocculant Solution Preparation
- Preparation of 2M HCl Solution

- Preparation of 2M NaOH Solution
- PH Adjustment of waste solution
- Addition of Coagulant during Rapid Mix for fixed time in Jar Test Apparatus
- Addition of Flocculant during slow mixing for fixed time Jar Test Apparatus
- Settling of sample for 60 minutes
- Analysis of Sample by UV Vis- Spectrophotometer

Sample Collection:

Waste water sample of textile Dyebath effluent was collected from a local industry. Dyebath waste contains two reactive dyes Sumifix Supra Red E-XF gran. and Sumifix Supra Yellow E-XF gran. in the ratio Red E-XF/ Yellow E-XF: 55%/45%.

Chemicals:

Alum was used as coagulant. Flocculants used were polymer A110 (anionic Polyacrylamide) and Polymer 202 As (Cationic), these flocculants were given in crystalline form by Khan Associates (TownShip). Other chemical are HCl and NaOH to adjust pH of the solution.

Instruments

- **UV Visible Spectrophotometer:** HITACHI 150-20 spectrophotometer with data processor.
- **pH Meter:** Portable pH meter-8414 with pH sensor
- Weighing Balance ARAK.

Solution Preparation:

Alum Solution Preparation:

Alum solution was prepared by adding 50 gm of reagent grade crystal of alum $\text{Al}_2(\text{SO}_4)_3 \cdot 16\text{H}_2\text{O}$ into distilled water and making the volume upto 1000 ml.

Flocculant solution Preparation:

As recommended by supplier, 1% solution of both flocculants was prepared by addition of 1 gram of each flocculant into 1000 ml of distilled water. Each day fresh solution of flocculants was prepared because solution of polymers expires after 24 hrs.

Acid and base solution Preparation:

Solution of 2M HCl and NaOH was prepared.

Laboratory Glassware:

Beakers, Pipettes, Measuring cylinders, Conical Flask etc.

Determination of λ_{\max} of dyebath waste water:

Determination of λ_{\max} of dye water is necessary in order to analyze samples after treatment at this wavelength. For determination of λ_{\max} of dyebath effluent, dyebath water was added in distilled water and very dilute solution of dye waste was prepared. Reference solution used in UV visible Spectrophotometer was distilled water. Dilute solution of dyes was placed in UV visible Spectrophotometer and scanned manually in the range of the wavelengths 400-800 nm with intervals of 10 nm starting from 400nm. After this, increment of 1 nm was made between the two values of wavelengths which gave maximum absorbance. In this manner the value of λ_{\max} at which maximum absorbance of colours achieved was obtained.

Graph was also plotted between wavelength and absorbance to see λ_{\max} graphically. λ_{\max} for dye sample was found to be 536 nm.



Figure 2: UV Visible Spectrophotometer

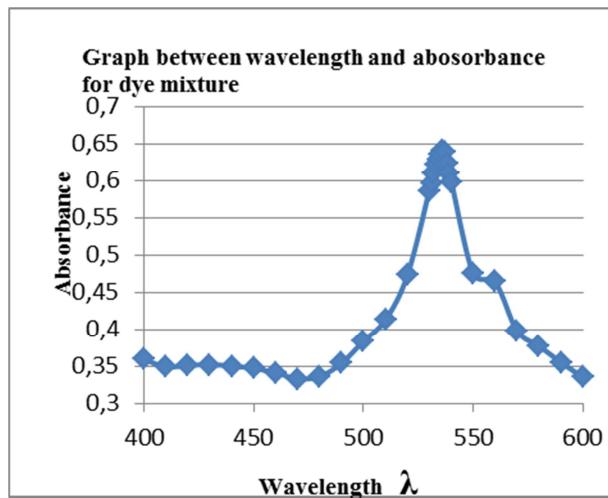


Fig 3. Graph of wavelength of dyebath waste solution vs. absorbance to find λ_{max}

Determination of Optimum pH.

1. A four beaker jar test apparatus was used for this study.
2. Beaker was filled upto 250 ml of dyebath waste water.
3. Adjust the pH of each beaker by adding HCL 2 M solution. Range of pH studied was from 4 to 11.
4. Fixed amount of coagulant (2g/L Alum) was added into each beaker and allowed for rapid mixing for 3 minutes at speed of 120 rpm.
5. During last seconds of mixing, 4 ml of flocculant (16ppm) was added into the beaker and speed reduced to 20 rpm. Slow mixing was allows for a period of 30 minutes for formation of flocs.
6. After treatment mixture was allowed to settle for 60 minutes.
7. Then 20 ml of sample was taken below 1 ml of upper layer of solution.
8. This sample was filtered and its absorbance was measured under UV Visible Spectrophotometer.
9. These experiments were separately performed with both flocculants.

Procedure with the addition of Coagulant combined with Flocculant:

1. Beaker was filled upto 250 ml of dyebath waste water.
2. Adjust the pH of each beaker by adding HCL 2 M solution.
3. Fixed amount of coagulant was added into each beaker and allowed for rapid mixing for 3 minutes at speed of 120 rpm. Optimum Concentration of coagulant was added.
4. During last seconds of mixing, flocculant was added into the beaker and speed reduced to 20 rpm. Slow mixing was allows for a period of 30 minutes for formation of flocs.
5. After treatment mixture was allowed to settle for 60 minutes.
6. Then 20 ml of sample was taken below 1 ml of upper layer of solution.
7. This sample was filtered and its absorbance was measured under UV Visible Spectrophotometer.

Effect of Mixing Speed on Percentage Colour Removal:

Experiments were performed in the same sequence with optimum pH and using optimum combination of coagulant and flocculant dosage while in each experiment, speed was varied from 100 to 200 rpm with increment of 20 rpm while mixing time of 3 minutes was used.

Effect of Mixing Time on Percentage Colour Removal:

Again experiments were performed with optimum pH of each flocculant and optimum dosages of Alum and flocculants. Mixing time varied from 3 to 18 minutes with increment of 3 minutes and mixing speed was fixed to 120 rpm.

RESULTS AND DISCUSSIONS

1. Determination of Optimum pH for Coagulation & Flocculation:

Determination of Optimum pH for Coagulation & Flocculation of mixture of Reactive Dyes using Alum as Coagulant and anionic Polymer A110 as a Flocculant.

Most important factor which affects colour removal of dyes is the pH of waste solution. In order to find the optimum pH for coagulation and flocculation jar test method was used. Fixed dosage of coagulant and flocculant was used by varying initial pH of waste solution in range of 4 to 11. Two sets of experiments were performed on Jar Test Apparatus with arrangement of four jars each set. Alum concentration was chosen to be 2 g/L and anionic flocculant (Polymer A110 1% solution) concentration 4 ml of flocculant per 250 ml of waste solution. Rapid mixing time of 3 minutes was allowed at 120 rpm with alum followed by addition of flocculant Polymer A110 with slow mixing for 30 minutes at 20 rpm. After treatment 20 ml of sample was taken and analyzed under spectrophotometer to measure its absorbance.

Table 1: Effect of pH on Coagulation Flocculation of Dyebath waste water using anionic Polymer A110

pH of Dyebath Solution	% Colour Removal (%)
4	57.0
5	65.4
6	64.6
7	70.4
8	67.0
9	60.4
10	61.6
11	63.4

Conditions:

- Flocculant = Polymer A110
- Cost of Flocculant= Rs. 350/kg
- Volume of waste= 250 ml
- Coagulant dose= 2g/L Alum
- Flocculant dose= 4ml/250 ml of waste
- Mixing Time = 3minutes
- Mixing Speed = 120 rpm
- $C_i = 863.8 \text{ ppm}$

Fig 4 shows that maximum colour removal of 70.4% is achieved at initial pH 7 of dyebath waste water. Optimum initial pH of dye bath waste water for coagulation Flocculation using anionic Polymer A110 combined with alum = 7

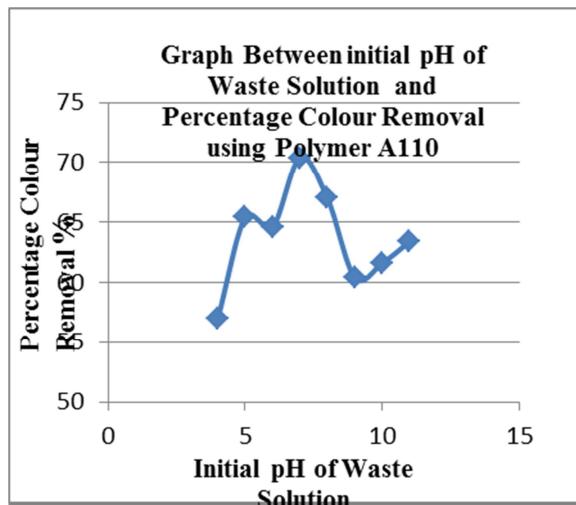


Fig 4: Effect of pH on percentage colour removal using Alum 2g/L and Anionic Polymer A110 (1% solution) 4ml/250 ml of dye bath waste water.

Determination of Optimum pH for Coagulation and Flocculation of mixture of Reactive Dyes using Alum as Coagulant and cationic Polymer 202 As as a Flocculant.

In order to find the optimum pH for coagulation and flocculation jar test method was used. Fixed dosage of coagulant and flocculant was used by varying initial pH of waste solution in range of 4 to 11. 2M HCl and 2 M NaOH solution was used for pH adjustment. Two sets of experiments were performed on Jar Test Apparatus with arrangement of four jars in each set. Alum concentration was chosen to be 2 g/L and cationic flocculant (Polymer 202 As 1% solution) concentration 4 ml of flocculant per 250 ml of waste solution. Rapid mixing time of 3 minutes was allowed at 120 rpm with alum followed by addition of flocculant (Polymer 202 As) with slow mixing for 30 minutes at 20 rpm. After treatment 20 ml of sample was taken and analyzed under spectrophotometer to measure its absorbance.

Table 2: Effect of pH on Coagulation Flocculation of Dyebath waste water using cationic Polymer A202

pH of Dyebath Solution	% Colour Removal (%)
4	57
5	65.4
6	68.2
7	67
8	64.6
9	60.4
10	61.6
11	63.4

Conditions:

Flocculant	=	Polymer 202 As
Cost of Flocculant	=	Rs 525/kg
Volume of waste	=	250 ml
Coagulant dose	=	2g/L Alum
Flocculant dose	=	4 ml/250 ml of waste
Mixing Time	=	3 minutes
Mixing Speed	=	120 rpm
C_i	=	863.8 ppm

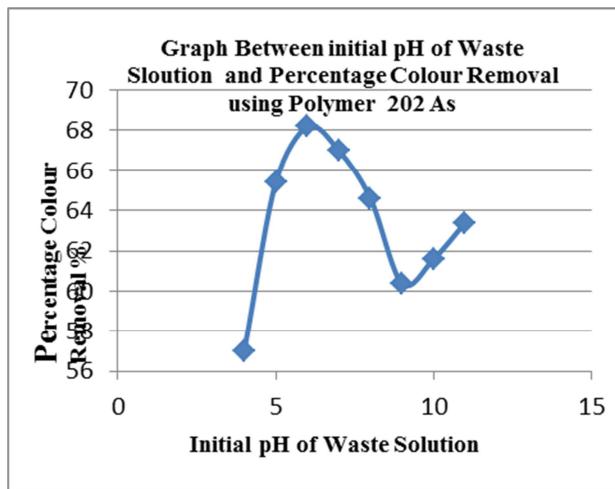


Figure 5: Effect of pH on percentage colour removal using Alum 2g/L and Anionic Polymer 202 As (1% solution) 4ml/250 ml of dye bath waste water.

Fig 5 shows that maximum colour removal of 68.2% is achieved at initial pH 6 of dyebath waste water. Optimum initial pH of dye bath waste water for coagulation Flocculation using cationic Polymer 202 As combined with alum = 6

Effect of Rapid Mixing Speed on Percentage Colour Removal using anionic Polymer A110.

Effect of Rapid mixing speed on coagulation

flocculation for removal of mixture of reactive dyes in dye bath waste is studied at the optimum pH and dosages of Alum and Polymer which have been determined before. Mixing speed range was taken from 100 rpm to 200 rpm with increments of 20 rpm, while mixing time was fixed to 3 minutes. It can be seen that with increasing mixing speed, Percentage colour removal also increases.

Table 3: Effect of Rapid Mixing Speed on Percentage Colour Removal using anionic Polymer A110:

Mixing Speed (rpm)	Percentage Colour Removal (%)
100	83.6
120	84.0
140	84.3
160	85.0
180	85.9
200	86

Conditions:

Dose of Alum used	=	2g/L
Dose of Polymer A110 used	=	8ml/250 ml of waste
Initial pH	=	7
Rapid Mixing time	=	3 minutes

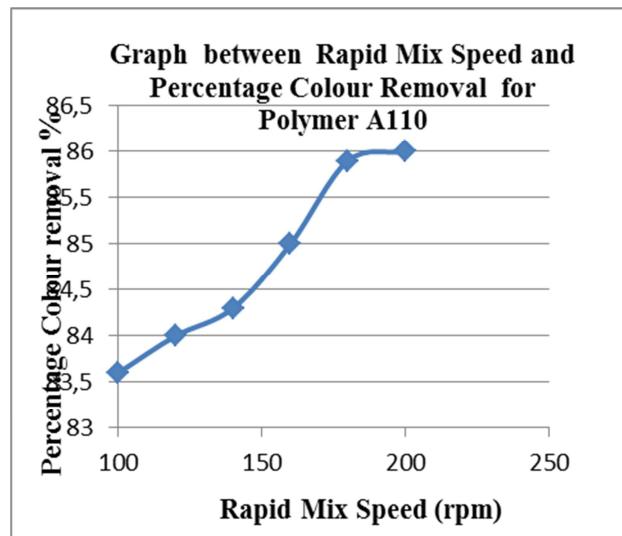


Fig 6: Effect on Percentage Colour Removal with increase in rapid mixing speed using Alum 2g/L and 8 ml of 1% solution of anionic Polymer A110.

Graph in Fig 6 shows that increase in mixing speed increases the color removal. This shows that high mixing speed enhances the performance of Polymer A110 for dyes removal from dye bath effluent. And the color removal is 86% at the speed of 200 rpm.

Effect of Rapid Mixing Speed on coagulation Flocculation of dyebath waste water using cationic Polymer 202 As:

Again effect of Rapid mixing speed on

coagulation flocculation for removal of mixture of reactive dyes in dye bath waste is studied with cationic polymer at the optimum pH and optimum dosages. Mixing speed range was taken from 100 rpm to 200 rpm with increments of 20 rpm, while mixing time was fixed to 3 minutes. It can be seen that with increasing mixing speed, Percentage colour removal increases discontinuously and maximum colour removal of 72.4% is achieved at 180 rpm.

Table 4: Effect of Rapid Mixing Speed on Percentage Colour Removal using cationic Polymer 202 As:

Mixing Speed (rpm)	Percentage Colour Removal (%)
100	70.3
120	71.5
140	70.3
160	71.6
180	72.4
200	71.9

Conditions:

Dose of Alum used	=	2g/L
Dose of Polymer 202 As used	=	10ml/250 ml of waste
Initial pH	=	6
Rapid Mixing time	=	3 minutes

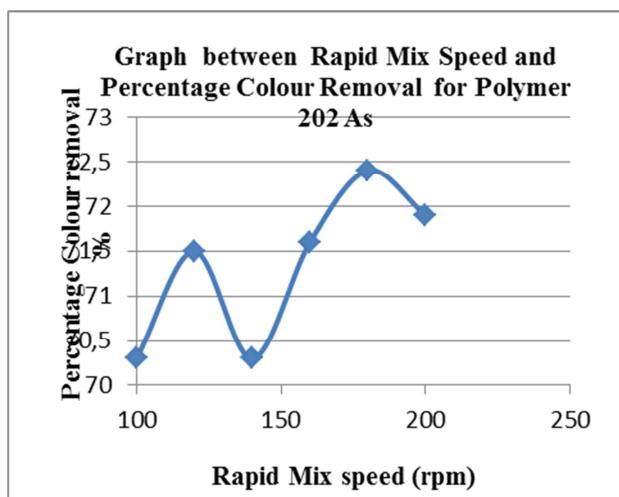


Fig 7: Effect on Percentage Colour Removal with increase in rapid mixing speed using Alum 2g/L and 10 ml of 1% solution of cationic Polymer 202 As.

Graph in Fig 7 shows that increase in mixing speed increases the color removal. This shows that high mixing speed enhances the performance of Polymer202 for dyes removal from dye bath effluent. And the maximum color removal is 72.4% at the speed of 180 rpm.

Effect of Rapid Mixing Time on coagulation Flocculation of dyebath waste water:

Effect of Rapid Mixing Time on Coagulation flocculation of dyebath waste water using anionic Polymer A110:

To investigate the effect of mixing time on dye removal by coagulation and flocculation experimentation was done with optimum dosages and pH as done before. Mixing time was varied from 3 to 18 minutes with increments of 3 minutes. Mixing speed of 120 rpm was chosen for experiments. In case of anionic polymer A110, percentage colour removal gradually increases as mixing time increases.

Table 5: Effect of Rapid Mixing Time on Percentage Colour Removal using anionic Polymer A110:

Rapid Mix Time min.	Percentage Colour Removal (%)
3	84.0
6	84.3
9	84.7
12	85.0
15	85.5
18	85.6

Conditions:

- Dose of Alum used = 2g/L
 Dose of Polymer A110 used = 8ml/250 ml of waste
 Initial pH = 7
 Rapid Mixing Speed = 120 rpm

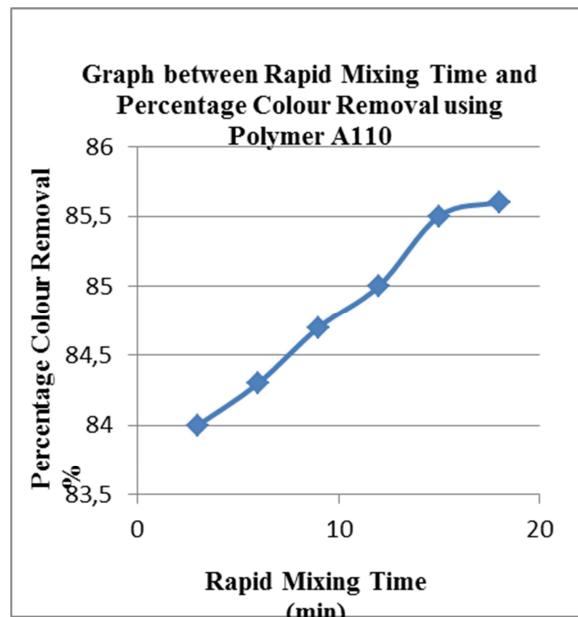


Fig 8: Effect on Percentage Colour Removal with increase in rapid mixing time using Alum 2g/L and 8 ml of 1% solution of anionic Polymer A110:

Graph in Fig 8 shows that increase in mixing time increases the color removal. This shows that high mixing time enhances the performance of Polymer A110 for dyes removal from dye bath effluent. And the maximum color removal is 85.7% when the mixing time is 18min.

Effect of Rapid Mixing time on Coagulation flocculation of dyebath waste water using cationic Polymer 202 As:

To investigate the effect of mixing time on dye removal by coagulation and flocculation experimentation was done with optimum dosages and pH as done before. Mixing time was varied from 3 to 18 minutes with increments of 3 minutes. Mixing speed of 120 rpm was chosen for experiments. In case of anionic polymer 202 As, percentage colour removal also gradually increases as mixing time increases.

Table 6: Effect of Rapid Mixing Time on Percentage Colour Removal using cationic Polymer 202 As:

Rapid Mix Time min.	Percentage Colour Removal (%)
3	71.5
6	71.8
9	71.9
12	72.2
15	72.3
18	72.5

Conditions:

- Dose of Alum used = 2g/L
 Dose of Polymer 202 As used = 10ml/250 ml of waste
 Initial pH = 6
 Rapid Mixing Speed = 120 rpm

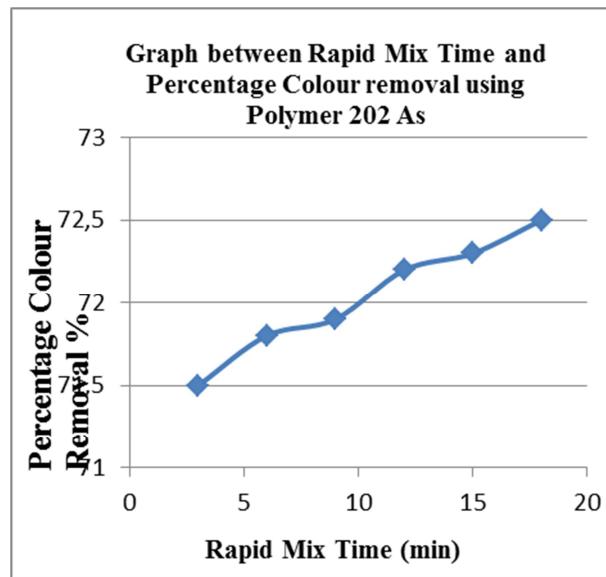
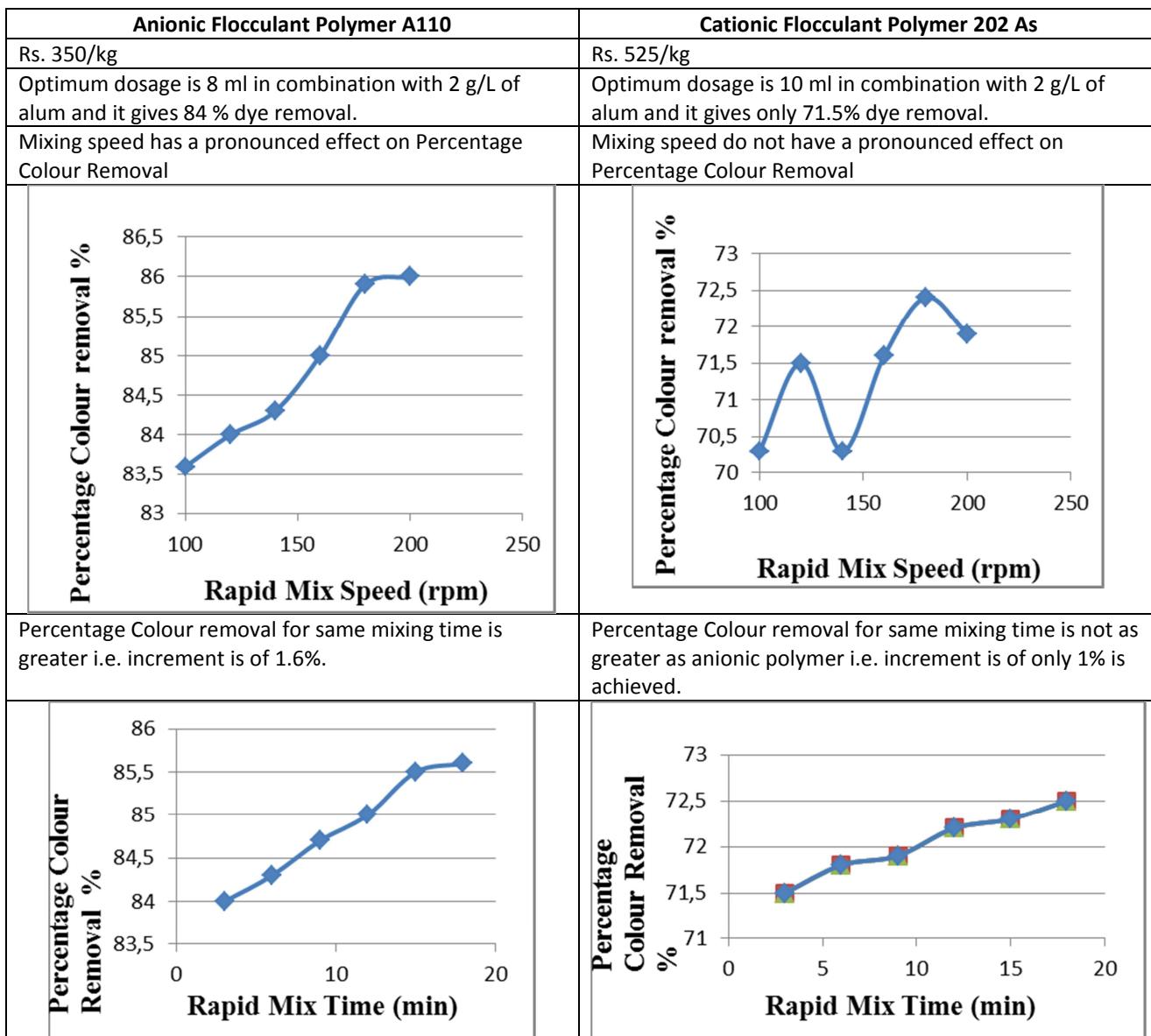


Fig 9: Effect on Percentage Colour Removal with increase in rapid mixing time using Alum 2g/L and 10 ml of 1% solution of cationic Polymer 202 As:

Graph in Fig 9 shows that increase in mixing time increases the color removal. This shows that high mixing time enhances the performance of Polymer202 for dyes removal from dye bath effluent. And the maximum color removal is 72.5% when the mixing time is 18min.

Comparison of Flocculants:

Results of previous study are summarized as:

Table 4.9: Comparison between Flocculant Polymer A110 & Polymer 202 A**CONCLUSIONS**

- Optimum pH for coagulation flocculation of dyebath waste water having mixture of reactive dyes using Alum (2g/L) as coagulant and anionic Polymer A110 (4ml of 1% solution in 250 ml of waste) as flocculant, is 7 with colour removal of 70.4 %.
- Using Alum (2g/L) as coagulant and cationic Polymer 202 As (4ml of 1% solution in 250 ml of waste) as flocculant, Optimum pH for coagulation flocculation of dyebath waste water having mixture of reactive dyes is 6 with color removal of 68.2 %.
- Effect of Rapid mixing speed on coagulation flocculation using optimum pH and optimum dosages of coagulant and flocculants is almost same. i.e. percentage colour removal increases with increasing Rapid Mixing Speed.
- Maximum color removal is 86% in case of Polymer A110 at 200rpm and at 180rpm color removal is 72.4%when Polymer 202As is used.

- Effect of Rapid mixing time on coagulation flocculation using optimum pH and optimum dosages of coagulant and flocculants is almost same. i.e. percentage colour removal increases with increasing Rapid Mixing time.
- Maximum color removal is when the mixing time is 18 min and for Polymer A110 it is 85.6% and for Polymer 202As is 72.5%.

FUTURE RECOMMENDATIONS

1. Coagulation and flocculation falls in the category of primary treatment in any waste treatment plant. To further purify a waste steam filtration or adsorption is usually used. In the present study colour removal of 84% is achieved. In order to achieve 100% colour removal it is recommended strongly to use adsorption followed by coagulation flocculation.
2. In this study only two flocculants have been considered, in future many flocculants can be studied.
3. Report is based only on Percentage colour removal. This research can be extended to study BOD and COD removal.
4. This study is performed batch wise, a continuous process studies can also be performed with this project.

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Régime alimentaire de deux requins: *Sphyrna zygeana* (Linnaeus, 1758) et *Isurus oxyrinchus* (Rafinesque, 1809) des côtes ivoiriennes

[Diet of two sharks: *Sphyrna zygeana* (Linnaeus, 1758) and *Isurus oxyrinchus* (Rafinesque, 1809) of the Ivorian coast]

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ABSTRACT: The study of diet examined 272 specimens of *Sphyrna zygeana* (162 males and 110 females) and 215 specimens of *Isurus oxyrinchus* (120 males and 95 females) from artisanal fisheries. They were collected between October 2009 and September 2010. The analysis of stomach contents revealed that 87estomacs *Sphyrna zygeana* were empty (31.98%) and 185 stomachs contained food (262 prey). 154 stomachs of *Isurus oxyrinchus* contained food (224 prey) and 61 stomachs were empty (28.37%). According to the index of relative importance (IRI) calculated both diets consisted mainly of fish. Levin's Index obtained from *S. zygeana* ($Bi = 0.446$) and *I. oxyrinchus* ($Bi = 0.432$) indicates that trophic niche is relatively narrow. These two species are specialist predators that use fewer resources with a preference for fish. The community index of Jaccard ($S_j = 0.265 < 0.5$) indicates a similarity between the diet of both species. There is also a dietary overlap ($\alpha = 0.7644$) between these two species and gender (*I. oxyrinchus*, $C_\lambda = 0.897$ and *S. zygeana*, $C_\lambda = 0.868$).

KEYWORDS: artisanal fishing, teleost, stomach contents, predators, specialist.

RÉSUMÉ: L'étude du régime alimentaire a porté sur 272 spécimens de *Sphyrna zygeana* (162 mâles et 110 femelles) et de 215 spécimens d'*Isurus oxyrinchus* (120 mâles et 95 femelles) issues de la pêche artisanale. Ils ont été récoltés entre Octobre 2009 et septembre 2010. Le régime alimentaire a été étudié en fonction de l'année, des saisons et du sexe. L'analyse du contenu stomacal a permis de constater que 87estomacs de *Sphyrna zygeana* étaient vides (31,98 %) et 185 estomacs contenaient des aliments (262 proies). 154 estomacs d'*Isurus oxyrinchus* contenaient des aliments (224 proies) et 61 estomacs étaient vides (28,37%). Selon l'indice d'importance relative (IRI) calculé, les deux régimes alimentaires étaient constitués principalement de poissons téléostéens. Leur régime alimentaire ne varie pas en fonction du sexe et de la saison. L'indice de Levin obtenu chez *S. zygeana* ($Bi = 0,446$) et *I. oxyrinchus* ($Bi = 0,432$) indiquent que leur niche trophique est relativement étroite. Ces deux espèces sont des prédateurs spécialistes qui utilisent peu de ressources avec une préférence pour les poissons. L'indice de communauté de Jaccard ($S_j = 0,265 < 0,5$) indique une similarité entre le régime alimentaire de ces deux espèces. Il existe aussi un chevauchement alimentaire ($\alpha= 0,7644$) entre ces deux espèces et entre les sexes (*I. oxyrinchus*, $C_\lambda = 0,897$ et *S. zygeana*, $C_\lambda = 0,868$).

MOTS-CLEFS: pêche artisanale, téléostéens, contenu stomacal, prédateurs, spécialistes.

1 INTRODUCTION

Les requins sont des poissons cartilagineux, qui appartiennent à la classe des Chondrichtyens et à la sous-classe des Elasmobranches [1]. En Côte d'Ivoire, les requins débarqués par la pêcherie artisanale ivoirienne occupent une place

considérable tant sur le plan de la diversité spécifique que de la quantité pêchée [2]. *Isurus oxyrinchus* et *Sphyraena zygeana* constituent une part importante des prises de la pêcherie artisanale en côte d'ivoire [3]. *Sphyraena zygaena* est l'une des neuf espèces de requin-marteau connu sous le nom de requin-marteau lisse ou requin-marteau commun. Il appartient à la famille des sphyraenidae et au genre sphyraena. *Isurus oxyrinchus* est l'une des deux espèces du genre *Isurus* [4], encore appelé requin-taureau bleu. Il appartient à la famille des Lamnidae. *I. oxyrinchus* est une espèce océanique et pélagique, répartie dans les eaux tempérées et tropicales de tous les océans. Dans l'Atlantique Ouest, il se repartit depuis le Golfe du Maine jusqu'au nord de l'Argentine y compris le golfe du Mexique et des Caraïbes [5]. Dans l'Atlantique Est, son aire de répartition s'étend de 60°N à la côte sud de l'Afrique du Sud, y compris la Méditerranée [6]. Quant à l'espèce *Sphyraena zygaena*, elle est côtière, pélagique et semi-océanique [7] et vit dans les mers tempérées et tropicales [8]. *Sphyraena zygaena* se rencontre en Atlantique occidental, depuis les côtes de la Nouvelle-Écosse à la Floride, des côtes des Etats-Unis et des îles Vierges au sud de l'Argentine [9]. L'espèce se rencontre également en Atlantique Est, depuis les îles britanniques jusqu'à la Côte d'Ivoire, y compris la Méditerranée [5]. Les requins sont surtout capturés pour leurs ailerons, leur peau et leur cartilage [10]. Ils constituent aussi une source importante de protéine. Outre leur grand intérêt pour l'alimentation et l'économie, les requins sont également utiles pour l'écosystème marin. Ils représentent un maillon important de la chaîne trophique, car la plupart des requins sont des prédateurs supérieurs dans le réseau trophique marin [11]. Ils ont un impact significatif sur la taille des populations proies, sur la structure et la composition de l'écosystème marin [12]. Bien que *Isurus oxyrinchus* et *Sphyraena zygeana* soient les plus débarquées, les données sur leur biologie et leur écologie sont quasi absents. Pourtant la disparition de ces prédateurs dans les écosystèmes marins peut avoir des conséquences négatives sur leur fonctionnement et leurs capacités de résilience [10]. Parmi les conséquences, on peut citer des perturbations des cycles et processus biogéochimiques, la favorisation des espèces invasives et les changements de distribution des méso-consommateurs comme les élasmobranches de petite taille qui peuvent concurrencer certaines espèces d'intérêt commercial [13], [14]. L'étude du régime alimentaire permet l'évaluation des interactions trophiques entre les espèces, la mortalité par prédation sur les stocks commercialement importants, ou les effets indirects des mesures de conservation des stocks des prédateurs [15]. Cette étude a été réalisée afin de déterminer les habitudes alimentaires en fonction de l'année, du sexe, et de la saison.

2 MATÉRIEL ET MÉTHODES

2.1 MATÉRIEL

Le matériel biologique utilisé est constitué par deux espèces de requins que sont: *Isurus oxyrinchus* et *sphyraena zygeana*. Ils ont été mesurés avec un mètre ruban. Les proies ont été pesées à l'aide de balances de précision.

2.2 MÉTHODES

2.2.1 COLLECTE ET IDENTIFICATION DES POISSONS

Les spécimens utilisés pour cette étude proviennent de la pêcherie artisanale maritime. Ils ont été récoltés d'Octobre 2009 et septembre 2010, au cours des enquêtes hebdomadaires effectuées au port de pêche d'Abidjan. Durant cette période, les enquêtes au débarcadère ont été réalisées pendant les cinq jours de pêche de la semaine (Mardi au Samedi). Les requins capturés ont été identifiés selon les descriptions de [16], [17], [18], [19], dénombrés et identifiés sexuellement. Chaque requin a été mesuré au centimètre près en appliquant le ruban centimétrique sur le flanc depuis l'extrémité de la mâchoire supérieure jusqu'à la base de la caudale (longueur standard). Les abdomens des spécimens récoltés ont été incisés. Leurs estomacs ont été prélevés, et pesés. Après ouverture des différents estomacs à l'aide d'une paire de ciseau, les proies ingérées ont été identifiées. Les poissons retrouvés dans les estomacs ont été identifiés selon les clés suivantes : [20], [21], [22], [19]. Les céphalopodes ont été identifiés selon [23], [24]. Les Crustacés ont été identifiés comme dans [21] jusqu'au niveau de l'espèce lorsque l'état de digestion le permettait. Les proies trop altérées ont été classées dans la rubrique "indéterminées". Une fois identifiées, les proies sont comptées manuellement et pesées à 1/100 gramme près. Les données obtenues ont permis de déterminer les indices alimentaires

2.2.2 INDICES ALIMENTAIRES

2.2.2.1 INDICE D'IMPORTANCE RELATIVE

Pour déterminer la préférence alimentaire, l'indice d'importance relative (IRI) de [25] a été utilisé. La valeur de l'IRI est calculée comme suit:

$$IRI = (N+W) F$$

N : le Pourcentage numérique

W : le Pourcentage pondéral

F : la Fréquence des proies

Cet indice mixte, qui intègre N, W et F permet une interprétation beaucoup plus réelle du régime en minimisant les biais occasionnés par chacun de ces pourcentages. La valeur de l'indice de chaque item est exprimée en pourcentage. Les aliments sont ensuite ordonnés par ordre décroissant selon la valeur du pourcentage indiciaire obtenu. Dans cet ordre, les pourcentages indiciaires des premiers aliments sont additionnés progressivement jusqu'à obtenir 50% ou plus, ces items sont appelés aliments préférentiels. Ce calcul est poursuivi jusqu'à obtenir 75% ou plus. Ces items sont appelés aliments secondaires; les autres items de la liste sont des aliments accidentels

$$\%IRI = 100 \frac{\sum_{i=1}^n IRI_i}{n} \quad \text{où } n = \text{nombre total de catégories de proie}$$

- Pourcentage numérique (N)

Nombre total d'individus de la proie «i»

$$N = \frac{\text{Nombre total d'individus de la proie «i»}}{\text{Nombre total de proies inventoriées}} \times 100$$

- Pourcentage pondéral(W)

Poids total de la proie «i»

$$W = \frac{\text{Poids total de la proie «i»}}{\text{Poids total de toutes les proies}} \times 100$$

- Fréquence des proies(F)

Nombre d'estomacs contenant la proie «i»

$$F = \frac{\text{Nombre d'estomacs contenant la proie «i»}}{\text{Nombre d'estomacs pleins}} \times 100$$

2.2.2.2 INDICE DE COMMUNAUTE DE JACCARD (Sj)

La similitude alimentaire entre ces deux requins a été évaluée en calculant l'indice de communauté de Jaccard (Sj)

$$Sj = c / (a+b-c)$$

a : nombre total de catégories de proies dans l'alimentation de l'espèce x

b : nombre total de catégories de proies dans l'alimentation de l'espèce y,

c : nombre total de catégories de proies communes aux espèces x et y.

Cet indice permet de faire les comparaisons inter et intraspécifiques du régime des différentes espèces. La similarité s'observe lorsque la valeur de Sj > 0,7; elle est moyenne si 0,5 < Sj < 0,7 puis faible quand Sj < 0,5 [26].

2.2.2.3 INDICE DE CHEVAUCHEMENT ALIMENTAIRE (α)

Le degré de compétition alimentaire entre ces deux requins a été mesuré à travers l'indice de chevauchement alimentaire. La valeur de l'indice (α) varie entre 0 et 1. Lorsque $\alpha = 0$, il n'y a pas de chevauchement alimentaire, puis elle est total quand $\alpha = 1$. Les régimes alimentaires sont considérés significativement similaires lorsque la valeur de α est supérieure ou égale à 0,6 [27]. Le calcul ne peut être effectué seulement que pour deux espèces capturées dans la même période [28]. Cet indice a été calculé en utilisant le poids (P) de chaque catégorie de proies selon la formule de la référence [29]:

$$\alpha = 1 - 0,5 (\sum |p_{xi} - p_{yi}|)$$

p_{xi} est la proportion de l'aliment i chez l'espèce X

P_{yi} la proportion de l'aliment i chez l'espèce y.

2.2.2.4 INDICE DE MORISITA-HORN ($C\lambda$)

L'indice de Morisita-Horn [30] a été utilisé pour évaluer le chevauchement alimentaire entre les sexes. La valeur de C_λ varie entre 0 et 1. Lorsque la valeur de:

- C_λ est proche de 0, les régimes sont complètement différents,
- C_λ est égale à 1 les régimes sont les mêmes.
- C_λ dépasse 0,6 les régimes alimentaires se chevauchent de façon significative.

L'indice est calculé selon la formule suivante :

$$C\lambda = 2 \frac{\sum_{i=1}^n (P_{xi} P_{yi})}{(\sum_{i=1}^n P_{xi}^2 + \sum_{i=1}^n P_{yi}^2)}$$

$C\lambda$ est l'indice de chevauchement entre le prédateur X and prédateur Y;

P_{xi} est la proportion de proie i par les prédateurs x;

P_{yi} est la proportion de proie i utilisé par les prédateurs y, et n est le nombre total de proies.

2.2.2.5 INDICE STANDARDISE DE LEVIN

La largeur de la niche trophique a été estimée à l'aide de l'indice standardisé la référence [31] dont les valeurs sont comprises entre 0 et 1. Lorsque $B_i < 0,6$ on a un régime alimentaire spécialisé, ce qui signifie que prédateur utilise peu de ressources de proies et préfère des proies spécifiques,

Si $B_i > 0,6$ le régime alimentaire est généraliste, ce qui signifie que prédateur utilise beaucoup de ressources sans préférence notable. L'indice est calculé selon la formule suivante :

$$B_i = 1/n - 1 \{(1/\sum_j j P_{ij}^2) - 1\}$$

B_i est l'indice de Levin pour prédateur i;

j P_{ij} est la proportion du régime alimentaire des prédateurs i donnée par proies j,

n est le nombre de catégories de proies.

3 RÉSULTATS

3.1 PROFIL GÉNÉRAL DU RÉGIME ALIMENTAIRE

Les contenus stomacaux de 272 spécimens de *Sphyraena zygeana* composés de 162 mâles et 110 femelles ont été examinés. Les tailles des individus mâles est comprises entre 100 cm et 208 cm, celles des femelles se situent entre 98 cm et 230 cm. Pour l'espèce *Isurus oxyrinchus*, l'examen du contenu des estomacs a porté sur 215 spécimens composés de 120 mâles de tailles comprises entre 97 cm et 200 cm, de 95 femelles de tailles comprises entre 91 cm et 233 cm. 87estomacs de *Sphyraena zygeana* examinés, étaient vides, soit un coefficient de vacuité de 31,98 %. L'analyse du contenu des estomacs pleins(185) de *Sphyraena zygeana* a permis d'identifier 262 proies. Chez *Isurus oxyrinchus*, l'examen du contenu des estomacs a permis de constater que 154 estomacs contenaient des aliments (224 proies) et 61 estomacs vides correspondant à un coefficient de vacuité de 28,37%. L'ensemble des proies retrouvées dans les estomacs de *Sphyraena zygeana* et d'*Isurus oxyrinchus* correspondait respectivement à un poids de 211559 g et 186495 g. La liste des proies consommées par *Sphyraena zygeana* ainsi que les valeurs des indices déterminés sont donnés dans le Tableau 1. Ces proies consommées étaient

composées 16 espèces de Poissons (N=72,52%) regroupées en 9 familles (Scombridae, Culpeidae, Carangidae, Hoemulidae, Polynemidae, Sciaenidae, Xiphidae, Coryphaenidae, Belonidae), de Céphalopodes (N=21,756%), de Crustacés (N=0.763%) et de Crabes (N=0.764%). Le **tableau 2** donne la liste des proies consommées par *I. oxyrinchus* ainsi que les valeurs des indices déterminés. Les contenus stomachaux d'*I. oxyrinchus* étaient constitués de 13 espèces de poissons (N=71.87 %) regroupés en 4 familles (Scombridae, Carangidae, Culpeidae, Coryphaenidae), de Crabes (N=4.018%), de Céphalopodes (N=3.57%), de Stomatopodes (N=20.09%) et de Gastéropodes (N=0.446 %). Les poissons retrouvés dans les estomacs de *Sphyraena zygeana* ont une fréquence d'apparition de 73,57% et représentent 93,3% du poids total des aliments suivie des céphalopodes (F=20,27%). On note chez *I. oxyrinchus* une fréquence d'apparition de 75,37% des poissons dont le poids a été estimé à 93.79 % de celui de la totalité des aliments ingérés. En tenant compte de la fréquence d'apparition, les Stomatopodes arrivent en second position (F=16,748%). La classification des aliments basée sur les pourcentages indiciaires de l'IRI (Indice d'Importance Relative) indique que les poissons constituent les aliments préférentiels chez les deux espèces des requins. Il existe cependant une différence entre les espèces de poissons consommées par chaque requin. Chez les requins marteaux, *Auxis thazard* (IRI= 28,112%) et *Katsuwonus pelamis*(IRI= 21,285%) sont les aliments préférés. *Coryphène hippurus* (IRI= 14,191 %) et les poissons dont l'indentification totale a été impossible constituent les aliments secondaires. Les autres aliments composés des Crabes (IRI=0.029), des céphalopodes (IRI=5,142%), des crustacés (IRI=0,436%) représentent les aliments accidentels pour *S. zygeana*. Les aliments préférés d'*I. oxyrinchus* est constitués de *E. alletteratus* (IRI= 47,496%) et *caranx hippos* (IRI= 11,89%) tandis que *Trachurus trachurus* (IRI=7.71%), *Auxis thazard* (IRI=6.952%) et *Thunnus albacares* (IRI=5,37%) representent les aliments secondaires. L'ensemble des autres poissons consommés (IRI=11,512%), les Crabes (IRI = 0,359%), les Céphalopodes (IRI=0,198%) et les Stomatopodes (IRI=8,514%) sont les aliments accidentellement consommées par *I. oxyrinchus*. L'indice de communauté de Jaccard permettant de mesurer la similitude alimentaire entre ces deux espèces de requin est $S_j = 0,265 < 0,5$. L'indice de chevauchement alimentaire calculé entre ces deux espèces de requin est $\alpha = 0,7644$. Enfin l'indice standardisé de Levin(Bi) obtenu chez *Sphyraena zygeana* est Bi= 0,446 et Bi= 0,432 chez *I. oxyrinchus*.

3.2 REGIME ALIMENTAIRE EN FONCTION DES SAISONS MARINES

En tenant compte des saisons l'étude du régime alimentaire chez *Sphyraena zygeana* a permis d'obtenir un coefficient de vacuité de 32,6% en grande saison froide, 43,75% en grande saison chaude, 26,31% en petite saison froide et 30,30% en petite saison chaude. Chez *I. oxyrinchus*, le coefficient de vacuité a été estimé à 25,3% en grande saison froide, 42,86% en grande saison chaude, 33,33% en petite saison froide, puis 45,45% en petite saison chaude. En ce qui concerne la consommation des aliments en fonction des saisons, les poissons restent les plus consommées par les deux espèces. Chez *S. zygeana*, on enregistre une fréquence d'apparition de 71,43% en petite saison froide, 92,31% en grande saison chaude, 78,46% en petite saison chaude et 69,17% en grande saison froide. La fréquence d'apparition des poissons dans le régime d'*I. oxyrinchus* est de 66,67% pendant la petite saison froide, 72,37% en grande saison froide, 95,45 % pour la petite saison chaude, et 91,66% pour la grande saison chaude. Les indices d'importances relatives en fonction des saisons indiquent que les aliments préférés du requin marteau lisse (*Sphyraena zygeana*) et requin mako (*I. oxyrinchus*) sont les poissons. Cependant la différence se situe au niveau des espèces ingérées par chaque requin. Chez *Sphyraena zygeana*, ce sont *Auxis thazard* (auxide) et *Katsuwonus pelamis* (listao) qui sont les aliments préférés (**figure 1 a et figure 2**) durant trois(3) saisons marines sur quatre (4). Ce n'est que pendant la petite saison chaude que l'espèce *Coryphaena hippurus* (IRI= 23,15%), et des poissons (IRI=19,04%) dont les espèces n'ont pu être déterminées à cause de leur digestion avancée se et l'espèce *Katsuwonus pelamis* (IRI= 15,51%) ont été l'aliment préféré. En ce qui concerne le requin mako, l'espèce de poisson préférée en petite saison froide est *E. alletteratus* (IRI= 47,496%). En grande saison chaude, les plus prisées est *E. alletteratus* (IRI= 35,717%) et *Caranx hippos* (IRI= 24,375%). Pendant la petite saison chaude, les proies préférentielles sont presque identiques à celles de la grande saison chaude à la différence de l'espèce *A. thazard* (21,092%) **figure 1b**. *E. alletteratus* demeure la proie la plus ingérée par pendant la grande saison froide *I. oxyrinchus* **figure 3**.

3.3 REGIME ALIMENTAIRE EN FONCTION DU SEXE

Chez le requin marteau lisse, 66 estomacs des mâles étaient vides tandis que 21 estomacs des femelles ne contenait pas d'aliment. Ceux-ci correspondaient respectivement à des coefficients de vacuité de 40.74% et 19.09%. Chez *I. oxyrinchus*, 39 estomacs pour les mâles et 22 pour les femelles étaient vides. Ces valeurs correspondaient à des coefficients de vacuités de 32,5% pour les mâles et 23,32% pour les femelles. Les poissons constituent les proies préférées chez les mâles et les femelles de *S. zygeana*, cependant les espèces les plus ingérées diffèrent selon le sexe. Chez les mâles ce sont les espèces *Auxis thazard* (IRI =31,909%) et *C. hippurus* (IRI=20,314%) qui sont les plus consommées. Les femelles ont préféré consommer *K. pelamis* (IRI=42,79%) et *Auxis thazard* (IRI =20,845%). Les proies secondaires étaient constituées des poissons (IRI= 9,003) dont l'on a pu déterminer l'espèce à cause de leur digestion très avancée, de *K. pelamis* (IRI=8,05%) et de *Galeoides decadactylus* (5,823%) chez les mâles. Seule l'espèce *Thunnus albacares* (IRI =11,77%) constituait la proie

secondairement consommée par les femelles. Les espèces de poissons les plus prisées par les femelles d'*Isurus oxyrinchus* est *Euthynnus alletteratus* (IRI= 30,47%) et *Caranx hippos* (IRI= 23,478%) tandis que Chez les mâles, *E. alletteratus* (IRI= 50,93%) à lui seule constitue l'aliment préféré. Les aliments qui occupent la seconde place dans le choix des males sont *T. trachurus* (IRI= 9,44 %), *Caranx hippos* (IRI=7,43%), *Caranx cryos* (IRI=6,608%) et *Squilla nantis* (IRI= 6.358%). L'espèce *Auxis thazard* (21.624 %) représenté aliment secondaire des femelles. L'indice de Morisita-Horn(C_λ) permettant de mesurer le chevauchement alimentaire entre les deux sexes a été estimé à 0,868 pour *S. zygeana* et 0,897 pour d'*Isurus oxyri*

Tableau 1: indices alimentaires de *Sphyraena zygeana* (%F : fréquence d'occurrence ; N : pourcentage numérique; P : pourcentage pondéral ; IRI : indice d'abondance relative des proies

FAMILLES	PROIES	F	%F	N	%N	P	%P	IRI	%IRI
	POISSONS	167	73,57	190	72,52	198307	93,3	1293	91,57
Carangidae	<i>Scomber japonicus</i>	4	1,762	8	3,053	5165	2,43	9,663	0,684
scombridae	<i>Auxis thazard</i>	31	13,66	36	13,74	32557	15,32	396,9	28,112
scombridae	<i>Sarda sarda</i>	5	2,203	12	4,58	13577	6,389	24,16	1,711
scombridae	<i>Katsuwonus pelamis</i>	23	10,13	27	10,305	41125	19,35	300,5	21,285
	<i>Belone belone</i>	2	0,881	2	0,763	976	0,459	1,077	0,076
hoemulidae	<i>Brachydeterus auritus</i>	3	1,322	3	1,145	1098	0,517	2,196	0,156
polynemidae	<i>Galeoides decadactylus</i>	12	5,286	14	5,344	7283	3,427	46,36	3,284
sciaenidae	<i>Pseudotolithus elongatus</i>	7	3,084	7	2,672	3482	1,638	13,29	0,942
xiphiidae	<i>Xiphias gladius</i>	1	0,441	1	0,382	956	0,45	0,366	0,026
scombridae	<i>Thunnus albacares</i>	16	7,048	16	6,107	19371	9,115	107,3	7,6
scombridae	<i>Acanthocybium solandri</i>	9	3,965	9	3,435	7581	3,567	27,76	1,967
carangidae	<i>Alectis alexandrinus</i>	2	0,881	2	0,763	2048	0,964	1,522	0,108
culpeidae	<i>Sardinella aurita</i>	1	0,441	2	0,763	362	0,17	0,411	0,029
Coryphaenidae	<i>Coryphaena hippurus</i>	19	8,37	19	7,252	35455	16,68	200,3	14,191
scombridae	<i>Euthynnus alletteratus</i>	13	5,727	13	4,962	11564	5,441	59,58	4,22
scombridae	<i>Scomberomorus tritor</i>	2	0,881	2	0,763	1064	0,501	1,114	0,079
	<i>poissons indet</i>	17	7,489	17	6,489	14643	6,89	100,2	7,097
	CRAVES	2	0,882	2	0,764	331	0,16	0,41	0,029
majidae	<i>Maja squinado</i>	1	0,441	1	0,382	120	0,056	0,193	0,014
homoldae	<i>Paromola cuvieri</i>	1	0,441	1	0,382	211	0,099	0,212	0,015
	CRUSTACES	12	5,287	13	4,962	1776	0,84	6,16	0,436
nephropidae	<i>Homarus gammarus</i>	2	0,881	2	0,763	456	0,215	0,862	0,061
palinuridae	<i>Palinurus elephas</i>	2	0,881	2	0,763	378	0,178	0,829	0,059
palinuridae	<i>Palinurus Spp.</i>	1	0,441	1	0,382	214	0,101	0,213	0,015
scyllaridae	<i>Scyllarus arctus</i>	2	0,881	3	1,145	196	0,092	1,09	0,077
scyllaridae	<i>Scyllarus latus</i>	1	0,441	1	0,382	210	0,099	0,212	0,015
	<i>crustacés indet</i>	4	1,762	4	1,527	322	0,152	2,957	0,209
	CEPHALOPODES	46	20,27	57	21,756	12106	5,697	72,6	5,142
octopodidae	<i>Octopus vulgaris</i>	4	1,762	6	2,29	1297	0,61	5,111	0,362
octopodidae	<i>Octopus macropus</i>	7	3,084	9	3,435	534	0,251	11,37	0,805
histiotheuthidae	<i>Histioteuthis bonnelii</i>	3	1,322	3	1,145	2383	1,121	2,995	0,212
loliginidae	<i>Loligo vulgaris</i>	2	0,881	2	0,763	961	0,452	1,071	0,076
sepiidae	<i>Sepia officinalis</i>	2	0,881	4	1,527	1081	0,509	1,793	0,127
sepiidae	<i>Sepia elegans</i>	12	5,286	12	4,58	1032	0,486	26,78	1,897
sepiidae	<i>Sepias spp.</i>	1	0,441	1	0,382	316	0,149	0,234	0,017
octopodidae	<i>Eledone maschata</i>	7	3,084	10	3,817	3672	1,728	17,1	1,211
octopodidae	<i>Eledone cirrhosa</i>	4	1,762	6	2,29	214	0,101	4,213	0,298
octopodidae	<i>Eledone spp.</i>	1	0,441	1	0,382	298	0,14	0,23	0,016
	<i>Cephalopdes indet</i>	3	1,322	3	1,145	318	0,15	1,711	0,121
	Total	287		262	100	226733	100	1451	100

Tableau 2 indices alimentaires d'*Isurus oxyrinchus* (%F : fréquence d'occurrence ; N : pourcentage numérique; P : pourcentage pondéral ; IRI : indice d'abondance relative des proies

FAMILLES	PROIES	F	%F	N	%N	P	%P	IRI	%IRI
	POISSONS	153	75,37	161	71,87	174920	93,79	1621,7	90,93
scombridae	<i>Euthynnus alletteratus</i>	39	19,212	42	18,75	47259	25,34	847,061	47,496
scombridae	<i>Caranx hippos</i>	19	9,36	21	9,375	24769	13,28	212,054	11,89
scombridae	<i>Trachurus trachurus</i>	16	7,882	17	7,589	18380	9,855	137,496	7,71
carangidae	<i>Auxis thazard</i>	15	7,389	15	6,696	18804	10,08	123,985	6,952
scombridae	<i>Thunnus albacares</i>	12	5,911	14	6,25	18557	9,95	95,766	5,37
carangidae	<i>Caranx cryos</i>	13	6,404	13	5,804	14551	7,802	87,132	4,886
carangidae	<i>poissons indet</i>	12	5,911	12	5,357	9643	5,171	62,233	3,49
carangidae	<i>Katsuwonus pelamis</i>	5	2,463	5	2,232	8315	4,459	16,48	0,924
carangidae	<i>Trachurus trecae</i>	7	3,448	7	3,125	2844	1,525	16,034	0,899
carangidae	<i>Scomberomorus tritor</i>	6	2,956	6	2,679	4617	2,476	15,234	0,854
culpeidae	<i>Caranx spp.</i>	3	1,478	3	1,339	2393	1,283	3,876	0,217
scombridae	<i>Acanthocybium solandri</i>	2	0,985	2	0,893	1871	1,003	1,868	0,105
scombridae	<i>Scomber japonicus</i>	2	0,985	2	0,893	1303	0,699	1,568	0,088
Coryphaenidae	<i>Coryphaena hippurus</i>	1	0,493	1	0,446	1054	0,565	0,498	0,028
	<i>Sardinella maderensis</i>	1	0,493	1	0,446	560	0,3	0,368	0,021
	CRABES	8	3,941	9	4,018	589	0,315	6,395	0,359
Palinuridae	<i>Palinurus regius</i>	3	1,478	3	1,339	534	0,286	2,402	0,135
Scyllaridae	<i>Scyllarus latus</i>	1	0,493	2	0,893	30	0,016	0,448	0,025
	<i>crustacés indet</i>	4	1,97	4	1,786	25	0,013	3,545	0,199
	CEPHALOPODES	8	3,942	9	3,57	1062	0,57	3,527	0,198
octopodidae	<i>Eledone maschata</i>	2	0,985	3	1,339	63	0,034	1,353	0,076
sepiolidae	<i>Rossia macrosoma</i>	1	0,493	1	0,446	18	0,01	0,225	0,013
loliginidae	<i>Loligo forbesi</i>	1	0,493	1	0,446	35	0,019	0,229	0,013
sepiidae	<i>Sepia bertheloti</i>	1	0,493	1	0,446	54	0,029	0,234	0,013
	<i>Cephalopdes indet</i>	2	0,985	2	0,893	571	0,306	1,181	0,066
	GATEROPDES indét	1	0,493	1	0,446	321	0,172	0,305	0,017
	STOMATOPODES	34	16,75	45	20,09	9924	5,321	151,85	8,514
squillidae	<i>squilla nantis</i>	17	8,374	17	7,589	5642	3,025	88,89	4,984
pandalidae	<i>Plesionika martia</i>	10	4,926	15	6,696	2583	1,385	39,81	2,232
panoeidae	<i>Parapenoeus longirostris</i>	7	3,448	13	5,804	1699	0,911	23,154	1,298
	TOTAL	203		224	100	186495	100	1783,4	100

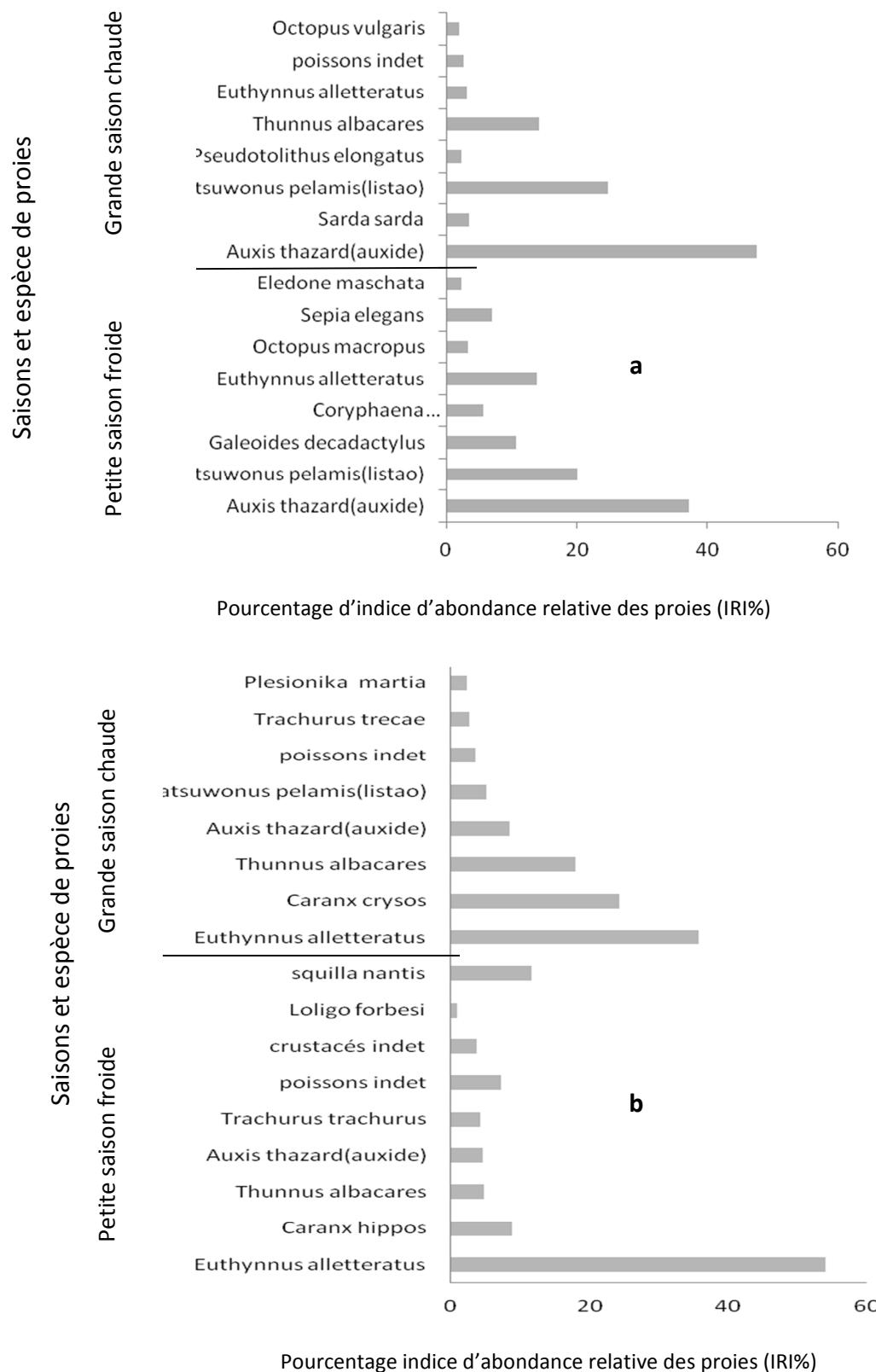


Figure 1. Distribution des pourcentages indice d'abondance relative des proies (IRI%) consommées par *Sphyraena zygeana*(a) et *Isurus oxyrinchus*(b) pendant la petite saison froide et grande saison chaude au large de la côte d'Ivoire.

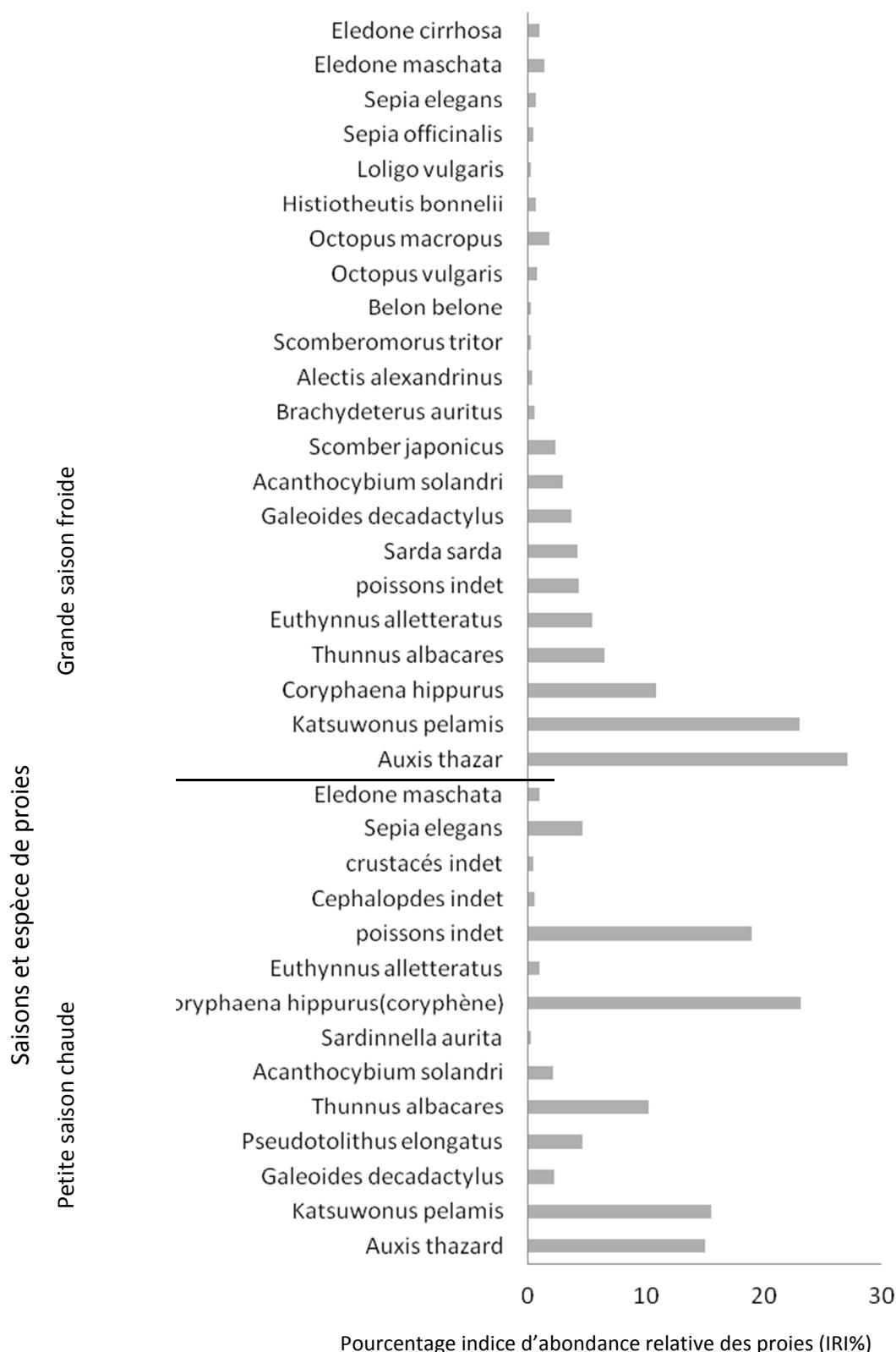


Figure 2. Distribution des pourcentages indice d'abondance relative des proies (IRI%) consommées par *Sphyraena zygeana* pendant la petite saison chaude et grande saison froide au large de la côte d'Ivoire

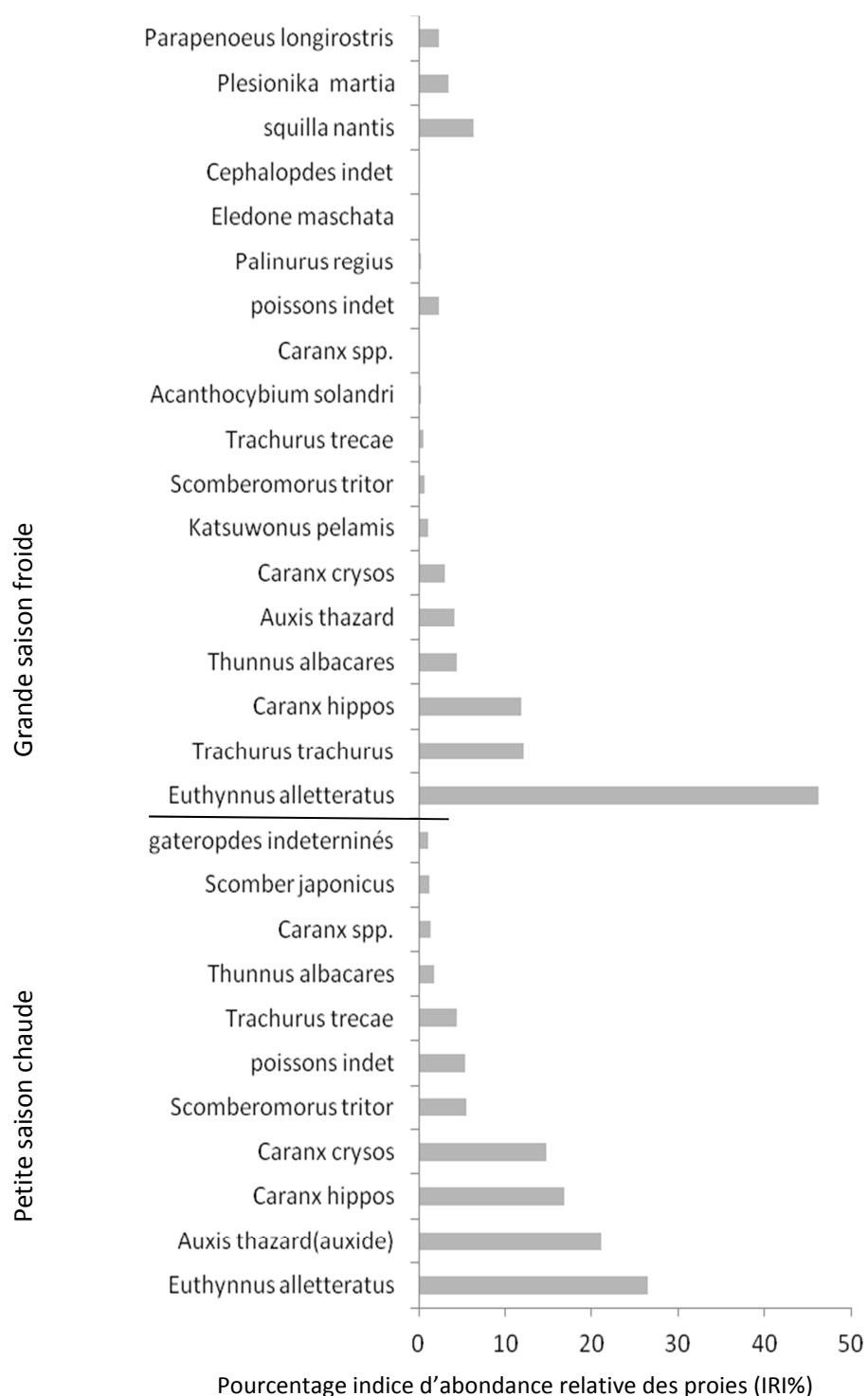


Figure 3. Distribution des pourcentages indice d'abondance relative des proies (IRI%) consommées par *Isurus oxyrinchus* pendant la petite saison chaude et la grande saison froide au large de la côte d'Ivoire

4 DISCUSSION

Le coefficient de vacuité pour cette étude du régime alimentaire chez *S. zygeana* (31,98%) est plus élevé que celui d'*I. oxyrinchus* (28,37%). Les fortes proportions d'estomacs vides observées sont souvent une conséquence de la méthode de pêche utilisée [32] qui favorise la régurgitation lors de la capture [33]. Parmi les quelles figurent les filets maillants qui sont vérifiés par les pêcheurs le lendemain matin ou l'après-midi [34]. Cette méthode de pêche qui est artisanale permet aux poissons de se débattre pendant longtemps dans le filet et de régurgiter parfois certaines proies non encore digérées [35]. C'est un phénomène aussi très fréquent lorsque la ligne est utilisée comme engin de pêche [33]. Cependant, les filets maillants contribuent moins à vider les estomacs que d'autres méthodes plus sélectives [36]. L'utilisation des filets maillants serait la méthode de pêche la plus appropriée pour l'analyse de l'alimentation des requins [32]. Selon la référence [37] le pourcentage élevé d'estomacs vides reflète aussi de courtes périodes d'alimentation, suivie par des périodes de digestion rapide. La référence [38] admet que la température élevée du corps du requin-taupe commun (*Isurus oxyrinchus*) aide également à digérer plus rapidement de grandes quantités de nourriture. L'étude du régime alimentaire en fonction des saisons marines montre des variations des coefficients de vacuité suivant les saisons marines. Les taux d'estomacs vides obtenus pendant les saisons chaudes sont plus élevées que ceux des périodes d'upwelling chez les deux espèces. Ces résultats concordent avec ceux de la référence [35] qui a estimé que les faibles taux de coefficient de vacuité observé en période d'upwelling (saison froide) sont dus à la disponibilité des proies à ces périodes. Cette disponibilité des proies s'explique par l'upwelling qui est favorable à l'arrivée massive des poissons qui constituent les proies les plus consommées par ces espèces de deux requins. D'autres raisons qui expliquent le taux élevé de vacuité sont les températures élevées en saison chaude, qui peuvent engendrer l'augmentation du transit gastrique [39]. La référence [40] estime que les faibles valeurs du coefficient de vacuité stomacale sont considérées comme un indice de disponibilité et de fréquence des proies dans le milieu.

Le profil général du régime alimentaire chez *S. zygeana* et *I. Oxyrinchus* montre que ces deux requins se nourrissent d'une diversité de proies. Pour cette étude, le régime alimentaire de *S. zygeana* constitué de poissons, de céphalopodes, de crabes et de crustacés diffère de celui *I. Oxyrinchus* par la présence des stomatopodes et des gastéropodes ainsi que par l'absence de crustacés chez le mako. Bien que ces deux régimes alimentaires diffèrent par la présence ou l'absence de quelques groupes zoologiques, les poissons téléostéens constituent l'aliment de base de *S. zygeana* (IRI = 91,57%) et *I. Oxyrinchus* (IRI = 90,93%). Ces résultats confirment ceux de la référence [41] qui estime que les poissons téléostéens (IRI= 93,7%) constituent les principales proies pour le requin mako. De nombreux requins de la famille des carcharhinidae à laquelle appartiennent *S. zygeana* ont un régime alimentaire essentiellement composé de téléostéens et de calmars [42], [43], [44], [45]. Selon la référence [18] *S. zygeana* préfère se nourrir de petits requins, de raies, de poissons osseux, de crevettes, crabes, et de céphalopodes. Ces résultats sont très proches de ceux obtenus dans cette étude car cette espèce de requin des eaux ivoiriennes se nourrit presque de ces mêmes proies. L'étude n'a cependant pas révélé un nombre très important de céphalopodes (IRI= 5.142%) dans les estomacs du requin marteau commun. Cela peut être dû à un facteur saisonnier qui conditionne l'abondance des céphalopodes dans cette région du littoral. Les variations de la fréquence d'apparition des principales catégories de proies à travers les régions indiquent que l'alimentation change selon la position géographique [46]. Ce changement est fonction de la disponibilité et de l'accèsibilité des proies dans le milieu fréquenté par le prédateur. Contrairement au résultat de la référence [47] les éasmobranches ne constituent pas une composante du régime alimentaire des requins mako capturés dans cette étude. La diversité des espèces de proies trouvées dans les estomacs de ces deux requins dans cette étude indique une alimentation de prédateur opportuniste. Lorsque les proies sont abondantes, le requin peut choisir un aliment particulier et maximiser la consommation. Ce qui explique l'abondance de certaines espèces des poissons dans leur régime pendant de la période d'upwelling favorable à la prolifération de ces poissons. Quand la nourriture est limitée, il ne peut pas se permettre cette sélectivité, il se nourrit de proies disponibles [48]. En réalité les espèces se nourrissent des proies qu'elles trouvent dans le milieu où elles vivent donc le régime alimentaire peut changer d'un endroit à l'autre ou d'une saison à l'autre. Chez ces deux espèces, la consommation des poissons notamment ceux prisés par les pêcheurs demeure la plus importante quelque soit la saison marine. Toutefois, il a été constaté que l'espèce *S. zygeana* a consommé plus de céphalopodes et de crustacés en saison froide qu'en saison chaude. La faible quantité de céphalopodes et de crustacés dans cette étude s'explique par leur disponibilité. Dans l'analyse du contenu des estomacs, certaines catégories de proies telles que les céphalopodes et crustacés peuvent être sous-estimées en raison de leur temps de digestion rapide, au profit d'autres qui sont surestimées pour leur temps de digestion plus long [49]. Chez l'espèce *I. Oxyrinchus*, il a été constaté également que la consommation des céphalopodes, des crustacés et des stomatopodes ont été moins importantes durant les saisons chaudes. Les poissons sont capables d'élargir leurs préférences alimentaires en fonction de la plus ou moins grande disponibilité des proies qu'ils consomment habituellement. En effet, en période de disette les prédateurs sont moins exigeants à la qualité de la nourriture. La meilleure proie pour un prédateur est théoriquement celle qui lui apporte le maximum d'énergie pour un coût de capture minimal. Le régime alimentaire d'une même espèce de poisson peut varier

assez considérablement selon la saison ou selon les milieux dans lesquels elle se trouve. Cela signifie que, pour survivre dans des conditions parfois extrêmes, les espèces adaptent, dans certaines limites, leur régime aux ressources dominantes disponibles. Face à une faible diversité de la nourriture, liée également à une moindre quantité, les espèces utilisent la ressource la plus abondante. A l'inverse, lorsque les proies deviennent plus nombreuses, les poissons s'alimentent à partir d'un nombre de taxons proies plus important. En ce qui concerne les proies préférées en fonction du sexe aucun changement n'a été observé chez ces deux requins. Des différences alimentaires entre les sexes peuvent cependant exister en raison de l'état physiologique des femelles [50]. D'une façon générale, les requins sont considérés comme ayant un caractère alimentaire opportuniste, ils consomment les proies qu'ils rencontrent, ce qui entraîne l'apparition de certaines proies dans le régime alimentaire selon la saison et l'habitat [6]. Les indices de Levin obtenus chez *S. zygeana* ($Bi = 0,446$) et *I. oxyrinchus* ($Bi = 0,432$) indiquent que la largeur de la niche trophique des espèces est étroite. Ces deux espèces de requin des côtes ivoiriennes sont donc des prédateurs spécialistes qui utilisent peu de ressources avec une préférence marquée pour certaines proies. L'indice de communauté de Jaccard ($Sj = 0,265 < 0,5$) obtenu montre qu'il existe une similarité entre le régime alimentaire de *Sphyraena zygeana* et d'*I. oxyrinchus*. Le chevauchement alimentaire ($\alpha = 0,7644$) et la similarité du régime alimentaire observés respectivement entre les deux espèces et les deux sexes trouvent leur explication dans l'étroitesse de la niche trophique. En effet, ces deux requins exploitent la même zone. Par conséquent, ils ont à leur disposition les mêmes aliments.

5 CONCLUSION

Cette étude sur le régime alimentaire de *Sphyraena zygeana* et d'*I. oxyrinchus* a permis de noter que ces deux espèces de requin se nourrissent essentiellement des poissons téloostéens. Ces deux requins ont des régimes alimentaires semblables et ne varient pas avec le sexe. La présence de la diversité des espèces de proies trouvées dans les estomacs indique que ces deux requins ont une alimentation de prédateur. Pendant les périodes d'upwelling ces requins se comportent en prédateurs spécialistes avec une préférence pour les poissons téloostéens et maximisent leur consommation. Tandis qu'en saisons chaudes, ces deux espèces se comportent en prédateurs opportunistes. Cependant, la consommation des poissons téloostéens demeure la plus importante quelque soit la saison marine. Il existe une compétition alimentaire entre *Sphyraena zygeana* et *I. oxyrinchus* mais aussi entre les mâles et la femelle d'une même espèce. Il faut également noter que les poissons plus consommés par ces requins sont également les plus recherchés par les artisans pêcheurs ivoiriens. Pour une meilleure compréhension du régime alimentaire de ces deux espèces, il serait indispensable d'approfondir ces travaux à travers l'étude des paramètres de la reproduction, la physiologie et l'écologie de ces deux requins afin de maîtriser leur biologie.

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PRESENCE D'ANOPHELES GAMBIAE A PLUS DE 1800 m D'ALTITUDE A LWIRO, REGION EST DE LA RD. CONGO

[ANOPHELES GAMBIAE'S LOCATED OVER 1800 MILES OF ALTITUDE AT LWIRO IN THE EAST OF THE DR. CONGO]

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ABSTRACT: The limit altitudinal of *Anopheles gambiae* is always topic to controversy in the region of Lwiro. In our routine exercises of surveillance of the anopheles mosquitoes vector of malaria, we come, for the first time, to find the larval lodgings over to *Anopheles gambiae* to 1886m altitude and a few to the some adults in houses. The implantation of the fish ponds is the main reason of this rise in altitude and numeric of this species in the middle. In these biotopes *Anopheles gambiae* is their present to 85.20%.

KEYWORDS: Anopheles, Fish ponds, Malaria, Surveillance, Limit altitudinal.

RESUME: La limite altitudinale d'*Anopheles gambiae* est toujours sujette à controverse dans la région de Lwiro. Dans nos exercices de routine de surveillance des moustiques anophèles vecteurs de malaria, nous venons, pour la première fois, de trouver les gîtes larvaires à *Anopheles gambiae* à 1886m d'altitude et un peu au dessus quelques adultes dans des maisons. L'implantation des étangs piscicoles est la cause principale de cette montée en altitude et numérique de cette espèce dans le milieu. Dans ces biotopes *Anopheles gambiae* y est présent à 85.20%.

MOTS-CLEFS: Anophèles, Etangs piscicoles, Paludisme, Surveillance, Limite altitudinale.

1 INTRODUCTION

Le paludisme est une des maladies tropicales qui causent plus de mortalités et morbidités au monde particulièrement en Afrique dans la région subsaharienne.

Les femmes enceintes et les enfants âgés de moins de 5 ans sont les plus grandes victimes à cause de leur faible immunité. Un enfant en dessous de 5 ans meurt de malaria toutes les trente secondes [1]. Chaque année, plus de un million des personnes meurent suite aux crises du paludisme, les estimations de 2012 rapportent plus 627 milles morts sur 207 millions des cas paludiques récentes en Afrique [2], [3]. Cette maladie est un grand facteur de sous développement en Afrique tropicale car elle handicape les activités économiques. Elle est due aux parasites endoerythrocytaires du genre

Plasmodium dont le plus virulent et mortel, le plus répandu en Afrique est le *Plasmodium falciparum*. Ce parasite est transmis à l'homme lors d'une piqûre d'un moustique femelle du genre *Anopheles*, dont le principal vecteur dans la région est *Anopheles gambiae* qui, selon les saisons, alterne la transmission avec *Anopheles funestus*, [4][5]. Après avoir remarqué que la lutte contre le paludisme rencontrait des contraintes sérieuses suite à la résistance des parasites aux antipaludéens ainsi que la résistance des vecteurs aux divers insecticides [6] , la politique sanitaire actuelle conseille l'utilisation des moustiquaires imprégnées d'insecticides à longue durée d'action (MILDA) [7].

Vers les années cinquante-soixante, *A. gambiae* était très rare dans la région de Lwiro car de 1964 à 1966, seul un adulte et trois larves de cette espèces avaient été capturés [8] à l'altitude inférieure à 1700m sans avoir trouvé un seul individu au-delà. D'autres études effectués sur la faune anophélienne de Lwiro et ses environs [9],[10]; n'avaient jamais signalé la présence d'*A. gambiae* au-delà de 1850m d'altitude. En effet, il était connu depuis longtemps que *A. gambiae*, était limité par l'altitude et ne pouvait se trouvait qu'en dessous de 1500m d'altitude [11].

Les résultats des captures intradomiciliaires ainsi que des pêches larvaires ont montré qu'*A. gambiae*, qui était très rare dans la région de Lwiro, devenait de plus en plus abondant dépassant 60% de la faune anophélienne sans qu'il ne soit signalé au-delà de sa limite altitudinale [12] [10].

Cette étude a été menée dans le but de surveillance épidémiologique basée principalement sur le monitoring hebdomadaire des gîtes larvaires dans la région de Lwiro en mettant un intérêt particulier à la recherche des larves d'anophèles dans les gîtes situés à plus de 1800 m d'altitude afin de nous rendre compte de la distribution altitudinale actuelle d'*A. gambiae* dans notre région. Quelques captures d'adultes étaient aussi effectuées dans le but de compléter nos pêches larvaires.

2 MATERIELS ET METHODES

Le milieu d'étude

De janvier à juin 2012, nous avons effectué des pêches larvaires et des captures d'anophèles adultes dans la région de Lwiro, région située sur le versant Est de la vallée du Rift Albertin. Les sites de pêches larvaires ont concerné six villages situés entre 1631m et 1886m d'altitude dont: Chegera, Lwiro, Bishibiru, Maziba, Nyakadaka et Chagala-Busombwe. Les gîtes larvaires ont été de quatre types dont : les ruisseaux (Mahyusa de Maziba à 1723m, Cishimo de Nyakadaka à 1629m et Kamiraihembe de Chegera à 1631m), les Etangs piscicoles (Lwiro entre 1675m et 1675m, Bishibiru à 1688m, Chagala-busandwe à 1886m et Nyakadaka à 1629m), le drain (de Lwiro à 1675m) et les flaques d'eau (de Nyakadaka à 1629m) (Tableau 1).

Les coordonnées longitudinales et altitudinales ont été recueillies en utilisant un appareil G.P.S. (Extrex GARMIN L.t.d 2000-2007, Made in TAIWAN).

Tableau 1 : Villages et gîtes larvaires de Lwiro

Localités	Gîtes	Altitude (en m)	Coordonnées
LWIRO	Etang 1	1678	S 02°14'42,2" E028°48'37,6"
	Etang 2	1684	S 02°14'42,4" E028°48'38,5"
	Etang3	1676	S02°14'42,7" E028°48'39,8"
	Etang 4	1675	S02°14'43,0" E028°48'42,4"
	Etang 5	1684	S02°14'43,7" E028°48'44,5"
	Etang 6	1684	S02°14'46,5" E028°48'44,8"
	Drain	1675	S02°14'46,5" E028°48'44,8"
NYAKADAKA	Etangs et Ruisseau et Flaque d'eau	1629	S02°14'54,7" E028°49'32,9"
MAZIBA	Ruisseau Mahyuza Et Etang	1723	S02°14'44,3" E028°47'58,1"
BISHIBIRU	Etang	1688	S02°15'08,5" E028°48'09,2"
CHEGERA	Ruisseau	1631	S02°14'17,2" E028°49'29,0"
CHAGALA-BUSANDWE	Etang	1886	S02°14'0" E028°47'37,1"

Pêches larvaires

Les larves ont été pêchées à l'aide des assiettes plates émaillées de couleur blanche. Elles ont ensuite été triées en utilisant des poires munies de tubes en verre transparent. Les larves d'anophèles ainsi sélectionnées étaient transférées dans des grands tubes à essai et transportées jusqu'au laboratoire au centre de recherche en sciences naturelles.

Capture des moustiques adultes

Dans la localité de Chagala-Busombwe, la plus haute en altitude, nous avons eu à prospecter 3 maisons en vue de capturer les adultes et s'assurer afin, de l'origine exacte des larves trouvées à ce niveau. Cette chasse diurne s'est faite par une équipe de quatre personnes munie d'une lampe torche et d'un tube à essai chacune. Les moustiques au repos dans les endroits obscures à l'intérieur des maisons, étaient récoltés et gardés vivants en vue de leur identification au laboratoire à l'aide de la clé de détermination et loupe WILD, de marque SWITZERIND M5-21810, au grossissement 10x25.

Identification des espèces.

L'identification des larves ainsi que des adultes était faite en utilisant la clé de détermination de Highton R. B. [13], ainsi que celle de Botha de Meillon [14]. Chaque larve était déposée dans une goutte de lactophénol placée sur un verre de montre et puis observée sous. Microscope binoculaire WILD, de marque SWITZERIND M11-15870, au grossissement 12x10.

3 RESULTATS

1° Les larves anophéliennes

Un total de 1111 larves a été récoltée dans les différents gîtes à travers les six localités à des altitudes différentes (Tableau 2). Ces larves appartiennent à cinq espèces anophéliennes : *A. gambiae* à 65,07% soit 723 ; *A. demeilloni* à 24,39% soit 267 larves; *A. funestus* à 8,19% soit 91 larves; *A. marshalli* à 1,89% soit 21 larves; *A. coustani* à 0,45% soit 5 larves, comme représenté dans le tableau 3.

A. gambiae a été présent dans toutes les localités où nous avons rencontré les étangs piscicoles, dans ces gîtes il y représente à 85,20% du total de 723 *A. gambiae* dénombrés ; dans les plaques d'eau à Nyakadaka à 14,38%. Il a été absent dans tous les ruisseaux sauf, dans le ruisseau Mahyza de Maziba où il a été à 0,41%. Le drain n'a hébergé aucune larve d'*A.gambiae*. La figure 1 représente la répartition d'*A. gambiae* selon les différents gîtes larvaires positifs.

2° Moustiques adultes

Un total de 13 moustiques adultes avait été capturé à Chagala-Busombwe, aux environs de 1890m d'altitude, dont 5 *A.gambiae*. et 8 culex.

Tableau 2 : Larves pêchées dans les différents gîtes

Localités	Gîtes	Altitude (m)	Espèces d'anophèles à Lwiro				
			<i>A. gambiae</i> .	<i>A. funestus</i>	<i>A. demeilloni</i>	<i>A. marshalli</i>	<i>A. coustani</i>
Lwiro	Etangs	1675-1684	212	12	0	0	0
	Drain	1675	0	0	1	0	0
Nyakadaka	Etang	1629	57	6	0	0	0
	Ruisseau		3	5	14	4	5
	Flaque d'eau		104	0	0	0	0
Maziba	Etangs	1723	37	8	0	0	0
	Ruisseau		3	54	14	4	5
Bishibiru	Etangs	1688	237	4	3	0	0
Chegera	Ruisseau	1631	0	7	139	0	0
Chagala-Busandwe	Etangs	1886	73	0	0	0	0

Tableau 3 : Importance numérique des espèces d'anophèles à Lwiro

Gîtes /Espèces	Etangs	Flaques d'eau	Ruisseaux	Drains	TOTAL	POURCANTAGE
<i>A. gambiae</i>	616	104	3	0	723	65.07%
<i>A. funestus</i>	30	0	61	0	91	8.19%
<i>A. demeilloni</i>	3	0	267	1	271	24.39%
<i>A. marshalli</i>	0	0	21	0	21	1.89%
<i>A.coustani</i>	0	0	5	0	5	0.45%
TOTAL	649	104	357	1	1111	100%
Pourcentage	58.41%	9.36%	32.13%	0.09%	100%	

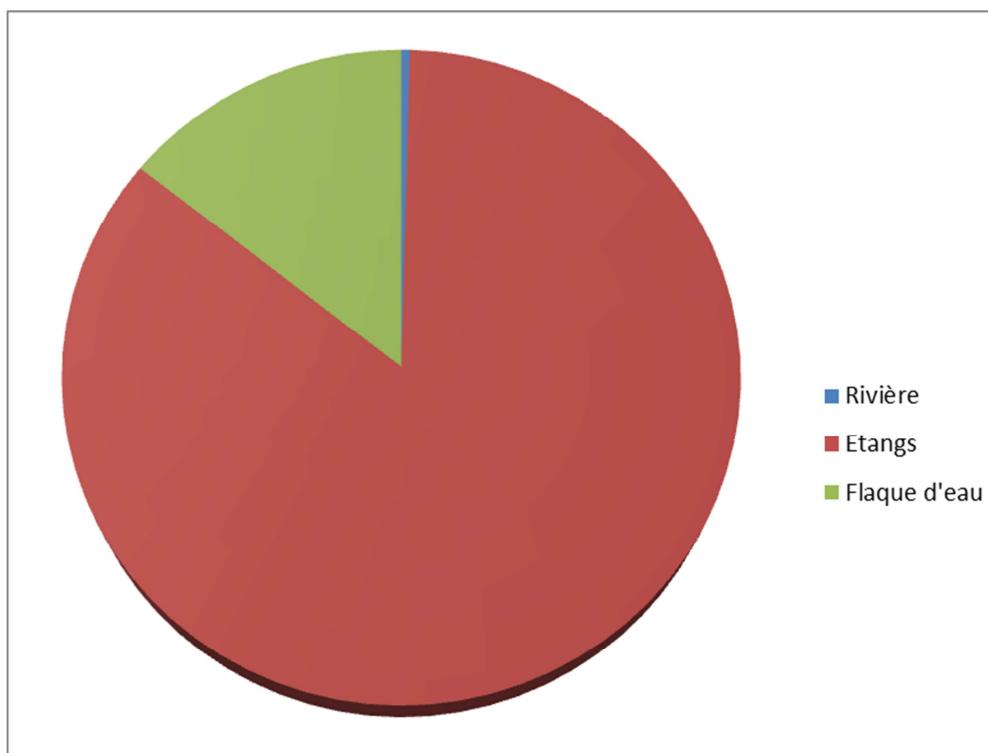


Figure 1 : Position d'*A. gambiae* selon les gîtes larvaires à Lwiro

4 DISCUSSION

La présence à Lwiro des cinq espèces d'Anophèles à savoir : *A.gambiae*, *A.funestus*, *A.marshalli*, *A.demeilloni* et *A.coustoni*, a déjà été confirmée par les études antérieurs [9], [10].

Sur un total de 1111 larves pêchées, *A. gambiae* occupe la première place avec 65,07% et cette a comme gîtes de prédilection, les étangs piscicoles. Cette prédominance en altitude de cette principale espèce vectrice du paludisme [12], [15] remonte aux années 80 avec l'introduction des Etangs piscicoles à Lwiro en 1987 [16] sans toutefois s'observé au delà de 1800m d'altitude. Les études entomologiques de l'époque concluaient «l'implantation des étangs piscicoles dans le milieu a eu comme mérite d'améliorer la santé alimentaire et le paludisme, deux phénomènes jadis absents à Lwiro ». A l'époque de la rareté de cette espèce, la zone était hypoendémique pour le paludisme [11]. En effet, le paludisme constitue la principale cause des consultations médicales à ces jours dans le centre pédiatrique et nutritionnel de Lwiro, une corrélation avec la densité de ses vecteurs principaux *A. gambiae* et *A. funestus* [18], [10] et pourtant le milieu appartient dans le troisième faciès épidémiologique, faciès montagnard (zone entre 1000 et 1500m d'altitude) où la transmission devrait être courte et assurée par la seule espèce *A. funestus* [7].

L'espèce affectionne des collections d'eau calmes, moins polluées, peu profondes et bien ensoleillées ; conditions qu'offrent les étangs piscicoles et les flaques d'eau.

A. gambiae peut s'adapter en altitude selon que les conditions écologiques locales lui sont favorables. C'est en effet, une espèce opportuniste d'accumulation d'eau douce [5]. La deuxième raison qui peut expliquer la présence d'*A. gambiae* à haute altitude semble être l'accroissement des activités humaines (drainage, modification de la couverture végétale, etc.) dues à la densité croissante de la population dans le milieu. La densité du vecteur *A. gambiae* (s.l) varie avec le degré d'urbanisation et de déforestation [19], [17]. Ses résultats se démarquent cependant, avec les travaux antérieurs, dans l'ordre d'arrivée des espèces qui semble se renverser pour les autres espèces comme *A. demeilloni* qui vient en deuxième place(24.39%) en remplacement de *A. funestus* et à *A. marshalli* [8], [10]. Ceci peut être dû à la période de capture qui s'est effectuée en pleine saison de pluie (de janvier en juin). La régression numérique d'*A. funestus* à Lwiro devant *A.gambiae* mérite aussi d'être éclairé car cette première peut vivre jusqu'à 2000m d'altitude [18], l'espèce *A.gambiae* abonde non seulement, à la fin de la saison de pluie, mais aussi les études effectuées en saison sèche ne contredisent plus cette tendance.

5 CONCLUSION

Les étangs piscicoles offrent des conditions écologiques favorables à l'espèce *A. gambiae*. Ce vecteur redoutable du paludisme peut s'adapter et se reproduire à des hautes altitudes à condition que la région offre des gîtes aux larves à l'eau calme, moins profonde, moins polluée, ensoleillée et des sources du sang aux femelles gravides. Ces conditions sont créées à haute altitude à Lwiro par l'anthropisation et les activités humaines correspondantes. Ceci explique la présence pour la première fois des *A.gambiae* au village de Chagala-Busandwe à 1886m d'altitude pour les larves et au delà pour les adultes. La montée persistante du paludisme dans cette zone de haute altitude de Lwiro coïncide avec la dominance numérique de ce grand hôte et vecteur des parasites plasmodiums, *A. gambiae*. La prévention contre les piqûres des moustiques par l'usage des moustiquaires imprégnées d'insecticide à longue durée d'action devra concerter même les personnes en altitude dans la région. La communauté locale, sanitaires et politiques devraient également prendre le temps de juger de l'opportunité de créer les étangs, comparer le rendement par rapport aux coûts dus au paludisme. La domestication des certains poissons larvivores des moustiques est à encourager aussi dans la région pour la lutte antivectorielle.

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Analysis of Changing Land Cover in Chittagong City Corporation Area (CCC) by Remote Sensing and GIS

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ABSTRACT: Growth pattern and trend is an important factor for a city or municipality because the future condition depends on the growth pattern and trend. Chittagong District is one of the three hill tracts districts in Bangladesh. It is found that growth trend of the Chittagong city is on the north east direction. On the south side it is no possible because of the presence of Patenga sea beach which defines the last boundary of the city area. In this process of urbanization, the physical characteristics of Chittagong is gradually changing as open space have been transform into building areas, low land and water bodies in to build up lands etc. In this project, proper analysis is done and the ERDAS software where build up area, vegetation area and water body is analyzed. Ward wise land cover change also found in this research. By considering this data, it has been found that north east direction is the growth trend. This study can help the future researchers to analysis growth pattern and trend analysis.

KEYWORDS: Remote Sensing, Land use, Change Detection, growth trend, spatio-temporal analysis.

1 BACKGROUND OF THE RESEARCH

RS and GIS techniques are being widely used to assess natural resources and monitor environment changes. It is possible to analysis land use change dynamics using time series of remotely sensed data. The incorporation of GIS and RS can help analyzing this kind of research in variety of ways like land cover mapping, detecting over the time. Lambin,(2001);

With the advancement of technology, availability of historic spatio-temporal data and high satellite images, GIS and RS techniques are now very useful for conducting researches like land cover change detection analysis. Mundia et al, (2005);

As a tinny district town initially Chittagong started to flourish and by the activities of port area, the city is now expanding which is mostly dependent on the river bank Karnafuly. At the very beginning Chittagong town started to grow as a small municipality in 1863 that was inhabited by 25000 people only. In 1864 the city was reconstituted as Chittagong municipality. It was further upgraded to Chittagong Municipal Corporation in 1990. At present the city area is 155sq. km. and is inhabited by around 4 million populations at present. Wikipedia, (2014);

Like many other cities in the world Chittagong, The second largest city of Bangladesh is also the outcome of rapid growth without systematic growth. Chittagong city has undergone radical changes in its physical form, not only in its vast expansion but also through internal physical transformations over the last decades. Ahmed,(2008);

At present time, the growth trend of Chittagong city in on the north east corner of the city. By considering the growth center, growth poles of Chittagong city such as Hatazari, Anowara, Raozan, etc. it is found that growth trend of the Chittagong city is on the north east direction. On the south side it is no possible because of the presence of Patenga sea beach which defines the last boundary of the city area. Parker, et al,(2001);

POSSIBLE OUTCOME

Possible outcome in this research is physical characteristics of Chittagong city are gradually changing as agriculture land, water body, sandy land and open space have been transformed into build up areas and its rate.

APPLICATION OF THE RESEARCH

In future this research help to find out the city growth trend, future growth pattern, and land use.

2 OBJECTS WITH SPECIFIC AIM

Analysis of changing land covers in Chittagong city corporation area.

2.1 OBJECTIVES OF STUDY

1. To classify land cover of the study area in different period using supervised classification.
2. To assess the classification using separability for accuracy assessment of the classification.
3. To analysis how the land cover of the study area is changing over the period of time.

3 METHODOLOGY OF THE RESEARCH

3.1 WORKING PROCEDURE

3.1.1 SELECTION OF THE RESEARCH AND STUDY AREA

- ✓ Analysis of changing land covers in Chittagong city corporation area.

3.2 OBJECTIVES OF STUDY

1. To classify land cover of the study area in different period using supervised classification.
2. To assess the classification using separability for accuracy assessment of the classification.
3. To analysis how the land cover of the study area is changing over the period of time.

3.3 DATA SOURCE

This research is dependent on secondary data source. To prepare the base map for analysis purpose and applying the different methods to achieve this the research objectives Landsat satellite image (1989, 2001, 2013) have been collected from the official website U.S geological survey (USGS).

Table 1: Detail of Landsat satellite images

	Landsat_1989	Landsat_2001	Landsat_2013
Date_acquired	1989-01-21	2001-02-07	2013-12-01
Cloud_cover	0.00	0.00	1.11
Output_format	Geotiff	Geotiff	Geotiff"
Sun_azimuth	139.53	139.33	153.95
Sun_elevation	37.15	42.99	42.25
Map_projection	Utm	Utm	Utm
Utm_zone	46	46	46
Grid_cell_size_reflective	30.00	30.00	30.00
Grid_cell_size_thermal	30.00	30.00	30.00
Spacecraft_id	Landsat_4	Landsat_7	Landsat_8

3.4 BASE MAP PREPARATION AND ACCURACY ASSESSMENT

For image classification purpose, supervised classification method has been used. Then after achieving satisfactory accuracy result, the base map has been finalized.

Table 2: Data Separability Of 2013

signature name	1	2	3	4	5
vegetation	0	8509.74	5983.73	14414.2	4920.68
water	8509.74	0	6218.2	18515.3	9333.72
buildup	5983.73	6218.2	0	13227	3752.65
sand	14414.2	18515.3	13227	0	10665.9
Open space	4920.68	9333.72	3752.65	10665.9	0

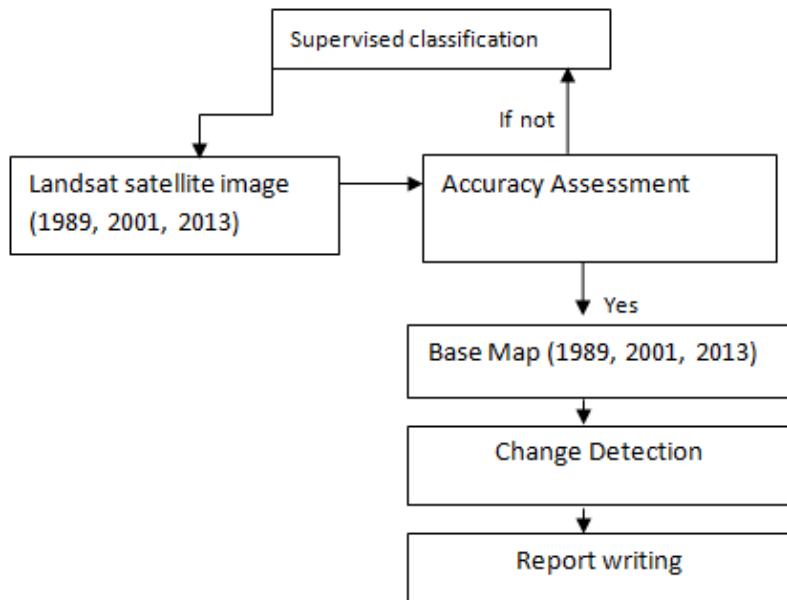
Table 3: Data Separability Of 2001

signature name	1	2	3	4	5
vegetation	0	44.42	75.5	82.01	154.86
buildup	44.42	0	76.66	53.52	127.46
water	75.5	76.66	0	126.69	197.16
Open space	82.01	53.52	126.69	0	75.215
sand	154.86	127.46	197.16	75.215	0

Table 4: Data Separability Of 1989

signature name	1	2	3	4	5
vegetation	0	23.62	60.66	102.31	57.21
buildup	23.62	0	48.1	91.5	58.31
Open space	60.66	48.1	0	44.2	104.47
sand	102.31	91.5	44.2	0	147.09
Water body	57.21	58.31	104.47	147.09	0

3.5 TYPICAL FLOW DIAGRAM



3.6 OUTPUT FILE

3.6.1 LAND USE MAP OF CHITTAGONG CITY

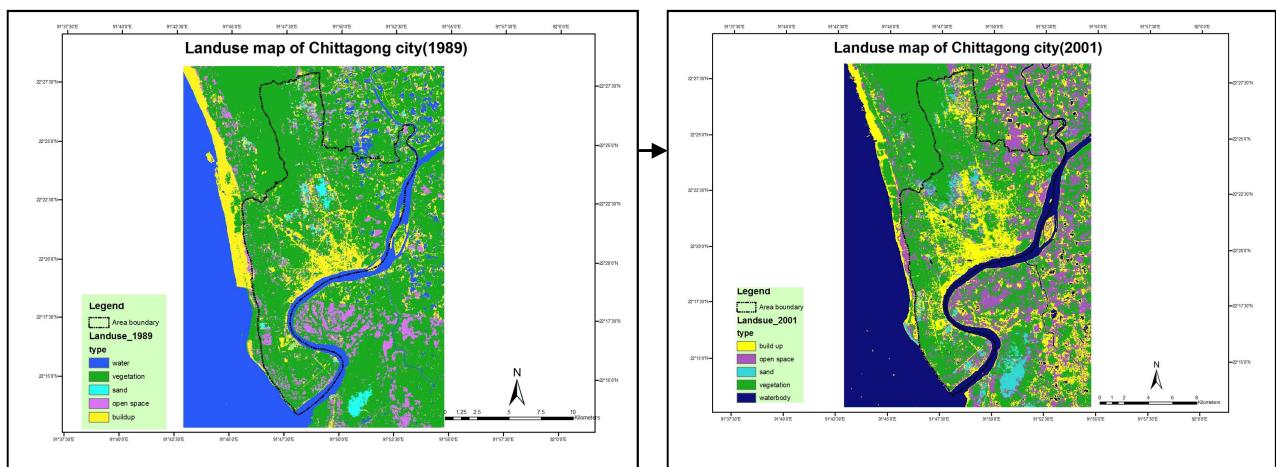


Figure 1: Land use map of Chittagong 1989

Figure 2: Land use map of Chittagong 2001

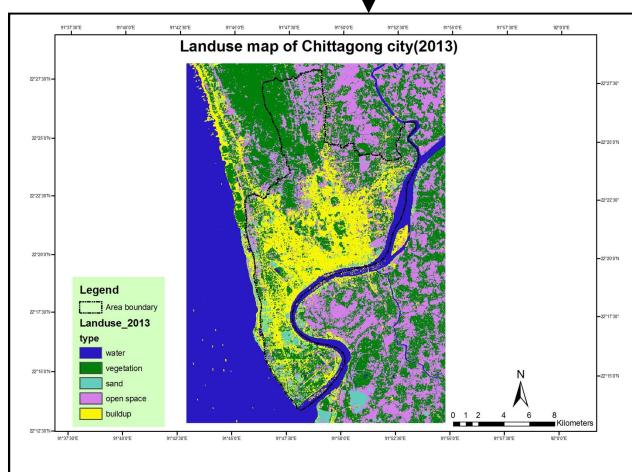


Figure 3: Land use map of Chittagong 2013

3.6.2 CITY GROWTH RATE ANALYSIS (BY USING CHANGE DETECTION TOOL)

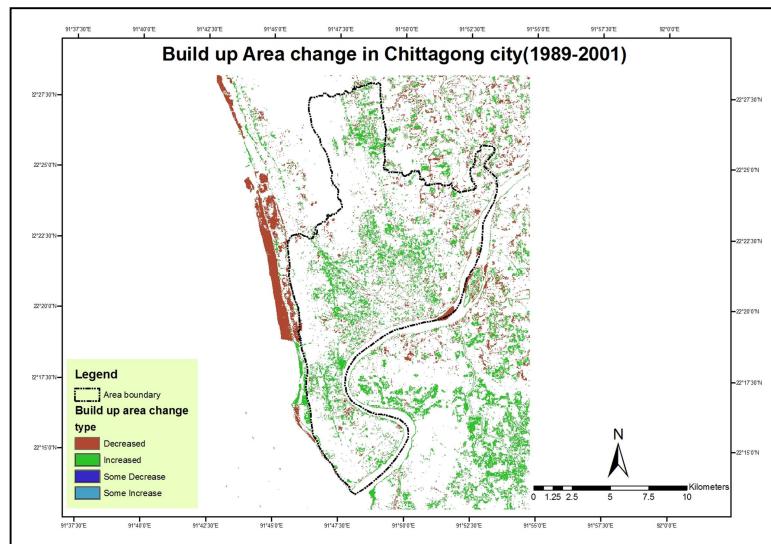


Figure 4: Build up area change in Chittagong city (1989-2001)

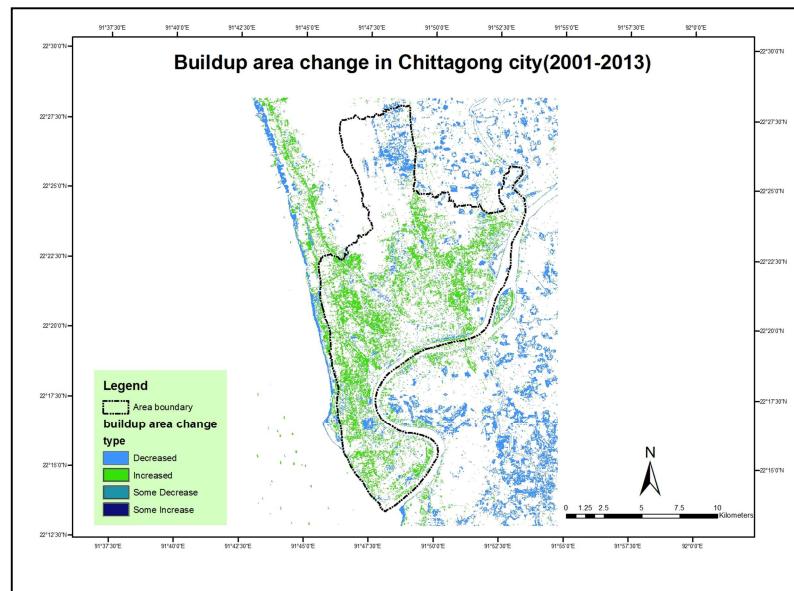


Figure 5: Build up area change in Chittagong city 2001-2013)

3.6.3 CITY GROWTH RATE ANALYSIS (BY USING MODEL BUILDER TOOL)

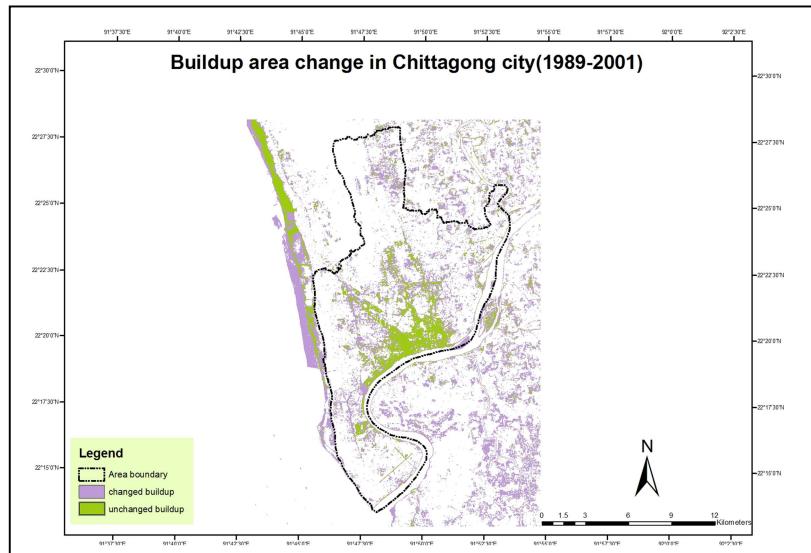


Figure 7: Build up area change in Chittagong city (1989-2001)

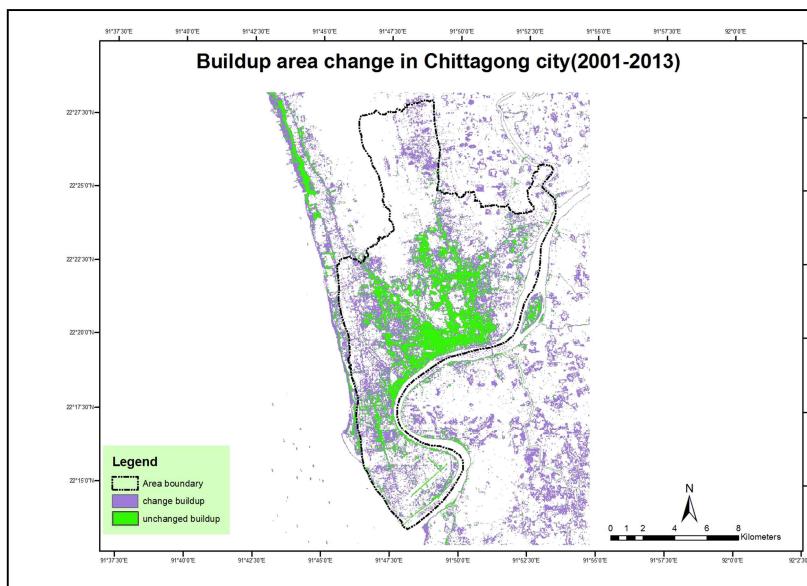


Figure 7: Build up area change in Chittagong city (2001-2013)

4 ANALYSIS AND FINDING

4.1 STATISTICAL ANALYSIS

The growth rate of a city can be identified by evaluating the growth change of buildup area in different time. In this research two tool of remotes sensing were used in to find out the change of different land use which are “Change detection” tool and knowledge “engineering tool”. In this chapter the manipulated data is used for analysis work.

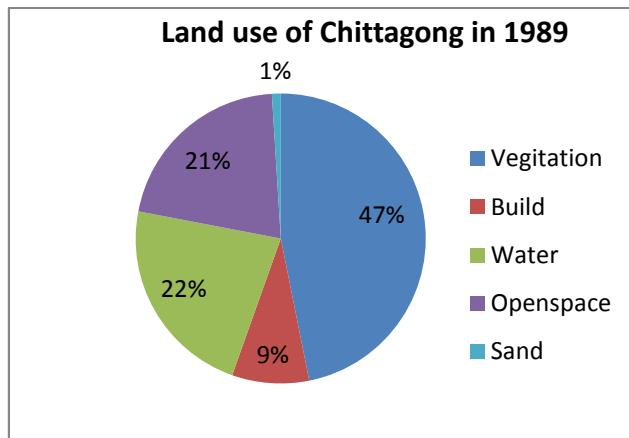


Figure 8: Land condition of Chittagong city (1989)

The above chart shows the different land use in 1989 of Chittagong City Corporation area. It can be seen that, about 55% lands were used as vegetation area and 26% as water body.

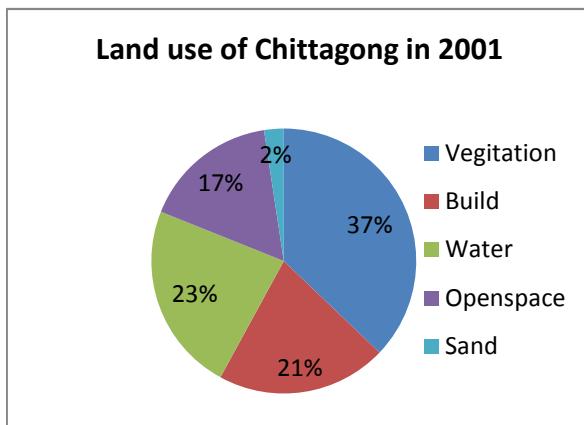


Figure 9: Land use condition of Chittagong city (2001)

From the chart it can be seen that, in 2001 the major land use was vegetation which was 37% and other land uses are water 23% and build up area 21%.

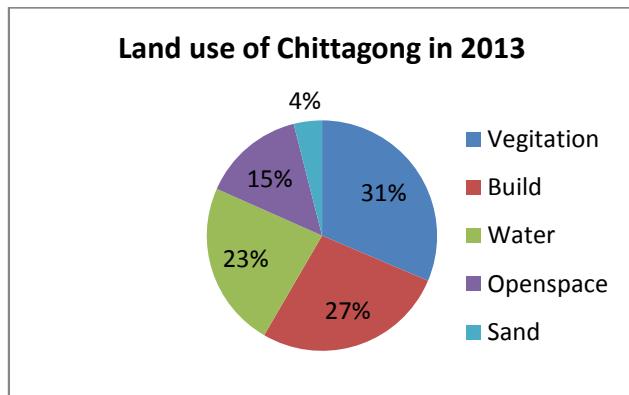


Figure 10: Land use of Chittagong city (2013)

The above graph shows the land use of Chittagong in 2013. The most area was covered by vegetation area which was 31% and build up area was 27%.

4.1.1 CITY GROWTH RATE ANALYSIS (BY USING CHANGE DETECTION TOOL)

In this research the growth of a Chittagong city is evaluated through the buildup area changing rate and pattern from 1989-2013.

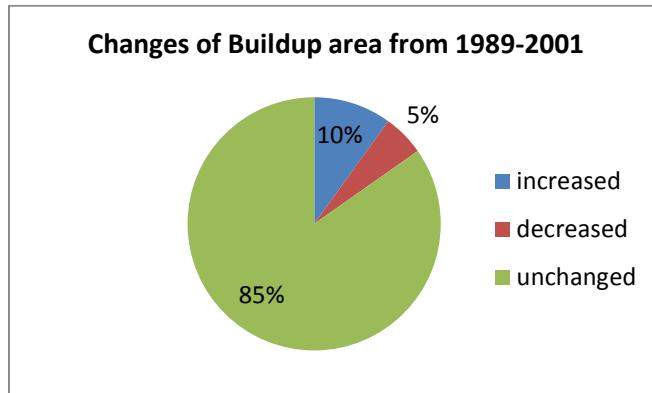


Figure 11: build up area change of Chittagong city (1989-2001)

The following graph shows the buildup area changing rate from 1989-2001. It can be seen that most of buildup area remain unchanged and 10% buildup area has been expanded from 1989 to 2001.

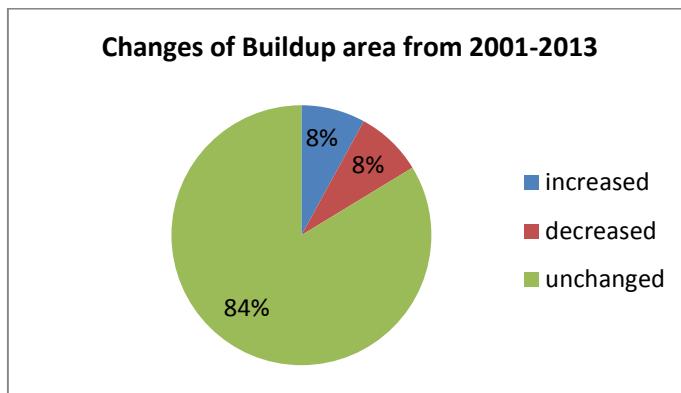


Figure12: build up area change of Chittagong city (2001-2013)

This graph shows the changing rate and pattern of buildup area from 2001-2013. From this it can be seen that 8% area were increased but again in the urban fringe area 8% area were decreased.

4.1.2 CITY GROWTH RATE ANALYSIS (BY USING MODEL BUILDER TOOL)

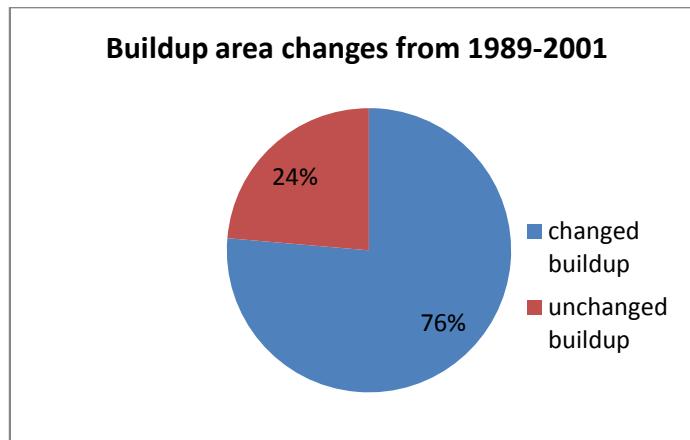


Figure 13: build up area change of Chittagong city (1989-2001)

From this graph it can be seen that most of the area became changed to buildup area from 1989-2001. The changed area from 1989-2001 was 76%.

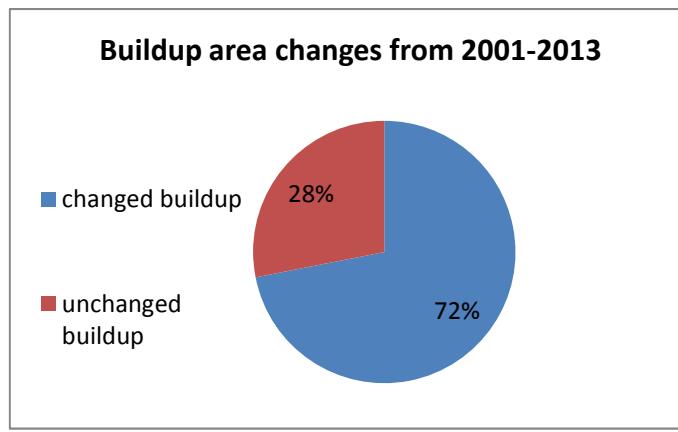


Figure 14: build up area change of Chittagong city (2001-2013)

From this graph it can be seen that most of the area became changed to buildup area from 2001-2013. The changed area from 2001-2013 was 72%.

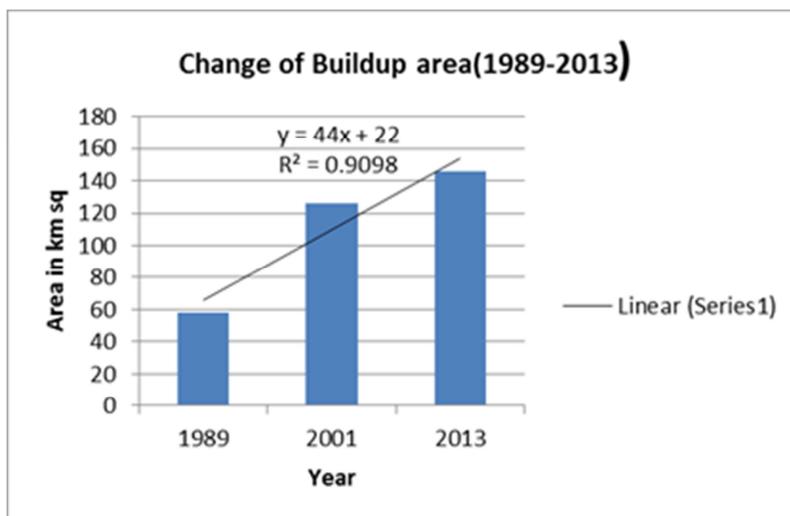


Figure 15: growth rate and trend of buildup area from 1989 to 2013.

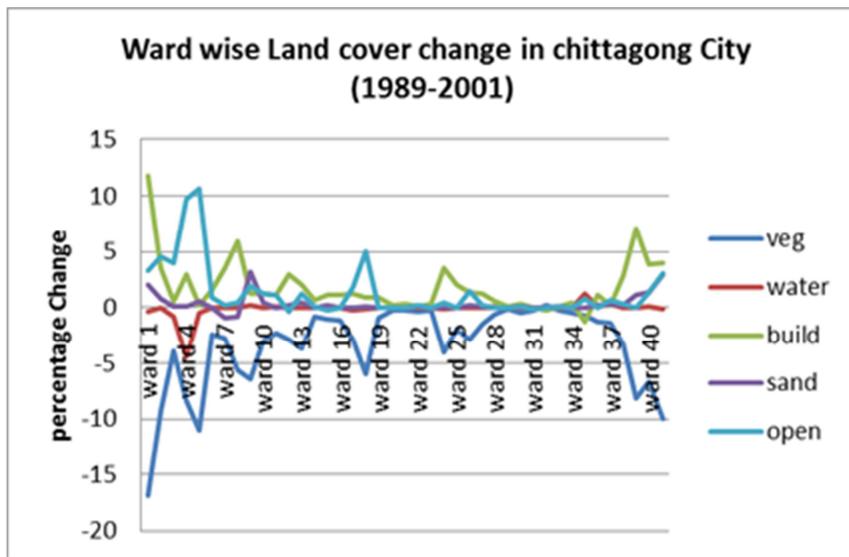


Figure 16: Ward wise Land cover Change in Chittagong city (1989-2001)

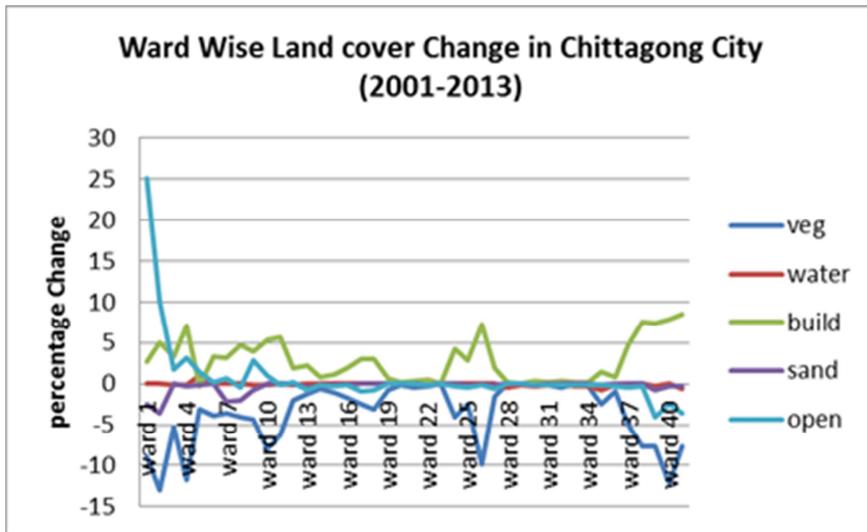


Figure 17: Ward wise Land cover Change in Chittagong city (2001-2013)

4.2 FINDINGS

In this research the growth trend has been evaluated through “The spatiotemporal analysis of Chittagong City Corporation” area by using Change detection tool and Model builder tool in Remote sensing software. Through the analysis of manipulated data it can be seen that the land use change from other criteria to build up from

- 1989-2001 was 76% and 2001-2013 was 72% (by using model builder)
- 1989-2001 the buildup area has increased 10% and 86% area remain unchanged as buildup area and 2001-2013 the buildup area has increased 8% and 84% area remain unchanged as buildup area (by using change detection tool).

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Removing Gradient and Ballistocardiographic Artifacts from EEG using FMRIB Toolox

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ABSTRACT: Real-time recording of the electroencephalogram (EEG) and functional magnetic resonance imaging (fMRI) may reveal the brain's activity at high temporal and spatial resolution. However, the EEG recorded during fMRI scanning is corrupted by large repetitive artifacts, called Gradient artifacts which are generated by the switched MR gradients. In addition, Ballistocardiographic artifacts (BCG) are overlaid on the EEG resulting from heart beat related body movements and blood flow changes. This thesis presents generic methods to remove fMRI environment-related artifacts from EEG data with the minimization of residual artifacts. Firstly, methods for removing gradient and BCG artifacts have been presented in this thesis which is based on capturing temporal variations in the artifacts by carrying out temporal principal component analysis (PCA) and recognition of a set of basis functions which describe the temporal variations in the artifacts. FASTR (fMRI Artifact Slice Template Removal) algorithm is used here for subtracting gradient artifacts in which a unique artifact template is generated for each slice as the local moving average plus a linear combination of basis functions that describe the variation of residuals. The basis functions are derived by performing temporal principal component analysis (PCA) on the artifact residuals and selecting the dominant components to serve as a basis set. QRS complexes are identified for the purpose of pulse artifact removal. These methods are implemented as an FMRIB toolbox in EEGLAB. The algorithms employed here give satisfactory results by removing all the artifacts. This artifact reducing analysis offers possibilities for improved neurological research and clinical neurosurgical applications.

KEYWORDS: Electroencephalogram (EEG), Gradient Artifacts, Ballistocardiographic Artifacts, Principle Component Analysis (PCA), Optimal Basis Set (OBS), Magnetic Resonance Imaging (MRI), Functional Magnetic Resonance Imaging (fMRI).

1 INTRODUCTION

Combined EEG/fMRI recording has been used to localize the generators of EEG events and to identify subject state in cognitive studies and is of increasing interest [1]. EEG recordings obtained inside the MR environments suffer from various kinds of artifact. There are two physical principles which underlie the generation of these artifacts. First, if the magnetic flux through a loop changes, an electromotive force (emf) is induced in the loop (Faraday's induction law). Second, there is a blood flow effect, whereby the movement of blood (a conductor) normal to a magnetic field leads to induced potentials. These principles result in two prominent types of artifacts. First, gradient artifacts are caused by the switching of magnetic gradients during FMRI. Second, ballistocardiographic (BCG) artifacts related to cardiac activities further contaminate the EEG data.

The switching of magnetic gradients is necessary for MRI image acquisition; and the related EEG signal distortions cannot be avoided by any shielding. Interleaved designs, where EEG recordings are analyzed during the "silent" interval between MR scanning, have been used, but they do not solve the principle problem and restrict the efficiency of the experiment. The two types of imaging artifact that can be distinguished are the gradient artifact (GA), which causes a massive distortion of the EEG, and radio frequency (RF) artifact. Because the latter has a much higher frequency than the EEG signal, it can be effectively suppressed by analog low pass filtering. Analog low pass filtering is mandatory anyway to avoid EEG amplifier saturation and aliasing problems. Accordingly, the GA represents the major source of MR imaging artifact. The GA is a

technical or exogenous artifact that reflects the imaging slice acquisition. Its major contribution is a very steep rising, transient signal with gradients that can be in the order of millivolts per millisecond. The GA completely dominates the EEG recording during MR image acquisition periods. Unlike the RF, the GA distorts the EEG spectrum over a broad frequency, including the frequency range of interest (< 100 Hz), and therefore cannot be fully accounted for by filtering. In fact, for many purposes, the GA is one of the two major artifacts that need to be dealt with statistically [2].

Different approaches have been proposed to remove gradient artifacts from biological signals collected during MRI scanning. Hoffmann proposed a frequency domain method, where the amplitude and phase of the data were set to zero at frequencies matching an artifact power spectrum template [3]. However, this approach suffers from the typical Fringing effect common to such frequency domain filters [4]. The most used method is average artifact subtraction [4, 5]. This utilizes the repetitiveness of the artifact to form an average artifact template, which is then subtracted from the EEG data. The efficacy of this approach has been demonstrated in the literature [4, 5, 6], though a number of quality and practicality issues still remain. Firstly, some residual artifacts remain on some channels. Allen proposed the use of adaptive noise cancellation (ANC) to remove these residuals; however, this approach does not remove all residual artifacts [5]. Secondly, in order to minimize the residuals, a high sampling frequency is needed [7].

In this paper, a method for the removal of gradient artifacts; FMRI artifact slice template removal (FASTR) is presented. In FASTR, a unique artifact template for each slice artifact in each EEG channel is constructed and then subtracted. Each slice template is constructed as the local moving average plus a linear combination of basis functions that describe the variation of residuals. The basis functions are derived by performing temporal principal component analysis (PCA) on the artifact residuals and selecting the dominant components to serve as a basis set. This technique is superior and applicable at a sampling rate as low as 2048 Hz.

Unlike the GA, which occurs only during slice acquisition periods, the ballistocardiogram (BCG) is always present in the scanner's magnetic field. The BCG contributes to the low frequency portion of the EEG signal (< 15 Hz). A concurrent recording of the EEG with the electrocardiogram (ECG) reveals that the periodic distortion present in most EEG channels is related to the cardiac cycle. While the exact origin of the BCG is not known yet, it is likely that the pulsatile flow of blood associated with the cardiac cycle induces a rocking, nodding head motion. Another source of influence could be that EEG electrodes (or cables) over, or adjacent to, pulsatile blood vessels are in steady motion. And finally, according to the Hall effect, the acceleration of blood, which is electrically conductive, could be a source of current induction that is registered in the EEG [8].

Several approaches have been proposed to remove the BCG artifact. Adaptive filtering has been proposed by Bonmassar : a piezoelectric sensor was used to generate a reference BCG signal, which was then used to filter out BCG contributions from the EEG [9]. This method is computationally expensive, requires the use of an extra sensor and assumes that no EEG correlated information is present in the sensor signal. Spatial PCA and independent component analysis (ICA) filters have also been proposed [4]. One problem with these approaches is that they necessitate the presence of a large number of sensors. Also, the identification of artifact components can be subjective and is usually done manually. Most importantly, spatial filters assume that all the sensors are contaminated by common sources, which is not the case. The BCG artifact derives from sources that are rotating/moving, which contaminate different sensors at different points during the cardiac cycle with different effects. The most commonly used method for removing the BCG artifact is the average artifact subtraction (AAS) [1], in which a moving average artifact template is computed from successive artifact occurrences, then subtracted from the data. This assumes that the BCG artifact is a slowly changing signal that can be accurately captured by a moving average. This can result in residual artifacts in the data [7].

In this study, a method where a basis set is constructed by performing temporal PCA on each EEG channel data has been exploited. The basis set is then fitted to, and subtracted from, each artifact occurrence. This approach has the advantage of not assuming any temporal relation between the different occurrences of the BCG artifact in a given EEG channel. Rather, the assumption is that over a sufficient period of EEG recording from any single EEG channel, the different BCG artifact occurrences in that channel are all sampled from a constant pool of possible shapes, amplitudes and scales. The principal components of all the occurrences can then describe most of the variations of the BCG artifact in that channel.

2 METHODS

2.1 THE GRADIENT ARTIFACT REMOVAL

During MR imaging, the magnetic field inside the MRI scanner continuously changes as a result of the switching of the magnetic field gradients [7]. The gradients change according to the imaging sequence being used. In an echo planar imaging

(EPI) sequence typically used in fMRI, gradient switching is repeated each time a new slice is collected, resulting in artifacts that repeat with the collection of each new fMRI slice. The amplitude of such artifact can be 100 times greater than the EEG signal and its frequency content overlaps that of the EEG, thus gradient artifacts cannot be simply filtered out. The artifact shape and amplitude varies from one EEG channel to another depending on the location of the electrodes and the wire connections [3, 10, 11].

FASTR (fMRI Artifact Slice Template Removal) algorithm

In this paper, an algorithm named ‘FASTR’ is presented which is used to remove the gradient artifact. fMRI artifact slice template removal, FASTR is based on constructing a unique template for each artifact segment, in each channel, generated during the acquisition of a single fMRI slice. The algorithm comprises four steps. First, the signal is interpolated (up-sampled) and the slice-timing triggers are adjusted to optimize the alignment. Second, a local artifact template subtraction is performed, in which a moving average artifact template is constructed for each slice artifact then subtracted. Third, the artifact residuals are estimated using basis functions derived from performing PCA on each channel’s artifact segments. The reason for splitting the artifact subtraction into two steps is that the algorithm is needed to be as adaptive as possible; the algorithm needs to adjust to sudden changes in the artifact shape (due to head movement for example). Performing PCA repeatedly on small sections of the data (to make it adaptive) would produce less than optimal basis functions. On the contrary, the moving average subtraction performed in step 2 is adaptive and removes more than 98% of the artifacts. Hence, it is opted to make the bulk of the artifact removal as adaptive as possible while maintaining the efficiency of using PCA to describe and remove the residuals. Fourth, adaptive noise cancellation (ANC) is performed [5]. ANC removes any components in the data that are correlated with a reference. By using the subtracted noise as a reference, artifact components not captured in the basis set are removed. More details about the function of the ANC filter is given later. The process encompassing all the four steps is referred to as FASTR. Fig. 1 shows a schematic of the FASTR algorithm. The schematic and the following details are for a single channel of EEG data. All the four steps are discussed below.

(1) Interpolation and Alignment of Slice-Timing Trigger

During the acquisition of simultaneous EEG/fMRI data, triggers are sent by the MRI machine at the start of each slice acquisition. These triggers are usually a simple 5-V TTL signal that can be read by the EEG amplifier and inserted in the data to indicate the starting location of each slice acquisition and the corresponding slice artifact (to be used in subsequent steps to form the artifact template). However, since the MRI machine and the EEG system are driven by separate clocks, some degree of misalignment—“jitter”—may occur in the exact location of the registered trigger relative to the artifact from one slice to the next. The jitter gets worse as the EEG sampling rate is reduced. Relying on these triggers for time-locking slices to construct an artifact template would therefore not be optimal. To remedy this problem, the first channel data (or any other EEG channel data) is sync interpolated (up-sampled) to bring the sampling rate to about 20 kHz and then divided into segments according to the slice-timing triggers [7]. In this thesis paper, the term artifact segment is used to indicate a window covering the duration of a single slice artifact occurrence. The first artifact segment is then taken as a reference. For each of the remaining slice artifact segments, the trigger location is adjusted to maximize the correlation with the reference. Although this process can be repeated for each EEG channel, this is not only computationally inefficient but is also unnecessary. It is found that in practice adjustments to one EEG channel apply equally to them all.

(2) Subtraction of Local Slice artifact Template

For any interpolated channel, \mathbf{Y}^a , which is collected during the acquisition of continuous fMRI, a 1-Hz high-pass filtered version, \mathbf{Y}^h is generated. The high-pass filter serves to remove any slow drifts in the EEG to ensure that the different artifact segments used in the average artifact estimation have the same baseline. This is useful since the artifact signal itself is unlikely to have any slow drifts or shifts in the baseline from one segment to another, thus the high-pass filtering will improve the artifact estimation. \mathbf{Y}^h is then segmented into N ($N = \text{volumes} \times \text{slices}$) equal-sized segments according to the adjusted/aligned slice-timing triggers. Each of these segments is a $1 \times q$ vector, where q is the number of time points spanning each artifact interval. The local moving average artifact template for each segment is calculated then as:

$$\mathbf{A}_j = \frac{1}{|I(j)|} \sum_{l \in I(j)} \mathbf{Y}_l^h \quad (1)$$

In Eq. (1), $j = 1, 2, \dots, N$ indexes the slice artifact segments, \mathbf{A}_j is a $1 \times q$ vector of the local moving average artifact template for segment j and l is an index of the different artifact segments to be averaged [7].

$I(j)$ is an index function, which determines which segments are included in the average. The slice segments in $I(j)$ are centered around segment j and are chosen so that there is a sufficient time gap between them to ensure that there is no EEG autocorrelation between the segments included in the template computation. This approach removes any data that

correlates with the FMRI slice acquisition indiscriminately. The user needs only to determine how many elements to include in $I(j)$, i.e., the length of the moving average window, and how much gap to leave between the selected segments. The selection of averaging window length $|I(j)|$ governs the adaptivity of the algorithm to changes in the artifact waveform (due to head movement for example). The shorter the window length, the more adaptive the algorithm. On the other hand, the shorter the window length, the more noisy the artifact template and the more real EEG data are likely to be removed. The gap between selected segments should be judged by how close the segments are in time. Based on experience, it is safe to assume that on the time scale of a slice artifact, EEG is uncorrelated after 350 ms. Hence, a gap of at least that much time should be left between successive segments included in the average. Finally, the computed template, A_j , is scaled by a constant α to minimize the least squares between the template and the data. We can then subtract the scaled artifact from Y^h to construct a signal, Y^r , which is the cleaned EEG data with residual artifacts.

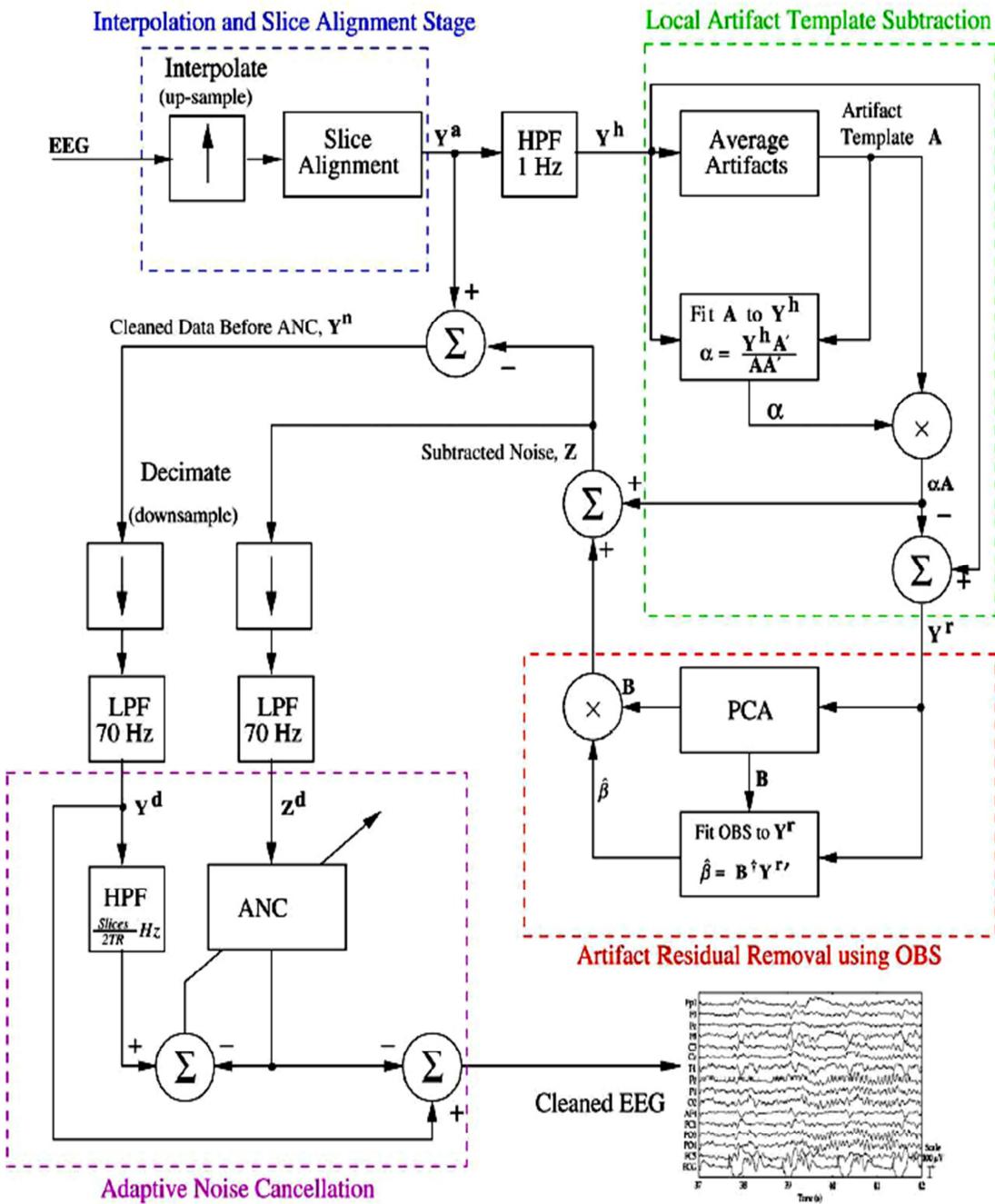


Fig.1. Schematic flow chart of the FASTR algorithm

(3) Reduction of Gradient Artifact Residual Using Optimal Basis Sets(OBS)

The vector \mathbf{Y}^r that results from the previous step is still likely to be contaminated with residual artifacts due to slight variations in the shape of the artifact from one slice to the next. The amount of variation is a function of the sampling rate and the synchrony between the clocks of the MRI and EEG systems. From \mathbf{Y}^r , we derive a set of basis functions for the residuals. First, a residuals matrix $\mathbf{S} \times q$ is formed, where p is the number of artifact segments included. As in the previous step, not all segments are included in \mathbf{S} . Instead of a fixed gap between the selected segments, however, segments should be selected after applying a gap of s or $s + 1$ in a random order, where s is the minimum gap determined in the previous step. This is to safeguard against only capturing variations that occur every $s + 1$ segments and to insure that all variations of the artifact residuals are sampled. For example, if it were determined in step 2 that one slice artifact segment should be skipped (i.e., $s = 1$) when calculating the local artifact, then in selecting segments to include in \mathbf{S} , we would sometimes skip one segment (s) and other times skip two segments ($s + 1$), in no particular order (randomly). The rows of \mathbf{S} are then demeaned, i.e., the mean of each segment is removed. The column-wise mean is also calculated and subtracted from the columns of \mathbf{S} , i.e., the mean effect of the residuals is calculated and removed. PCA is then performed on \mathbf{S} . The different variations in the residual artifacts will be captured in the principal components of \mathbf{S} , ordered according to the variance explained by each component. For simplicity, we use the term principal component (PC) to refer to the projection of \mathbf{S} onto the principal component coefficients. The first C PCs, including the calculated mean effect, constitute an optimal basis set (OBS), $\mathbf{B}q$ ~~X~~ c for describing the gradient artifact residuals variations. The number of components C is selected based on the amount of variance explained by the PCs. It was observed that for most channels in a single data set, the same number of components is needed to explain the variance of the artifact. It is recommended that C is chosen conservatively, since including unnecessary components may result in the loss of data.

Each segment of \mathbf{Y}^r can now be written in terms of \mathbf{B} as:

$$\mathbf{Y}_j^{r'} = \mathbf{B}\beta_j + \varepsilon_j \quad (2)$$

where β_j is a $C \times 1$ vector of weights to fit \mathbf{B} to \mathbf{Y}^r and ε_j is a an error term for the segment [7]. The weights for each segment are then estimated by least squares and added to the artifact noise found in step 2 to construct the final estimation of the gradient artifacts, \mathbf{Z} , and an artifact-subtracted EEG data \mathbf{Y}^n (Figure 1).

The final estimated noise is subtracted from the original interpolated EEG data, not the high-pass filtered version used for the artifact estimation, since the removed baseline drifts or slow oscillations might be of interest to the user. Both \mathbf{Z} and \mathbf{Y}^n are low-pass filtered at 70 Hz then down-sampled back to the original sampling frequency to form \mathbf{Z}^d and \mathbf{Y}^d , respectively. Although steps 2 and 3 contribute to the same desired outcome, the approach taken in each is complementary to the other. In general, the process as a whole should be adaptive and accurate. Step 2 works to remove the bulk of the artifact variance and is adaptive to sudden changes in the artifact shape. However, the moving average approach in step 2 does not capture the exact artifact shape. Step 3 serves to remove the details of the residuals. This necessitates that the OBS accurately describes the variations in the residuals. To this end, the residuals matrix \mathbf{S} needs to have as many entries as possible for the PCA to produce an accurate OBS; this requirement limits the adaptivity of the OBS approach. At the same time, PCA need not be performed on the whole length of the recording. In this implementation, each 1-min portion of the data is processed at a time, partly for computer memory concerns, but also to provide a degree of adaptivity.

(4) ANC (Adaptive Noise Cancellation)

The final step is the removal of any remaining residuals using adaptive noise cancellation (ANC). Figure 1 includes a schematic of the ANC filter. In ANC, a signal contaminated with noise constitutes the input to the filter, \mathbf{Y} . The source of the noise is assumed to be known and is referred to as the reference signal. The actual noise in the signal is assumed to be correlated with the reference in an unknown manner. The ANC filter holds a vector of weights, which is used to calculate the output of the filter at each time point. The weights of the filter are updated at each time point using the least mean-square (LMS) algorithm. In general, the performance of the filter is controlled by the step size, μ , and the length of the weight vector, L , which control the stability and convergence of the filter. When the filter converges, it estimates the noise from the signal that is correlated with the reference. However, the accuracy of the estimation is limited by the quality of the reference and choice of μ and L . Also, high power fluctuations in the input can cause the filter to diverge [7].

In FASTR, the final artifact estimation \mathbf{Z}^d is used as the reference in the ANC. Since ANC removes from the data components that are correlated with the reference, the subtracted noise \mathbf{Z} provides a more accurate reference for this purpose and was found to have less of an effect on real data. Additionally, the input to the ANC filter is a high-pass filtered version \mathbf{Y}^d . The cut-off frequency is selected to be half of the fundamental gradient artifact frequency, i.e., $f_c = \text{slices}/2\text{TR}$. The output of the filter is then subtracted from the original \mathbf{Y}^d to produce the final clean EEG data.

It is found that the ANC filter consistently converged and removed components which were clearly related to the artifact. However, on its own it fails to adapt quickly enough to adequately remove all residuals. This is probably due to not providing an accurate enough reference. In addition, on its own, ANC occasionally diverges when applied to channels with high amplitude residuals. However, it is found that applying it as a last step removes any remaining residuals even though in most cases they are not detectable by visual inspection. These residuals can be due to the fact that the basis functions in the OBS do not perfectly describe all residual variations.

2.2 ALGORITHM FOR BALLISTOCARDIOGRAPHIC ARTIFACT REDUCTION

Like gradient artifact residuals, BCG artifacts are time varying. However, the variations in BCG artifacts are unpredictable and more difficult to characterize. It is assumed that each occurrence of a BCG artifact, in any given EEG channel, is independent of any previous occurrence. Moreover, it is assumed that the different occurrences are sampled from an unknown set of possible variations. These assumptions present the use of OBS as an ideal solution, where the principal variations can be captured by doing a PCA analysis on a matrix of BCG artifact occurrences [7].

- All QRS peaks are shifted forward in time by 210 ms, which is a standard delay between QRS complexes and the occurrence of BCG artifacts.
- For each channel in the EEG data, all BCG artifact occurrences are aligned in a matrix **A**. The rows of **A** are then demeaned. The column-wise mean is also calculated and subtracted from the columns of **A**, i.e., the mean effect of the residuals is calculated and removed.
- Then PCA is performed on **A**. The different variations in the artifacts will be captured in the principal components of the matrix, ordered according to the variance explained by each component. For simplicity, the term principal component (PC) is used to refer to the projection of the matrix onto the principal component coefficients.
- The first 3 PCs (including the mean effect) are taken as an OBS **B** for describing the ballistocardiographic artifacts variations. Then the EEG signal of the considered channel can be expressed in terms of **B** as:

$$X_I = \mathbf{B}\alpha_I + \varepsilon_I \quad (9)$$

Where, α_I is a 4×1 vector of weights to fit **B** to **X** and ε_I is an error term for the BCG artifact segment and I is the indexes of BCG artifact segments.

- The OBS is then fitted to, and subtracted from, each BCG artifact occurrence. The process is repeated for each channel.

3 EEG DATA ANALYZING TOOLBOX

To Analyze the EEG data collected inside the MR scanner two toolboxes are used in this thesis both of which are integrated as plug-ins in EEGLAB, which is a very popular graphical toolbox for EEG analysis and visualization in MATLAB. The FMRIB (Functional Magnetic Resonance Imaging of Brain) plug-in is a set of MATLAB tools which allow the removal of FMRI-related artifacts from EEG data. These tools are designed to work within the EEGLAB environment, providing a GUI to remove FMRI gradient artifacts, detect QRS complexes from an ECG channel, and remove pulse (ballistocardiographic/BCG) artifacts from the EEG [15]. The schematic diagram of the processing steps of removing artifacts is demonstrated in Fig. 2.

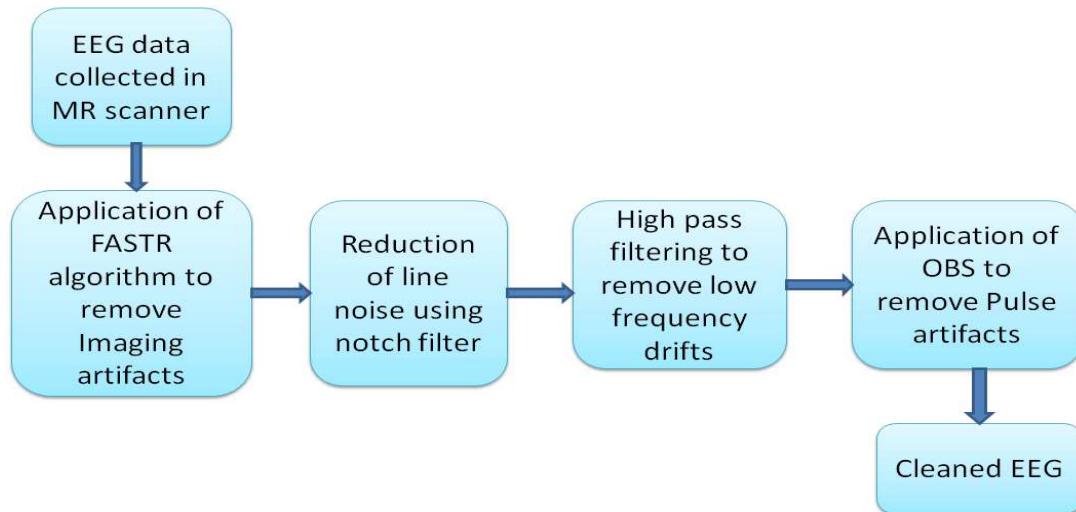


Fig.2. Processing steps of removing Gradient and Ballistocardiographic artifacts

4 EEG DATA SOURCE

The data used in this thesis is a secondary data collected during an fMRI recording session using EPI (Echo Planer Imaging) sequence [15]. The data was collected from 32 channels according to the 10-20 international system. The last two channels are EMG and ECG channels. The data (including the EMG and ECG channels) were sampled at 2048 Hz. The sampling rate of the data should be sufficient as to not have any aliasing from high frequency gradient noise (maximum gradient artifact frequency in a typical EPI sequence is about 700-800Hz). FMRI setting were TR=3s, 21 slice per volume for a total scanning time of 2mins. There were 40 FMRI volumes collected, resulting in 840 slices. The subject was instructed to open and close his eyes in periods of 10 s during scanning using the scanner communication system and earphones. The data include an event type 'slice' for each slice collected. Fig. 3 shows the original data which is contaminated with imaging or gradient artifacts, pulse or ballistocardiographic artifacts and line noise.

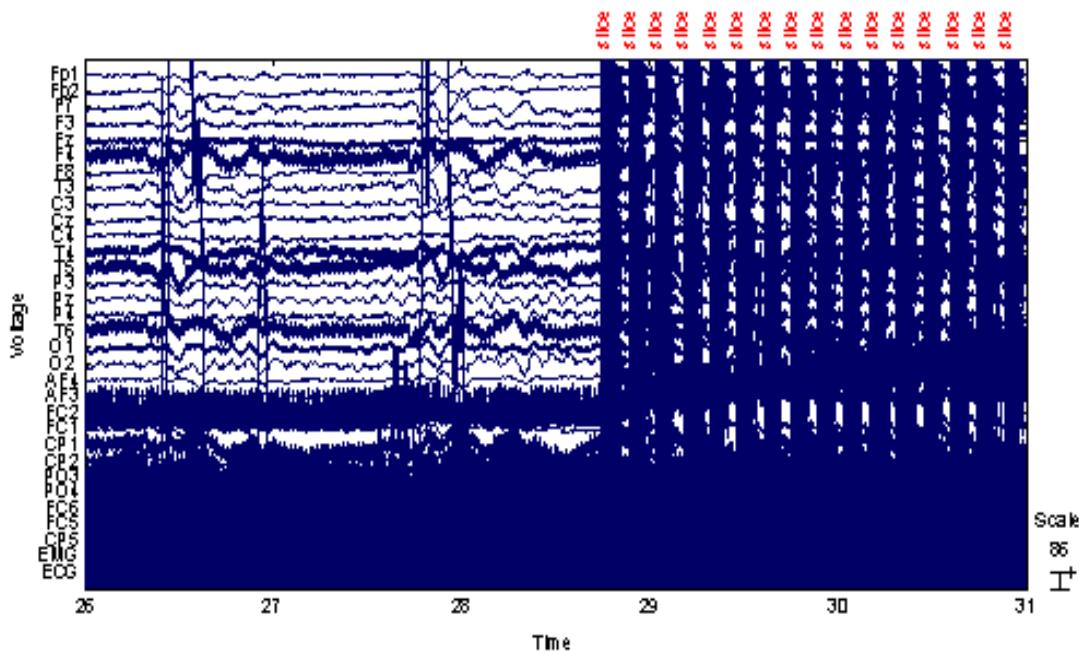


Fig. 3. EEG data frame of 2 mins containing imaging, pulse and line noise

5 RESULTS

Fig. 4 below shows the EEG data free of imaging artifact. The red lines are the slice triggers indicating the start of the fMRI acquisition. The high amplitude ECG signal can also be noticed. The pulse or BCG artifacts correlated with the ECG is also evident from the Figure. It can be noticed that using the subtracted overall noise from steps 1 to 3 as a reference in the filter instead of a binary vector was less likely to remove real data. This can be noticed in the shape of the BCG artifacts, as using the subtracted noise as a reference did not cause the shape to distort. It is evident from the Figure that imaging artifacts are entirely minimized.

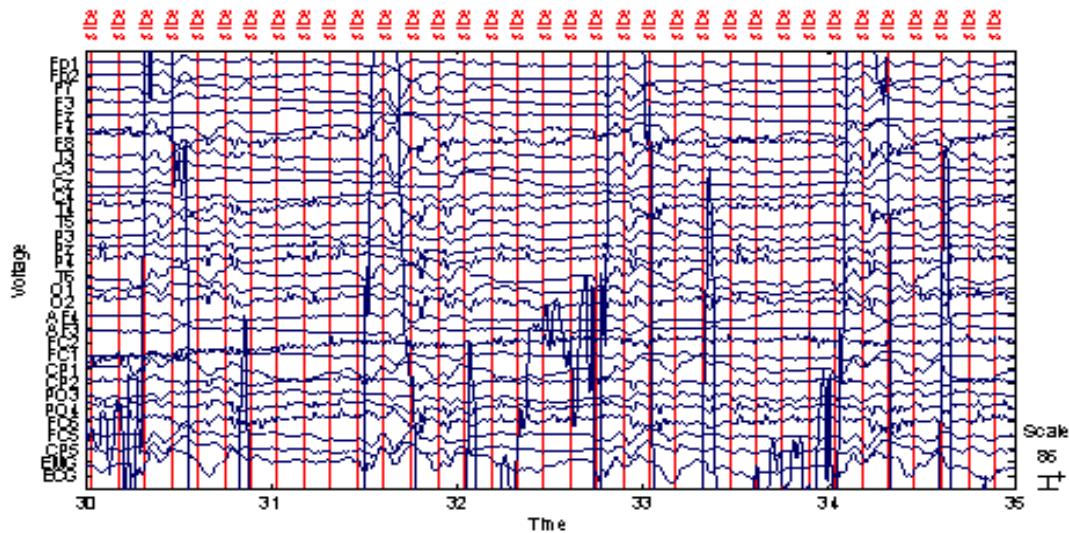


Fig. 4. EEG data after removal of gradient artifact using FASTR algorithm

Fig. 5 shows the EEG signal after the correction of pulse artifact using optimal basis sets. It is observed from the fig that about 10s after the start of fMRI (at about 39.5s) the alpha rhythms start and then disappear after another 10s. This corresponds to the opening and closing of the eyes in the experiment.

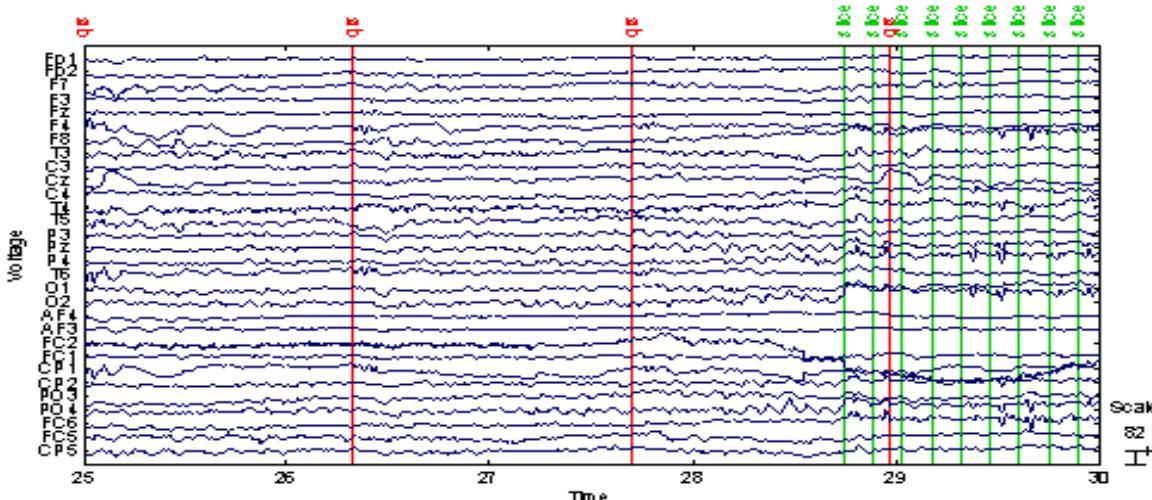


Fig. 5. Quality of EEG after correcting Ballistocardiographic artifacts using OBS

6 CONCLUSION

As was said at the start of this paper, Simultaneous EEG and fMRI is a potentially powerful technique in functional neuroimaging. Along with the potential benefits, comes a series of challenges in implementing such a technique. The main

obstacles are artifacts from MRI gradients and ballistocardiographic effects superimposed on the normal EEG, as well as the need for practical implementations of methods for their removal.

In this study, an algorithm is presented which removes gradient artifacts and any residuals from data sampled at only 2048 Hz, without the need to adjust any hardware or imaging sequences. Because of the nature of EEG data, it is difficult to assess the quality of the EEG using a simple measure. However, it is quite evident that majority of the artifacts are reduced significantly. Applying these algorithms to practical cases and troubleshooting the problems if come any will be the future focus of the work.

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Intégration par la Transformation de Laplace

[Integration by Laplace's Transformation]

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ABSTRACT: It is well known that the notion of integral in mathematic branch is among the most difficult contrarily to some known techniques as integration by part or by change of variable, the integral is forgotten. The mathematic theories contain other notions having the applications which allow to determine the integral of some types of functions, for instance Laurent's series, Beta's functions, Gamma's functions, Laplace's transformations,...There is a way to wonder if those notions can be taught at the secondary school for resolving major problems of some types of non -integrals functions by part or variable change. This should allow us to legitimate the teacher who is always absorbed by difficult questions that learners of mathematics come across. Thus, our goal is to propose remedial techniques to calculate the integral based on Laplace's transformation which the basic knowledge is not contrary to Laplace's transformation defined thanks to an integral what means that the present notions can be accommodated to the rest of integral proposed in the 6th form of scientific section in our country.

KEYWORDS: scientific, notions, functions, techniques, calculate, mathematic, series, variable, integral.

RESUME: Il est connu dans le monde mathématique que la notion d'intégrale est parmi les notions les plus difficiles et qu'en dehors de quelques techniques connues, comme l'intégration par partie et l'intégration par changement de variable, on a tendance d'abandonner le calcul de l'intégrale de certaines catégories des fonctions. Pourtant les théories mathématiques contiennent d'autres notions ayant des applications permettant de déterminer les intégrales de quelques types des fonctions comme par exemple les séries de Laurent, les fonctions beta et gamma, les transformées de Laplace,... Il y a lieu alors de s'interroger si ces notions peuvent s'enseigner au secondaire afin de résoudre le problème épineux du calcul des intégrales de certains types des fonctions non intégrables par parties ou par changement de variable. Ceci nous permettrait de légitimer l'enseignant qui est toujours absorbé par les questions difficiles que les apprenants rencontrent et amènent à l'enseignant pour résolution. Notre objectif est de proposer une autre technique de calculer les intégrales basées sur la transformation de Laplace dont la connaissance de base n'est rien d'autre que la transformée de Laplace définie à partir d'une intégrale ; ce qui signifie que ces notions peuvent s'accorder avec le reste des intégrales proposées en 6^{ième} scientifique. Il restera à vérifier pour les didacticiens la didacticité de ces notions.

MOTS-CLES: scientifique, notions, intégrale, calculer, fonctions, techniques, mathématique, séries, variable.

1 INTRODUCTION

Il est bien connu dans la communauté mathématique que la notion de l'intégrale est l'une des notions les plus difficiles de la mathématique et qu'en dehors de quelques techniques usuelles (intégration par parties et intégration par changement de variable) ; il n'existe pas de méthodes pour le calcul d'intégrales. En effet, A.GUICHARDET affirme que la théorie de l'intégration est un chapitre difficile des mathématiques à tel point que de bons auteurs préfèrent s'en passer [1].

Pourtant, les théories mathématiques contiennent d'autres notions ayant des applications permettant de déterminer les intégrales de quelques types des fonctions. Ces notions sont notamment les séries de Laurent qui permettent les calculs des résidus et les transformées de Laplace que nous voulons développer dans ce travail.

Dès lors on peut se demander s'il est possible d'enseigner ces notions à l'école secondaire ou au premier cycle de graduat afin de faciliter les calculs des intégrales de certaines fonctions non intégrables par les techniques d'intégration par partie et par changement de variable à l'école secondaire ,étant donné que ces notions ne sont pas prévues quelque part sur le programme national .En effet lorsqu'un praticien ne sait se servir de l'une ou l'autre de ces deux techniques d'intégration, il est désarmé et il abandonne l'intégrale qu'il voulait calculer , ce qui est un problème auquel nous voudrions apporter une solution dans ce travail en développant cette autre technique d'intégration basée sur les transformations de Laplace.

En effet, très souvent les élèves et /ou étudiants s'adonnent au calcul des intégrales et apportent aux professeurs des exercices qu'ils ne sont pas à mesure de calculer. Cela pose parfois des difficultés liées à la légitimité de l'enseignant et du contenu qu'il transmet aux étudiants.

Par ailleurs il n'existe pas de techniques permettant d'abord de vérifier si une fonction est intégrable afin de se livrer au calcul de l'intégrale de cette fonction et on ne dit pas non plus quels types des fonctions sont intégrables par les techniques usuelles d'intégration. Cela laisse les élèves ou les étudiants essayer le calcul de l'intégrale de n'importe quelle fonction sans se rassurer si elle est intégrable ou si la technique connue y est applicable.

Par exemple un élève de sixième année scientifique a demandé au professeur de calculer l'intégrale $\int_0^{+\infty} e^{-x^2} dx$. Il voulait savoir comment calculer cette intégrale et pourtant cette intégrale ne peut être calculée qu'au niveau de maîtrise [1], mais la transformée de Laplace permet d'obtenir la valeur de cette intégrale ;une technique basée sur les calculs fonctionnels.

Etant donné que ce problème est fondamental et qu'il n'est pas facile de trouver une solution, notre objectif est de proposer une autre technique de calculer des intégrales basée sur la transformée de Laplace. Nous proposons dans ce texte la connaissance enseignable que nous avons extrait de la connaissance savante. La connaissance de base n'est rien d'autre que la transformée de Laplace qui se définit à partir d'une intégrale ; ce qui signifie donc que cette notion s'accorde avec le reste du contenu proposé pour les intégrales en sixième année du secondaire et au premier cycle du supérieur. Ce contenu où nous présentons cette technique sera basée sur des démonstrations des théorèmes ;ce contenu peut être ensuite présenté sur des fiches de préparations qu'on pourra ensuite expérimenter dans nos écoles afin d'en étudier le rendement.

NB: Dans la suite de ce travail T.L. signifie Transformée de Laplace.

2 MATERIEL ET METHODES

Pour atteindre nos objectifs nous assigné dans ce travail, nous avons essentiellement utilisé la méthode axiomatique afin de démontrer certains résultats et théorèmes contenus dans ce travail.Cette méthode a été appuyée par la technique documentaire qui nous a aidé à collectionner la revue de la littérature afin de constituer la partie théorique de cet article.

3 RESULTATS DU TRAVAIL

3.1 QUELQUES DÉFINITIONS

- La transformation de Laplace est une opération qui, à une fonction f d'une variable réelle t , associe une fonction $F(p) = \int_0^{+\infty} e^{-pt} f(t) dt$, de variable complexe $p, p \neq 0$

-L'intégrale $\int_0^{+\infty} e^{-pt} f(t) dt$, si elle existe, est appelée intégrale de Laplace. La fonction complexe $F(p)$ est la transformée de Laplace de la fonction réelle $f(t)$ symbolisée par $L\{f(t)\} = F(p)$ ou $f(t) : \leftarrow F(p)$ ou $F(p) \rightarrow : f(t)$; L est l'opérateur de transformation de Laplace.

I.2 .Propriétés de la T.L.

P₁ . **Unicité** si deux fonctions continues f et g possèdent une même transformée F(p) alors f et g sont identiquement égales. [4]

P₂. Linéarité

Soit $f(t) = \sum_{i=0}^n C_i f_i(t)$ une fonction qui est combinaison linéaire des f_i avec $i \in [0, n] \cap \mathbb{N}$; C_i des constantes réelles, et $L\{f_i(t)\} = F_i(p)$.

$$L\{\sum_{i=0}^n C_i f_i(t)\} = \sum_{i=0}^n C_i \cdot L\{f_i(t)\} = \sum_{i=0}^n C_i \cdot F_i(p) \quad [4]$$

P₃. Translation ([2], p.105)

Si $L\{f(t)\} = F(p)$ alors $L\{e^{at}f(t)\} = F(p - a)$, $\forall a \in \mathbb{C}$.

P₄. Dérivation

$$L\{f(t)\} = F(p) \Rightarrow L\{t^n f(t)\} = (-1)^n \frac{d^n}{dp^n} F(p) \quad [4]$$

P₅ . Division par t

Si $L\{f(t)\} = F(p)$ alors $L\left\{\frac{f(t)}{t}\right\} = \int_p^{+\infty} F(u) \text{ entendu que } \lim_{t \rightarrow 0} \frac{f(t)}{t} \text{ existe} \quad [5]$

P₆. Similitude , $\forall a > 0$

$$\text{Si } L\{f(t)\} = F(p) \text{ alors } L\{f(at)\} = \frac{1}{a} F\left(\frac{-p}{a}\right) \quad [2]$$

P₇ . Intégrale de produit de convolution

Si $L\{f_1(t)\} = F_1(p)$ et $L\{f_2(t)\} = F_2(p)$ alors

$$= L\left\{\int_0^t f_1(t-\theta) \cdot f_2(\theta) d\theta\right\} \quad [4]$$

3.2 INTEGRATION PAR LA TRANSFORMATION DE LAPLACE

3.2.1 DÉFINITION

- Intégrer une fonction par la T.L, n'est ni l'intégrer suivant les techniques usuelles de calcul d'intégrales définies, ni l'intégrer suivant la définition de calcul d'intégrales impropre mais plutôt en se servant des principes que nous développons dans ce travail.
- Une fonction réelle f est intégrable au moyen de la T.L si
 - Sa transformée de Laplace F(p) existe
 - La fonction F(p) à variable complexe p est continue en $a = Re(p)$

3.2.2 PRINCIPES D'INTÉGRATIONS

Soit f(t) une fonction variable réelle t

Soit F(p) = $\int_0^{+\infty} e^{-pt} f(t) dt$ la transformée de f(t).

Principe 1 :[3]

En supposant $I = \int_0^{+\infty} e^{-at} f(t) dt$ avec $a > 0$ l'intégrale à calculer alors la valeur numérique de I s'obtient en effectuant $I = F(a)$

Principe 2: [3]

Si l'intégrale à calculer

$I = \int_0^{+\infty} f(t) dt$ existe alors $\operatorname{Re}(p) > 0$, $F(p) = \int_0^{+\infty} e^{-pt} f(t) dt$ existe aussi et la valeur réelle de I se calcule par $I = \lim_{p \rightarrow 0^+} \operatorname{Im} F(p)$

Principe 3 : Il découle du théorème de convolution

$\int_0^t f_1(\theta) \cdot f_2(t - \theta) d\theta \gg L^{-1}\{F_1(p) \cdot F_2(p)\}$. Pour que le principe soit possible, l'intégrale $\int_0^t f_1(\theta) \cdot f_2(t - \theta) d\theta$ sera telle que

$$f_2(t) = f_2(t - \theta) = 1 \text{ ou tout simplement } f_2(\theta) = 1,$$

$$F_1(p) = L\{f_1(\theta)\} \text{ et } F_2(p) = L\{f_2(\theta)\} = \frac{1}{p}$$

3.2.3 PROPRIÉTÉS ÉLÉMENTAIRES

En se servant de principe 2 et des propriétés sur la T.L. nous pouvons affirmer sans démontrer ce qui suit :

a) $\int_0^{+\infty} cf(t) dt = c \int_0^{+\infty} cf(t) dt$, avec f intégrable par la T.L. et c une constante.

b) $\int_0^{+\infty} (c_1 f_1(t) + c_2 f_2(t)) dt = c_1 \int_0^{+\infty} f_1(t) dt + c_2 \int_0^{+\infty} f_2(t) dt$ avec f_1, f_2 et $c_1 f_1 + c_2 f_2$ intégrables par la T.L. et c_1, c_2 des constantes

Exemples 1

1) Sachant que $F(p) = \int_0^{+\infty} e^{-pt} \sin t dt = \frac{1}{p^2 - 1}$ et que l'intégrale $I = \int_0^{+\infty} e^{-2t} \sin t dt$ existe alors on peut calculer

$$I = \int_0^{+\infty} e^{-2t} \sin t dt = F(2) = \frac{1}{3}$$

2) On peut vérifier que $I = \int_0^{+\infty} \frac{dt}{1+t^2}$ existe. En s'appuyant au principe 2, on peut affirmer que $\int_0^{+\infty} \frac{e^{-pt}}{1+t^2} dt$ existe aussi. En intégrant par parties l'intégrale $I = \int_0^{+\infty} \frac{e^{-pt}}{1+t^2} dt$,

$$\text{il vient que } \int_0^{+\infty} \frac{e^{-pt}}{1+t^2} dt = \frac{1}{1-p^2} \left(\frac{\pi}{2} + p \right)$$

Ainsi la valeur de l'intégrale

$$I = \int_0^{+\infty} \frac{\sin t - xt}{1+t^2} dt = \lim_{p \rightarrow 0} \frac{1}{1-p^2} \left(\frac{\pi}{2} + p \right) = \frac{\pi}{2}$$

3) Calculons l'intégrale définie $I = \int_0^{\frac{\pi}{2}} \sin^2 \theta d\theta$ pour $t = \frac{\pi}{2}$

$$\text{On a } I = \int_0^{\frac{\pi}{2}} \sin^2 \theta d\theta = L^{-1} \left\{ \frac{2}{p^2(p^2+4)} \right\}$$

$$= L^{-1} \left\{ \frac{1}{2p^2} - \frac{1}{2(p^2+4)} \right\}$$

$$= \frac{1}{2} t - \frac{1}{4} \sin 2t$$

$$\text{Pour } t = \frac{\pi}{2}, \int_0^{\frac{\pi}{2}} \sin^2 \theta d\theta = \frac{\pi}{2}$$

NB Si on attribue à la partie réelle p (respectivement variable complexe) une valeur quelconque du domaine d'intégration, on obtient la valeur de l'intégrale pour chaque catégorie des fonctions étudiées.

4) Par la transformée de Laplace montrons que :

a) $\int_0^{+\infty} t \cdot e^{-2t} \cdot \cos t dt = \frac{3}{25}$

D'après la propriété sur la transformée,

$$L\{t \cdot cost\} = -\frac{d}{dp} \left(\frac{p}{p^2+1} \right) \text{ où}$$

$\frac{p}{p^2+1} = L\{cost\}$ et donc $L\{t \cdot cost\} = \frac{p^2-1}{(p^2+1)^2}$ est continue en $p=2$, il vient que $I = \int_0^{+\infty} t \cdot e^{-2t} \cdot cost \cdot dt = \frac{3}{25}$

b) $\int_0^{+\infty} e^{-t} \frac{\sin t}{t} dt = \frac{\pi}{4}$.

En effet $L\left\{\frac{\sin t}{t}\right\} = \int_p^{+\infty} \frac{1}{(u^2+1)} du$ (voir la propriété 5 de la division d'une fonction $f(t)$ par t).

D'où $L\left\{\frac{\sin t}{t}\right\} = [arc \tan u]_p^{+\infty} = \frac{\pi}{2} - arc \tan p$

En posant $p = 1$, on a : $I = \int_0^{+\infty} e^{-t} \frac{\sin t}{t} dt = \frac{\pi}{4}$.

c) $\int_0^{+\infty} \frac{e^{-at}-e^{-bt}}{t} dt = \ln \frac{b}{a}$. En effet en vertu du principe 2 de l'intégration par la T.L, l'intégrale $I = \int_0^{+\infty} e^{-pt} \left(\frac{e^{-at}-e^{-bt}}{t} \right) dt$ existe aussi et $L\left\{\frac{e^{-at}-e^{-bt}}{t}\right\} = \int_p^{+\infty} \left(\frac{1}{u+a} - \frac{1}{u+b} \right) du$
 $= \left[\ln \frac{u+b}{u+a} \right]_p^{+\infty} = \ln \frac{p+b}{p+a}$

En prenant la limite lorsque $p \rightarrow 0_+$, il vient que : $\int_0^{+\infty} \frac{e^{-at}-e^{-bt}}{t} dt = \ln \frac{b}{a}$.

d) $I = \int_0^{+\infty} e^{-\sqrt{2}} \left(\frac{sht \cdot \sin t}{t} \right) dt = \frac{\pi}{8}$

En effet la transformée de $f(t) = sht \cdot \sin t$ et donc

$$L\{sht \cdot \sin t\} = \frac{p}{p^4+4}$$

$$\text{Par la suite } L\left\{\frac{sht \cdot \sin t}{t}\right\} = \int_p^{+\infty} \frac{u}{u^4+4} du,$$

$$\begin{aligned} &= \frac{1}{4} \int_p^{+\infty} \frac{dn}{n^2+1}, \quad u^2 = 2n \Rightarrow u du = dn \\ &= \frac{1}{4} [arc \tan n]_p^{+\infty} = \frac{1}{4} \left[arc \tan \frac{u^2}{n} \right]_p^{+\infty} \\ &= \frac{1}{4} \left[\frac{\pi}{2} - arc \tan \frac{p^2}{2} \right] \end{aligned}$$

En prenant $p = \sqrt{2}$, on a $\int_0^{+\infty} e^{-\sqrt{2}} \left(\frac{sht \cdot \sin t}{t} \right) dt = \frac{\pi}{8}$

e) $I = \int_0^{+\infty} e^{-x^2} dx = \frac{1}{2}\sqrt{\pi}$

Considérons une fonction $g(t) = \int_0^{+\infty} e^{-tx^2} dx$, puis trouvons la transformée de Laplace.

Alors $L\{g(t)\} = \int_0^{+\infty} e^{-pt} \left[\int_0^{+\infty} e^{-tx^2} dx \right] dt$. Intervertissons l'ordre d'intégration, on a :

$$\begin{aligned} L\{g(t)\} &= \int_0^{+\infty} \int_0^{+\infty} e^{-(p+x^2)t} dt dx \\ &= \int_0^{+\infty} \left[\frac{-e^{-(p+x^2)t}}{p+x^2} \right]_0^{+\infty} dx \\ &= \int_0^{+\infty} \frac{dx}{p+x^2} \\ &= \frac{1}{\sqrt{p}} \left[arc \tan \frac{x}{\sqrt{p}} \right]_0^{+\infty} \\ &= \frac{\pi}{2\sqrt{p}}. \end{aligned}$$

En inversant, il en résulte que

$$g(t) = \frac{\pi}{2} L^{-1} \left\{ \frac{1}{\sqrt{p}} \right\} = \frac{1}{2} \sqrt{\pi} t^{-\frac{1}{2}} \text{ et que pour } t=1 \text{ on a } I = \int_0^{+\infty} e^{-x^2} dx = \frac{1}{2} \sqrt{\pi}$$

4 CONCLUSION

Les transformations de Laplace jouent un rôle très considérable dans d'autres disciplines comme la physique et la biologie.

Cependant ces notions ne sont pas enseignées au secondaire voire même au premier cycle de graduat ; pourtant elles sont utiles pour faciliter le calcul des intégrales de certaines fonctions qui échappent aux techniques usuelles c'est-à-dire intégration par parties et intégration par changement de variable, figurées sur le programme de mathématique de l'enseignement secondaire et supérieur de la République Démocratique du Congo.

Dans cet article, nous avons suggéré qu'il est possible d'enseigner les notions de transformée de Laplace au secondaire en vue de montrer aux élèves et /ou les étudiants que les techniques d'intégration connues qui ne suffisent pas pour intégrer toutes les fonctions peuvent être complétées par d'autres techniques, ce qui signifie que le calcul des intégrales de certaines fonctions peut se faire au moyen des transformations de Laplace. Néanmoins, il est à signaler que l'intégration par la transformée de Laplace n'est pas aussi une technique applicable à toutes les fonctions mais qu'il faut que la fonction à intégrer par cette technique possède de transformée de Laplace.

Malgré cela, la transformée de Laplace procure des résultats élégants dans son application à tel point que son enseignement au secondaire et au supérieur ne poserait aucun problème surtout que les notions y relatives ne s'écartent pas de la dérivation et de l'intégration habituelles.

Les conditions d'intégration par la T.L. sont nécessaires et non suffisantes. Les principes d'intégration complètent ces conditions et facilitent alors l'intégration de certaines fonctions réelles.

Cependant certaines questions n'ont pas été débattues dans cet article ; c'est par exemple celle de savoir le type des fonctions dont l'intégrale se calcule par les deux techniques usuelles d'intégration : en effet cela permettrait aux élèves et étudiants d'éviter de se livrer au calcul de l'intégrale, si elle existe, de n'importe quelle fonction.

Comme nous ne prétendons pas avoir épousé tout le thème ni avoir élaboré une œuvre parfaite ; nos successeurs seraient intéressés par cette question et par celle qui concerne l'élargissement des fonctions intégrables par la T.L. en utilisant par exemples les méthodes de détermination des T.L. par séries, aux équations différentielles,...

Les matières proposées dans cette article peuvent aussi être expérimentées dans nos écoles secondaires afin d'en étudier le rendement et voir dans quelle mesure ces notions peuvent être insérées dans le programme national vu leur importance ci-haut évoquée.

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ETAT PHYTOSANITAIRE DES PLANTATIONS ET CHAMPS DE CAFEIER DE KABARE NORD, SUD KIVU, EST DE LA RD. CONGO

[PEST STATUS AND PLANTING FIELDS OF COFFEE IN NORTH OF KABARE ,SOUTH KIVU, EASTERN OF DR. CONGO]

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ABSTRACT: In the perspective of enquiring the state of the plantations phytosanitary of coffee tree of the North Kabare in order to undertake the averages ways of fighting (preventive, curative or integral) able to grow up the coffee production in the science subjects in the South Kivu coffee tree a study for evaluation the phytosanitary state of coffee plantations in the region of Kabare the North has been done. At the end of the study, it has noticed that the anthracnose, the rust, the die-back and the sigatoka even the thrips unwrapping, the drawing pin coffee tree, the dentals drawing pin, the rongers leaves catapillar, the pyral of drupes and the coffee tree hannetons are respectively the illnesses and the found insects in the coffee plantations of the North Kabare but with the incidence relatively different. The anthracnose's rate incidence has been very highest (33%), followed by the coffee trees rust (30%) than the sigatoka (22%) and at the end die-back (15%). As far as ravagers are concerned, the drawing pin of coffee tree presented a relative incidence the highest of 32% of order, followed by the unwrapping thrips (15%), and the coffee tree hannetons (14%), of rongers leaves catapillar (14%), of pyral of drupes (13%) and at the end of dentel drawing pin (12%). All the coffee trees of the region of the North Kabare are old in the way that their ages vary between 43, 1 years and 69 years with 57, 5 years of average.

KEYWORDS: Pests, diseases, coffee plantations, Democratic Republic of Congo, cultivar.

RÉSUMÉ: Dans la perspective de s'enquérir de l'état phytosanitaire des caférières de Kabare Nord en vue d'entreprendre les moyens de lutte (préventive, curative ou intégrée) capables d'accroître la production dans la filière café du Sud Kivu, une étude évaluative des maladies et ravageurs a été faite. Ainsi, la technique documentaire et d'échantillonnage systématique, l'enquête phytosanitaire, la méthode d'observation, la clé d'identification et le prélèvement des coordonnées géographiques ont été utilisés. De même, les logiciels Statistix 8 et Arc Map 9.2 ont été utilisés. Au terme de l'étude, le constant est que l'Anthracnose, la rouille, le Die-back et la Cercosporiose ainsi que les Thrips enrouleurs, la Punaise du cafier et à dentelles, les Chenilles rongeuses de feuilles, les Pyrales de drupes et les Hannetons du cafier sont respectivement rencontrés dans les caférières de ladite région mais à des incidences relativement différentes. Le taux d'incidence de l'anthracnose a été plus élevé (33%), suivi de celui de la rouille des cafiers (30%) puis celui de la cercosporiose (22%) et enfin celui du die-back (15%). Quant aux ravageurs, la punaise du cafier présentait une incidence relative la plus élevée d'ordre de 32%, suivi du thrips enrouleur (15%), puis de l'hanneton du cafier (14%), de la chenille rongeuse de feuilles (14%), de la pyrale de drupe (13%) et enfin de la punaise à dentelle (12%). Toutes les caférières de la région de Kabare Nord sont vieilles, étant donné que leurs âges varient entre 43, 1 ans et 69 ans avec une moyenne de 57, 5 ans.

MOTS-CLEFS: Ravageurs, maladies, caférières, République Démocratique du Congo, cultivar.

1 INTRODUCTION

En République Démocratique du Congo, comme dans la quasi-totalité des pays de l'Afrique de l'Ouest, de l'Afrique de l'Est et de l'Afrique Centrale, l'expansion et/ou l'introduction de la culture du café émane des colonisateurs dans l'optique de fournir les matières premières agricoles aux pays métropoles [1].

Les cultures de rente et la quantité minimale de production étaient imposées aux indigènes. De même, le prix d'achat des produits agricoles était imposé, cause pour laquelle, les cultures de rente intéressaient moins les indigènes et paraissaient moins rentables à leur égard [2] et [3]. Pour maintenir le monopole de vente, il était strictement interdit aux indigènes de semer les principales cultures d'exportation dont notamment, le tabac en Rhodésie du Sud, le café, le thé et le pyrèthre au Kenya [4]. Cette idée de monopolisation des cultures de rente, en particulier de la culture du café fut également observée sur la côte centre-est de Madagascar [5] et dans la province du Kivu du Congo Belge, cet état de choses a pris fin lorsque les pays africains ont accédé à l'indépendance [6].

En République Démocratique du Congo, même si l'Etat tire la plupart de ses recettes publiques et d'exportation de l'extraction minière, l'agriculture est le principal secteur économique du pays en termes de PIB (51% du PIB en 2002 et 17% des recettes en devises) et d'emplois (elle fait vivre 70% de la population). Celle-ci permet en même temps de concilier la conservation et l'utilisation durable de la diversité biologique dans son environnement immédiat.

Les plantations et champs des cultures agro-industrielles (café, cacao, palmier à huile, canne à sucre, hévéa) sont exploités dans des zones où les conditions édaphoclimatiques sont propices auxdites cultures. Les cultures de rente contribuent à l'augmentation des revenus des ménages, à l'amélioration de l'économie des provinces et du pays. A titre illustratif, la production moyenne était estimée, en 2001, à 162.000 tonnes d'huile de palme, 1,5 million de tonnes de cannes à sucre, 39.000 tonnes de café (80% robusta), 6.250 tonnes de cacao, 4.200 tonnes de caoutchouc, 3.800 tonnes de tabac et 1.800 tonnes de thé [7].

Les graines du café comme bon nombre de drupes des plantes tropicales, ont une valeur nutritive particulièrement appréciable. L'apport significatif en potassium, magnésium, phosphore, chlore, silice, calcium, sodium, fer, azote, caféine, acide choréique, glucides, lipides, etc à l'organisme humain explique l'intérêt de café [8] et [9].

Quoique produit au Sud, le café est en grande partie consommé au Nord. Au fait, sur le plan mondial, environ 5,1 millions de tonnes de café vert sont consommées parmi lesquelles l'Europe de l'Ouest, le Japon et l'Amérique du Nord utilisent 79%, tandis que la consommation domestique dans les pays exportateurs dont le Brésil et l'Ethiopie est de l'ordre de 24,6 %. A l'horizon 2025, la consommation globale de café vert pourrait atteindre 10 millions de tonnes pour une production de 9,4 à 9,8 millions de tonnes. Il s'avère qu'il surgira un risque de déficit de l'offre [10].

Dans la perspective de combler ce déficit, les pays exportateurs devraient songer au dédoublement de la production de café.

Cela serait possible aux cas où il y aurait extension des surfaces plantées par la mise en valeur de jachères anciennes et/ou de terres vierges, acquisition de nouvelles technologies agricoles, amélioration des pratiques culturales adoptées dans les plantations existantes d'une part et maîtrise de l'état phytosanitaire des caférières mises en place d'autre part en vue d'entrevoir le remplacement de vieilles caférières avec du matériel végétal amélioré si nécessaire [11].

Peu de recherches ont été menées à l'Est de la République Démocratique du Congo, spécialement au Sud Kivu en vue de déterminer les maladies et insectes ravageurs de cafier, pourtant le cafier est la principale culture industrielle d'exportation exploitée par les paysans du Sud Kivu en général et ceux de la région de Kabare Nord en particulier. Il serait ainsi intéressant d'identifier les maladies et ravageurs majeurs des cafiers afin d'entreprendre les moyens de lutte (préventive, curative ou intégrée) susceptible d'accroître la production du café au Sud Kivu. Cela étant, la présente étude cherche à s'enquérir de l'état phytosanitaire des caférières de Kabare Nord.

L'étude a été conduite à partir du mois de mai 2012 jusqu'au mois de juin 2013 dans la région de Kabare Nord plus précisément dans les groupements de Lugendo, d'Irhambi-Katana, de Bugorhe, de Luhihhi, de Miti et de Bushumba où les cafiers sont cultivés. Les groupements de Bugorhe, de Miti et d'Irhambi-Katana se trouvent à une altitude d'environ 2000m et sont proches du Parc National de Kahuzi-Biega. Les trois autres groupements ont une altitude relativement basse pouvant varier entre 1460 m et 1600 m, de même ils sont voisins du lac Kivu [12].

La région de Kabare Nord est caractérisée par un climat tropical humide, tempéré par les montagnes. L'altitude varie entre 1460 m au niveau du lac Kivu et plus de 1900 m au niveau de Tshibati, le climat est du type AW suivant la classification de Köppen. Il est aussi caractérisé par deux saisons dont une courte saison sèche allant de juin jusqu'en août et une longue saison de pluies allant de septembre à mai. Les pluies sont abondantes et atteignent une hauteur moyenne annuelle de 1500

mm [13]. Toutefois, suite aux phénomènes des perturbations climatiques dont la ville de Bukavu et ses environs connaissent ces derniers temps, il s'observe un changement de la distribution annuelle des pluies ainsi que l'augmentation de la température moyenne dans ladite région [14]. Le sol de Kabare Nord est très fertile à cause de son origine volcanique [15].

Le logiciel Arc Map 9.2 a servi de dresser la carte des caférières de la région de Kabare Nord dont la figure 1 présente.

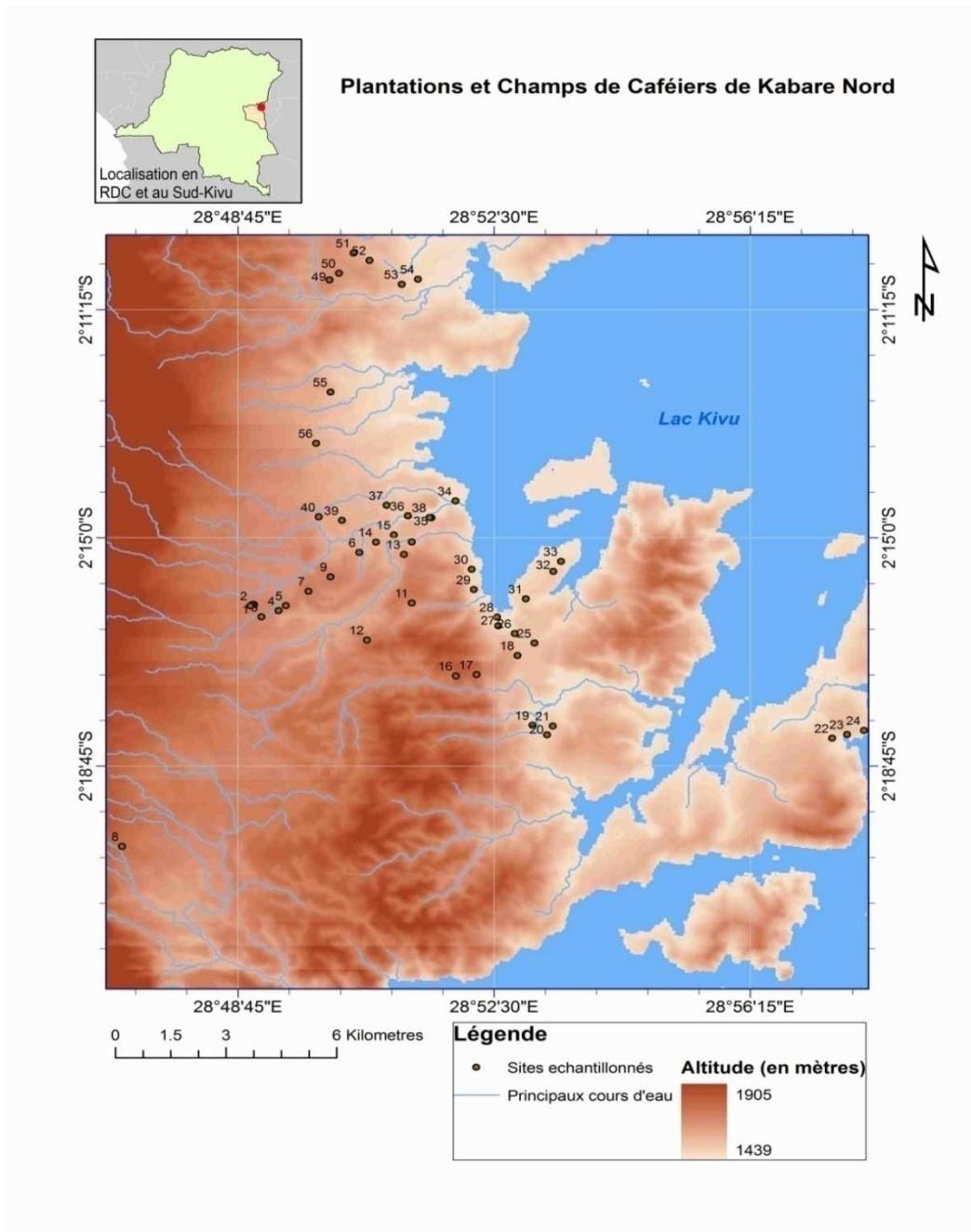


Fig. 1. Caférières de Kabare Nord

Le tableau 1 donne des informations supplémentaires relatives à la légende de la carte sus présentée des sites échantillonnés dans la région de Kabare Nord.

Tableau 1. Informations supplémentaires relatives à la légende de la carte présentée par la figure 1

Numéro	Plantation	Site	Altitude(m)	Latitude et longitude
0	Bwengehera	site 1	1700	S 02°16'05.8" et E 028°48'59.1"
1	Bwengehera	site 2	1689	S02°16'05.7" et E0 28°48'57.9"
2	Bwengehera	site 3	1695	S02°16'07.0" et E028°48'56.1"
3	Bwengehera	site 4	1668	S02°16'18.0" et E028°49'05.5"
4	Buhandahanda	site 1	1664	S02°16'11.8" et E028°49'20.5"
5	Buhandahanda	site 2	1673	S02°16'06.8" et E028°49'27.0"
6	Buhandahanda	site 3	1612	S02°15'14.4" et E028°50'31.5"
7	Buhandahanda	site 4	1695	S02°15'52.7" et E028°49'46.8"
8	INERA	site 1	1707	S02°20'04.2" et E028°47'03.11"
9	Nzinzi	site 1	1694	S02°15'38.5" et E028°50'06.2"
10	Nzinzi	site 2	1688	S02°15'04.1"S et E0 28°51'17.6"
11	Nzinzi	site 3	1707	S02°16'04.3" et E028°51'17.6"
12	Nzinzi	site 4	1767	S02°16'40.7" et E028°50'38.3"
13	Kakondo III	site 1	1623	S02°15'16.3" et E028°51'10.8"
14	Ruvoma	site 1	1583	S02°15'04.2" et E028°50'46.2"
15	Ruvoma	site 2	1567	S02°14'57.1" et E028°51'02.0"
16	Nyakaliba	site 1	1763	S02°17'16.2" et E028°51'56.4"
17	Nyakaliba	site 2	1759	S02°17'14.9" et E028°52'14.6"
18	Nyakaliba	site 3	1606	S02°16'56.0" et E028°52'50.5"
19	ITAV-Mushweshwe	site 1	1508	S02°18'04.7" et E028°53'03.7"
20	ITAV-Mushweshwe	site 2	1534	S02°18'14.1" et E028°53'16.5"
21	ITAV-Mushweshwe	site 3	1541	S02°18'05.5" et E028°53'21.6"
22	Butorangwe	site 1	1515	S02°18'17.5" et E028°57'27.0"
23	Butorangwe	site 2	1517	S02°18'13.8" et E028°57'40.1"
24	Butorangwe	site 3	1513	S02°18'09.8" et E028°57'55.0"
25	Luhih centre	site 1	1548	S02°16'43.8" et E028°53'05.4"
26	Bukonzikoni	site 1	1525	S02°16'34.4" et E028°52'48.1"
27	Mirumba	site 1	1505	S02°16'26.8" et E028°52'33.7"
28	Cikumbo centre	site 1	1498	S02°16'18.2" et E028°52'32.6"
29	Biyenga	site 1	1487	S02°15'51.0" et E028°52'12.2"
30	Biyenga centre	site 1	1496	S02°15'31.1" et E028°52'10.3"
31	Mwirunga	site 1	1523	S02°16'00.2" et E028°52'57.8"
32	Mwirunga	site 2	1515	S02°15'33.2" et E028°53'22.1"
33	Mwirunga	site 3	1520	S02°15'23.3" et E028°53'28.8"
34	Kakondo I	site 1	1462	S02°14'23.7" et E028°51'56.0"
35	Kakondo I	site 2	1505	S02°14'40.2" et 28°51'34.9"
36	Kakondo I	site 3	1504	S02°14'38.4" et E028°51'14.2"
37	Kakondo II	site 1	1538	S02°14'28.0" et E028°50'55.5"
38	Kakondo II	site 2	1564	S02°14'40.0" et E028°51'33.3"
39	Kankule	site 1	1594	S02°14'42.9" et E028°50'16.3"
40	Kankule	site 2	1591	S02°14'39.4" et E028°49'55.8"
41	Kadjucu/Itanganika	site 1	1478	S02°09'00.2" et E028°54'30.0"
42	Kadjucu/Itanganika	site 2	1473	S02°09'01.3" et E028°54'31.8"
43	Musimbo/Kadjucu	site 1	1566	S02°09'12.3" et E028°53'44.0"
44	Munanira/Kadjucu	site 1	1659	S02°09'35.2" et E028°53'45.5"
45	Munanira/Kadjucu	site 2	1708	S02°09'48.8" et E028°53'38.8"
46	Tchagiza/Kadjucu	site 1	1656	S02°09'35.3" et E028°53'23.1"
47	Zibera centre/Kadjucu	site 1	1589	S02°09'31.2" et E028°52'41.3"
48	Buhini/Kadjucu	site 1	1510	S02°09'51.9" et E028°52'03.9"
49	Kabonere/Mabingu	site 1	1738	S02°10'45.8" et E028°50'05.4"
50	Kalengera/Mabingu	site 1	1736	S02°10'39.3" et E028°50'13.7"
51	Ntagalulwa/Mabingu	site 1	1690	S02°10'19.4" et E028°50'26.4"
52	Nyamurondo/Mabingu	site 1	1651	S02°10'26.6" et E028°50'40.5"
53	Kashongolere/Mabingu	site 1	1584	S02°10'50.1" et E028°51'08.8"
54	Kashongolere/Mabingu	site 2	1532	S02°10'45.1" et E028°51'23.0"
55	Cibimbi/Katana	site 1	1592	S02°12'36.4" et E028°50'06.3"
56	Katana Centre	site 1	1620	S02°13'26.8" et E028°49'53.6"

2 METHODES

Nous avons procédé par la technique documentaire et l'enquête phytosanitaire précédée d'une pré-enquête qui a été conduite dans les groupements de la région de Kabare Nord. La méthode d'observation et la photographie ont été utilisées afin de prendre connaissance des maladies et insectes existant dans les sites échantillonnés. L'identification des maladies et insectes a été faite en utilisant les photographies selon la proposition de [16].

Le travail a été effectué selon la technique d'échantillonnage systématique proposée par [17]. Cette technique consiste à choisir une première unité et ensuite à partir de celle-ci, de façon régulière les autres unités qui constituent l'échantillon, la raison de la progression arithmétique choisie était 3 et le deuxième cafier comme le début de tri des arbres. Les incidences des maladies et insectes ont été comparés par le logiciel Statistix 8.

Le GPS/GARMIN a été utilisé pour prélever les coordonnées géographiques des sites échantillonnés, à une erreur d'à peu près 8-9 mètres. Le logiciel Arc Map 9.2 a été utilisé pour dresser la carte des caférières de Kabare Nord ci-haut présentée par la figure 1.

3 RESULTATS

Les figures 2 et 3 ci-après mettent en relief les résultats de l'enquête phytosanitaire menée dans des caférières de la région de Kabare Nord.

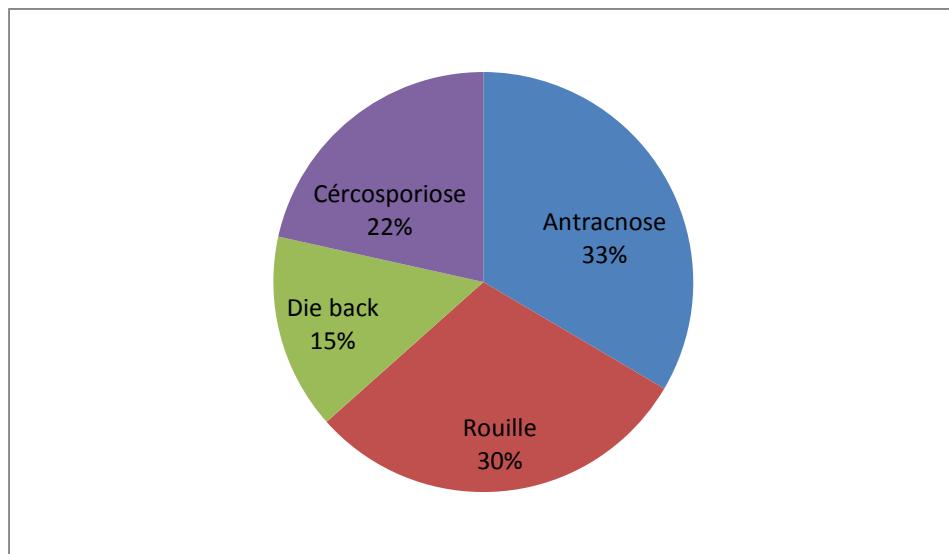


Fig 2. Incidence relative des maladies des cafiers rencontrées dans les caférières des groupements de la région de Kabare Nord

Il ressort des résultats présentés dans la figure 2 que l'anthracoïse, la rouille, le die-back et la cercosporiose sont les maladies observées dans des caférières de la région de Kabare Nord à des incidences relativement différentes. L'anthracoïse a été plus observée (33%), suivi de la rouille des cafiers (30%) puis de la cercosporiose (22%) et enfin du die-back (15%).

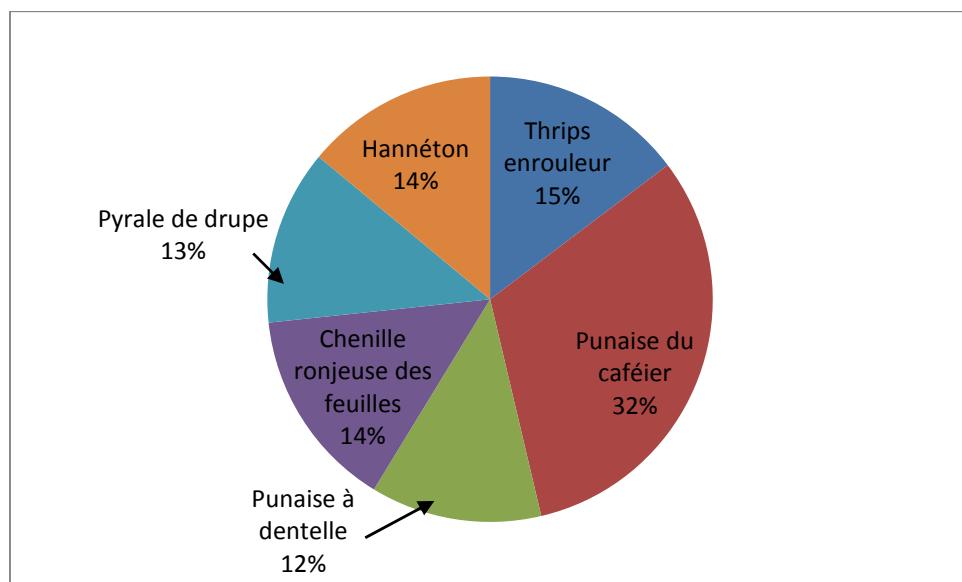


Fig 3. Incidence relative des insectes ravageurs des caféiers dans des caférières des groupements de la région de Kabare Nord

Au vu des résultats présentés dans la figure 3 il s'avère que la punaise du caféier présente une incidence la plus élevée (32%) suivi de thrips enrouleur (15%), puis de l'hanneton du caféier et de la chenille rongeuse des feuilles qui sont exa-equo (respectivement 14%), ensuite de pyrale de drupe (13%) et enfin de la punaise à dentelle (12%) dans les caférières de la région de Kabare Nord.

La figure 4 ci-après, présente les âges des caférières des groupements de la région de Kabare Nord :

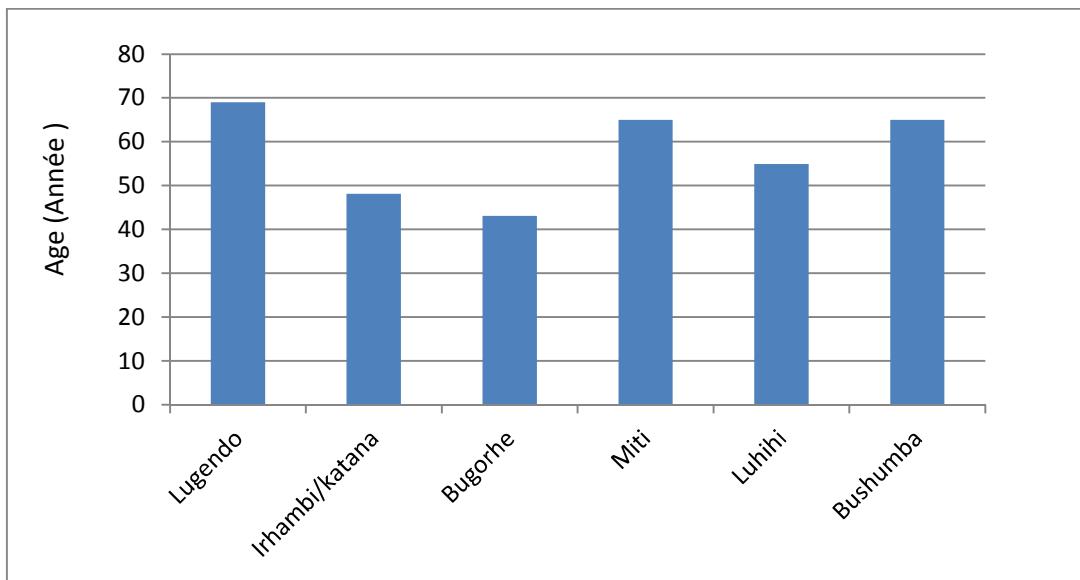


Fig 4. Ages en années des caférières des groupements de la région de Kabare Nord.

Il ressort des résultats présentés dans la figure 4 que toutes les caférières de la région de Kabare Nord ont un âge variant entre 43,1 ans et 69 ans, avec une moyenne de 57,5 ans.

La figure 5 met en exergue la répartition des maladies des caféiers observées dans les caférières des groupements de la région de Kabare Nord

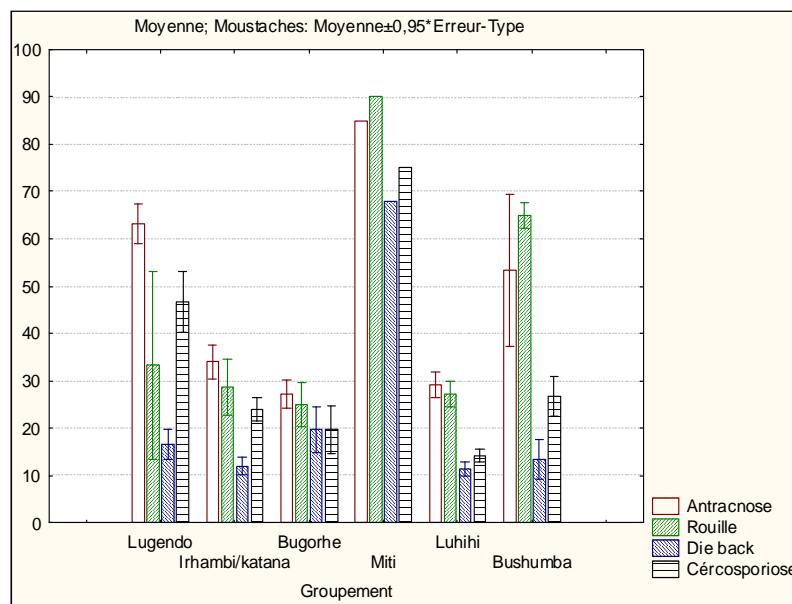


Fig 5. Répartition des maladies des cafériers observées dans les caférières des groupements de la région de Kabare Nord

Au regard des résultats présentés dans la figure 5, il ressort que dans tous les groupements enquêtés dans la région de Kabare Nord, les maladies comme l'anthracnose, la rouille du cafier, le die-back et la cercosporiose sont présentes dans des caférières. En comparant les groupements entre eux, il s'avère que pour la rouille du cafier, le groupement de Miti se place en première position, suivi respectivement d'autres groupements ci-après : Bushumba, Lugendo, Irhambi/Katana, Luhiji et Bugorhe. De même, pour l'anthracnose, le groupement de Miti vient en première position suivi respectivement des groupements de Lugendo, de Bushumba, d'Irhambi/Katana, de Bugorhe et de Luhiji. Quant au die-back, le groupement de Miti est placé encore une fois en première position suivi respectivement d'autres groupements ci-dessous : Bugorhe, Lugendo, Bushumba, Irhambi/Katana et Luhiji. Enfin, à propos de la cercosporiose, les groupements sont attaqués dans l'ordre de grandeur décroissante ci-après : Miti, Lugendo, Bushumba, Irhambi/Katana, Bugorhe et Luhiji. Toutefois, partant des comparaisons faites dans chaque groupement, il sied de signaler que dans le groupement de Miti, la rouille prédomine respectivement sur l'anthracnose, la cercosporiose et le die-back ; dans le groupement de Lugendo, l'anthracnose prédomine respectivement sur la cercosporiose, la rouille du cafier et le die-back ; dans les groupements d'Irhambi/Katana et de Luhiji, l'antracnose prédomine respectivement sur la rouille du cafier, la cercosporiose et le die-back ; dans Bugorhe, l'anthracnose prédomine sur toutes les maladies observées suivie de la rouille du cafier ainsi que de la cercosporiose et du die-back qui sont en codominance ; enfin, dans Bushumba la rouille du cafier prédomine respectivement sur l'anthracnose, la cercosporiose et le die-back.

Les informations ayant trait à la répartition des insectes ravageurs des cafériers observés dans les caférières des groupements de la région de Kabare Nord sont mentionnées dans la figure 6.

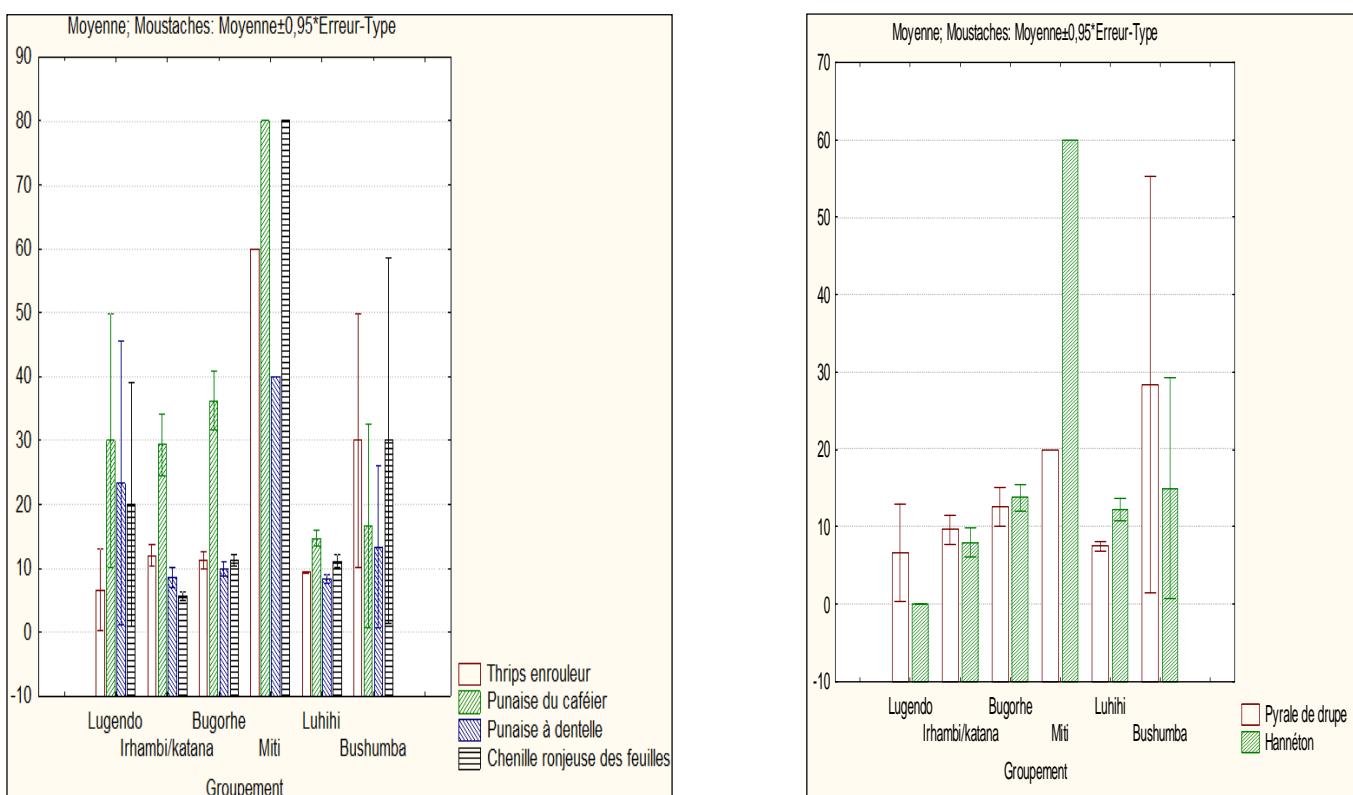


Fig 6. Répartition des insectes ravageurs des cafiers observés dans les caférières des groupements de la région de Kabare Nord

Il ressort des résultats présentés dans la figure 6 que tous les cafiers de la région de Kabare Nord sont attaqués par les insectes comme le thrips enrouleur, la punaise du cafier, la punaise à dentelle, la chenille rongeuse des feuilles, la pyrale de drupe et le hanneton. L'attaque faite par la punaise du cafier classe le groupement de Miti en première position suivi respectivement des groupements ci-dessous : Bugorhe, Lugendo, Irhambi/Katana, Bushumba et Luhilihi. La forte présence des chenilles rongeuses des feuilles dans le groupement de Miti, place celui-ci en première position suivi respectivement des groupements de Bushumba, de Lugendo, de Bugorhe, de Luhilihi et d'Irhambi/Katana. Les cafiers du groupement de Miti sont également plus attaqués par les thrips enrouleurs contrairement à ceux du groupement de Lugendo qui sont les moins attaqués par lesdits insectes. De même, les cafiers du groupement de Miti sont plus infestés par les punaises à dentelles contrairement à ceux du groupement de Luhilihi lesquels sont les moins infestés comparativement à d'autres. Quant aux hannetons du cafier, ils sont plus abondants dans le groupement de Miti et moins abondants dans le groupement de Lugendo. Enfin, les pyrales des drupes sont plus abondantes dans le groupement de Bushumba et moins abondantes dans le groupement de Lugendo. Néanmoins, dans le groupement de Miti, la punaise du cafier et la chenille rongeuse des feuilles sont les principaux insectes ravageurs des cafiers; la punaise du cafier est le principal insecte ravageur des cafiers respectivement dans les groupements de Lugendo, d'Irhambi/Katana, de Bugorhe, de Luhilihi et de Bushumba.

L'association des cafiers avec d'autres cultures (cultures vivrières, industrielles, les bananiers), l'absence ou l'insuffisance des entretiens, la quasi-non application des produits phytosanitaires et le vieillissement des caférières de la région de Kabare Nord seraient l'une des causes de la prolifération des maladies et insectes ravageurs des cafiers dans les groupements de ladite contrée.

La figure 7 ci-dessous présente les interactions entre les variables :

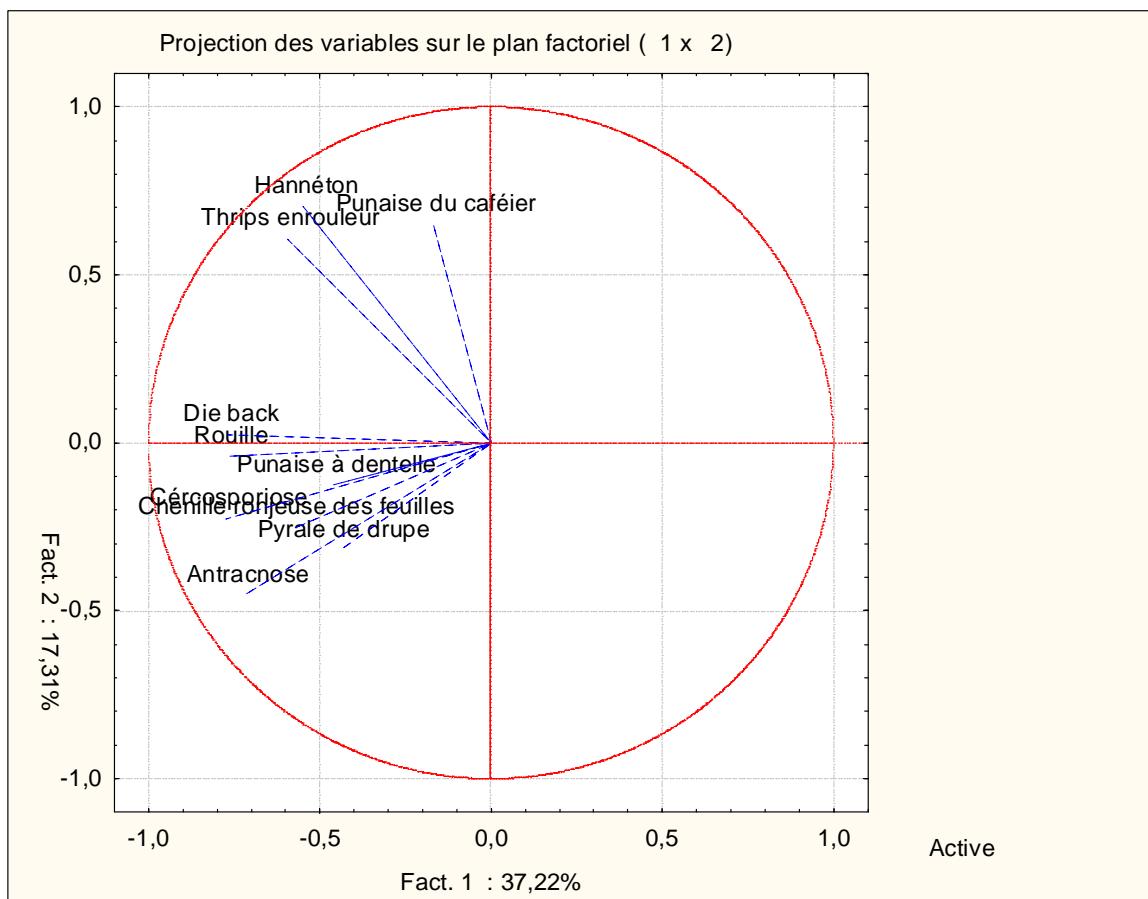


Fig 7. Interaction entre les variables maladies et insectes ravageurs des cafiers

Il ressort de la figure 7 que les occurrences de la punaise du cafier, de l'hanneton et du thrips enrouleur semblent être corrélées tandis que celles du die-back, de la rouille, de la cercosporiose, de la punaise à dentelle, de la chenille rongeuse des feuilles, de la pyrale de drupe et l'antracnose sont également corrélées.

4 DISCUSSION

Les figures 2 et 3 relatives à l'enquête phytosanitaire des caférières de la région de Kabare Nord révèlent que les maladies comme l'antracnose, la rouille, le die-back et la cercosporiose sont présentes à des taux d'incidences relativement différents. L'antracnose a été plus observée (33%), suivi de la rouille des cafiers (30%) puis de la cercosporiose (22%) et enfin du die-back (15%). Quant aux insectes ravageurs des cafiers, les thrips enrouleurs, la punaise du cafier, la punaise à dentelle, les Chenilles rongeuses de feuilles, les pyrales des drupes et les hannetons du cafier sont également présents dans des caférières de ladite région à des taux d'incidences relativement différents. Pour la punaise du cafier, il s'est avéré que son incidence est la plus élevée (32%) par rapport à d'autres ravageurs suivie de thrips enrouleur (15%), puis de l'hanneton du cafier et de la chenille rongeuse des feuilles qui sont ex-aquo (respectivement 14%), ensuite de la pyrale de drupe (13%) et enfin de la punaise à dentelle (12%) dans les sites échantillonnés. La présence de ces insectes et maladies sus évoqués seraient l'une des causes de la régression de la production du café au Sud Kivu en général et dans la région de Kabare en particulier de la même façon que c'était le cas du Burundi [16], [18], [19], [20] et [21], de l'Amérique [22], du Cameroun [23], de la Nouvelle Calédonie [24], de la Côte d'Ivoire [25], [26], [27], [28], [29], [30] et [31].

Selon les résultats présentés dans la figure 4 il sied de signaler que toutes les caférières de la région de Kabare Nord sont vieilles avec l'âge moyen de 57,5 ans. Une étude similaire qui a été menée par [32] sur les vergers des agrumes de la côte occidentale du Lac Kivu a révélé que les vergers dont il est questions sont également vieux d'au moins 25 ans. De même, selon le rapport annuel de la Composante Café de l'ISABU [21], les Cultivars des caférières présentement en diffusion (Mibirizi, Bourbon Mayaguez 71 et 139 et Jackson 2/1257) au Burundi datent d'avant 1962, par conséquent elles sont vieilles.

La figure 5 révèle que dans tous les groupements (Miti, Bushumba, Lugendo, Irhambi/Katana, Luhiki et Bugorhe) enquêtés dans la région de Kabare Nord, les maladies comme l'antracnose, la rouille du cafier, le die-back et la

cercosporiose sont présentes dans des caférières mais à des taux d'incidence relativement différents. Comparativement aux régions caféicoles de la République Burundaise, il a été constaté que les effets néfastes de l'anthracnose sur la production du café sont notables. Au fait, les taux d'attaque d'au moins 50% ont été observés en mars 1999 à Buhoro (78%) en commune Gashikanwa et Gasebeyi (64%) en commune Tangara dans la province de Ngozi, Gasorwe à Ngongoma (64%), Gashoho à Bwisha (59%) et Butihinda à Butihinda (54%) en Province de Muyinga. Lors de la campagne 2000/2001, l'incidence de l'anthracnose sur la récolte a été très négative en ce sens qu'elle a contribué à la réduction de la production à plus de 30%. La propagation de la maladie en 2001/2002 et sa persistance en 2002/2003 ont favorisé son extériorisation plus accrue sur les rameaux et les drupes. Des faits de dessèchement et de noircissement des baies ont suivi et sont également produits même actuellement [19].

Concernant l'attaque des insectes, la figure 6 montre que tous les cafériers des groupements de la région de Kabare Nord sont attaqués par les insectes dont le thrips enrouleur, la punaise du cafier, la punaise à dentelle, la chenille rongeuse des feuilles, la pyrale de drupe et le hanneton également à des taux d'incidence relativement différents. De même, il a été constaté dans les régions caféicoles du Burundi depuis les années 1960 jusqu'à présent, la punaise du cafier, les Chenilles rongeuses de feuilles, les cochenilles, etc causent des dégâts énormes sur les cafériers [33].

Quant aux interactions entre les variables maladies et insectes ravageurs des cafériers, la figure 7 montre que les occurrences de la punaise du cafier, de l'hanneton et du thrips enrouleur semblent être corrélées tandis que celles du die-back, de la rouille, de la cercosporiose, de la punaise à dentelle, de la chenille rongeuse des feuilles, de la pyrale de drupe et l'anthracnose sont également corrélées. En se basant sur la pensée de [16], ces corrélations s'expliqueraient par le fait que les défoliations dues aux insectes ou aux maladies parasitaires prédisposent les cafériers au die-back, ainsi que tout facteur empêchant une nutrition normale de la plante comme la compétition des plantes adventices, la faible fertilité du sol; les élévations des températures dans les régions des basses et haute altitudes prédisposent les cafériers à la rouille alors que les caférières de la région de Kabare Nord se trouvent dans les basses ou hautes altitudes, aussi les ombrages se trouvant ça et là dans les caférières précitées expliqueraient la présence de la rouille dans les sites échantillonnés. De même, étant donné que les plants des cafériers de Kabare Nord sont trop vieux (l'âge variant entre 43,1 ans et 69 ans avec une moyenne de 57,5 ans), une déficience nutritionnelle, l'absence ou l'insuffisance de l'entretien des cafériers prédisposeraient ces cafériers aux diverses maladies comme la cercosporiose. Aussi, la position en haute altitude qu'occupe la région de Kabare Nord prédispose les cafériers de cette zone à l'anthracnose. En plus de cela, la non application régulière et au temps opportun des produits phytosanitaires expliquerait la forte attaque des maladies et ravageurs à l'égard des cafériers de Kabare.

5 CONCLUSION

L'étude dont il est question a été menée dans la région de Kabare Nord, plus spécialement dans les groupements de Lugendo, Irhambi-Katana, Bugorhe, Miti, Luhiji et Bushumba où les cafériers sont abondamment cultivés. Nous avons procédé par le dépouillement bibliographique et l'enquête phytosanitaire précédée d'une pré-enquête à base de la technique d'échantillonnage systématique.

A l'issue de nos investigations, il s'est avéré que d'une part l'anthracnose, la rouille, le die-back et la cercosporiose sont les maladies observées dans des caférières de la région de Kabare Nord à des incidences relativement différentes et d'autre part le thrips enrouleur, le hanneton, la punaise à dentelle, la punaise du cafier, la chenille rongeuse des feuilles ainsi que la pyrale des drupes sont des insectes ravageurs des cafériers observés dans les caférières sus évoquées mais aussi à des incidences relativement différentes.

L'anthracnose a été plus observée (33%), suivi de la rouille des cafériers (30%) puis de la cercosporiose (22%) et enfin du die-back (15%). En comparant les groupements entre eux, il s'avère que pour la rouille du cafier, le groupement de Miti se place en première position, suivi respectivement d'autres groupements suivants : Bushumba, Lugendo, Irhambi/Katana, Luhiji et Bugorhe. Aussi, pour l'anthracnose, le groupement de Miti vient en première position suivi respectivement des groupements de Lugendo, de Bushumba, d'Irhambi/Katana, de Bugorhe et de Luhiji. Quant au die-back, le groupement de Miti est placé encore une fois en première position suivi respectivement d'autres groupements ci-dessous : Bugorhe, Lugendo, Bushumba, Irhambi/Katana et Luhiji. Enfin, à propos de la cercosporiose, les groupements sont attaqués dans l'ordre de grandeur décroissante ci-après : Miti, Lugendo, Bushumba, Irhambi/Katana, Bugorhe et Luhiji. Toutefois, partant des comparaisons faites dans chaque groupement, il sied de signaler que dans le groupement de Miti, la rouille prédomine respectivement sur l'anthracnose, la cercosporiose et le die-back ; dans le groupement de Lugendo, l'anthracnose prédomine respectivement sur la cercosporiose, la rouille du cafier et le die-back ; dans les groupements d'Irhambi/Katana et de Luhiji, l'anthracnose prédomine respectivement sur la rouille du cafier, la cercosporiose et le die-back ; dans Bugorhe, l'anthracnose prédomine sur toutes les maladies observées suivie de la rouille du cafier ainsi que de la cercosporiose et du die-back qui sont en codominance ; enfin, dans Bushumba la rouille du cafier prédomine respectivement sur l'anthracnose, la cercosporiose et le die-back.

De même, la punaise du cafier présente une incidence la plus élevée (32%) suivi de thrips enrouleur (15%), puis de l'hanneton du cafier et de la chenille rongeuse des feuilles qui sont exa-equo (respectivement 14%), ensuite de pyrale de drupe (13%) et enfin de la punaise à dentelle (12%) dans des caférières de la région de Kabare Nord. L'attaque faite par la punaise du cafier classe le groupement de Miti en première position suivi respectivement des groupements ci-dessous : Bugorhe, Lugendo, Irhambi/Katana, Bushumba et Luhihhi. La forte présence des chénilles rongeuses des feuilles dans le groupement de Miti, place celui-ci en première position suivi respectivement des groupements de Bushumba, de Lugendo, de Bugorhe, de Luhihhi et d'Irhambi/Katana. Les cafériers du groupement de Miti sont également les plus attaqués par les thrips enrouleurs contrairement à ceux du groupement de Lugendo qui sont les moins attaqués par lesdits insectes. De même, les cafériers du groupement de Miti sont plus infestés par les punaises à dentelles contrairement à ceux du groupement de Luhihhi lesquels sont les moins infestés comparativement à d'autres. Quant aux hennetons du cafier, ils sont plus abondants dans le groupement de Miti et moins abondants dans le groupement de Lugendo. Enfin, les pyrales des drupes sont les plus abondantes dans le groupement de Bushumba et les moins abondantes dans le groupement de Lugendo. Néanmoins, dans le groupement de Miti, la punaise du cafier et la chenille rongeuse des feuilles sont les principaux insectes ravageurs des cafériers ; la punaise du cafier est le principal insecte ravageur des cafériers respectivement dans les groupements de Lugendo, d'Irhambi/Katana, de Bugorhe, de Luhihhi et de Bushumba.

Quant aux interactions entre les variables, les interactions entre la punaise du cafier, l'hanneton et le thrips enrouleur semblent être corrélées tandis que celles existant entre le die-back, la rouille, la cercosporiose, la punaise à dentelle, la chenille rongeuse des feuilles, la pyrale de drupe et l'anthracnose sont également corrélées.

Concernant l'âge des plants des cafériers, toutes caférières de la région de Kabare Nord sont très âgées dufait que leurs âges varient entre 43,1 ans et 69 ans avec une moyenne de 57,5 ans.

Eu égard à ce qui précède, et étant donné qu'il est impérieux de redynamiser la filière cafrière du Sud Kivu dans la perspective d'accroître la production du café, il sied de suggérer ce qui suit :

- Que les caficulteurs de Kabare Nord songent à l'entretien de leurs caférières ainsi qu'au remplacement de vieux plants de cafiers par les nouvelles variétés résistantes aux maladies et insectes, qu'ils appliquent régulièrement et au temps opportun les produits phytosanitaires non toxiques à l'environnement.
- Compte tenu de la rareté, du coût élevé, de l'impact négatif de tant des pesticides de synthèse sur l'environnement et de l'activité des divers extraits des plantes sur les maladies ainsi que les insectes ravageurs des cultures d'une part et de la potentialité des plantes insecticides dont la région de Kabare regorge, il serait judicieux d'entreprendre les recherches sur l'activité insecticide des extraits des plantes locales contre les maladies ou les insectes ravageurs des cafiers dans ladite région.

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EVALUATION IN VITRO DE L'ACTIVITE INSECTICIDE DES ALCALOÏDES, SAPONINES, TERPENOÏDES ET STEROÏDES EXTRAITS DE *Capsicum frutescens* L. (SOLANACEAE) CONTRE *Antestiopsis orbitalis ghesquierei*, INSECTES RAVAGEURS DES CAFEIERS

[EVALUATION IN VITRO ACTIVITY OF INSECT ALKALOID, SAPONINS, TERPENOIDS OR STEROIDS EXTRACTS *Capsicum frutescens* L. (SOLANACEAE) AGAINST *Antestiopsis orbitalis ghesquierei*, PESTS OF COFFEE TREES]

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ABSTRACT: In an attempt to find non-harmful to humans and does not pollute the environment, effective tack against the coffee and alternatives to synthetic pesticides polluters of the environment, an in vitro test of activity biodegradable organic substances insecticides, insecticide alkaloids, steroids, saponins and isolated *Capsicum frutescens* L. terpenes was performed in the presence of synthetic pesticides (Supadip and Dimethoate) and water as controls. Mortality tack the coffee very varied significantly depending on the treatment, concentration as well as the interaction of treatment and concentrations of insecticides tested substances. The insecticidal activity of Supadip was superior to all other insecticides tested at doses of 0.01ml / l and 0.1 ml / l (100% mortality) at the dose 0,636g / l, the alkaloids have Capsicum similar to that of Supadip and dimethoate (100% mortality) effect. Steroids have a mortality of 57% at the dose 0,636g / ml saponins and terpenes have a minimum effect to said dose. Dimethoate was inactive at doses 0.1 ml / l and 0.01ml / l. Alkaloids have low lethal dose LD₅₀ (0.21 ± 0,015g / ml) compared with other active ingredients extracted from fruits of *Capsicum* tested on tack (0.54 ± 0,012g / ml for steroids, 0.93 ± 0,054g / ml saponins and 0,277g ± 1.70 / ml for the terpenes). The chemical analysis shows that fruits of *Capsicum* alkaloids, phenols, flavonoids, terpenes, steroids, and carotenoids lipoids saponins present are strongly present and finally are medium tannins, quinones and glucosides are present sparsely.

KEYWORDS: Drawing pin, insecticidal plants, pepper, Coffee tree, North Kabare.

RÉSUMÉ: Dans la perspective de trouver les substances organiques insecticides biodégradables, non nocifs à l'homme et ne polluant pas l'environnement, efficaces contre la punaise du cafier et alternatives aux pesticides synthétiques pollueurs de l'environnement, un test in vitro de l'activité insecticide des alcaloïdes, stéroïdes, saponines et terpènes isolés de *Capsicum frutescens* L. a été réalisé en présence des pesticides de synthèse (Supadip et Diméthoate) et l'eau comme témoins. La mortalité de la punaise du cafier variait très significativement selon le traitement, la concentration ainsi qu'avec l'interaction des traitements et les concentrations des substances insecticides testées. L'activité insecticide de Supadip était supérieure à tous les autres produits insecticides testés aux doses de 0,01ml/l et 0,1ml/l (100% de mortalité), à la dose 0,636g/l, les alcaloïdes extraits de *Capsicum* ont un effet similaire à celui de Supadip et Diméthoate (100% de mortalité). Les stéroïdes ont une mortalité de 57 % à la dose 0,636g/ml , les saponines et terpènes ont un effet minimal à ladite dose. Le Diméthoate était inactif aux doses 0,1ml/l et 0,01ml/l. Les alcaloïdes présentent une faible dose létale DL₅₀ (0,21±0,015g/ml)

par rapport aux autres principes actifs extraits des fruits de *Capsicum* testés sur la punaise ($0,54 \pm 0,012$ g/ml pour les stéroïdes ; $0,93 \pm 0,054$ g/ml pour les saponines et $1,70 \pm 0,277$ g/ml pour les terpènes). L'analyse chimique des fruits de *Capsicum* montre que les alcaloïdes, phénols, flavonoïdes, terpènes, stéroïdes, caroténoïdes et lipoïdes sont fortement présents les saponines sont moyennement présentes et enfin les tanins, les quinones et les glucosides sont faiblement présents.

MOTS-CLEFS: Punaise du cafier, plantes insecticides, piment, cafier, Kabare Nord.

1 INTRODUCTION

Les cafiers font partie des principales cultures industrielles d'exportations dans la province du Sud Kivu, en République Démocratique du Congo, en particulier et dans le monde en général [1], [2]. Ils poussent naturellement dans des régions tropicales et appartiennent au genre *Coffea* ainsi qu'à la famille des Rubiacées. Deux espèces dont *Coffea arabica* et *Coffea canephora* (ou cafier robusta), sont habituellement cultivées dans lesdites régions et sont plus utilisées pour des fins de production de la boisson [3].

Néanmoins, les cafiers, comme toutes les cultures des pays tropicaux sont soumis aux attaques d'un certain nombre d'insectes ravageurs dont *Antestiopsis orbitalis ghesquierei* [4], [5], [6] et [7]. Ils en détruisent les fruits, les fleurs, les tiges et/ou les racines, ils peuvent également diminuer plus ou moins fortement la récolte, soit exceptionnellement la supprimer complètement et faire périr les cafiers [8] et [9]. L'attaque des cultures peut aussi entraîner des conséquences diverses aux drupes comme la perte du pouvoir germinatif des semences, de la qualité et de la quantité des cerises [10].

En province du Sud Kivu, durant les treize dernières années, la caféculture est en régression. Cependant les pertes de rendement dues aux maladies, insectes, etc sont énormes (99%) et constituent un problème économique grave [11]. Afin de contribuer à la protection des cultures, l'usage des méthodes modernes et naturelles de protection des plantes respectivement à base des pesticides de synthèse et des plantes à effets insecticides sont en vogue depuis longtemps [12] [13] et [14]. Pourtant bon nombre des pesticides synthétiques comme ceux de la famille des organochlorés polluent l'environnement, portent atteinte à la santé de l'homme, ont des effets rémanents [15] et [16]. Cela étant, et compte tenu de l'abondance des plantes à effets insecticides dans la nature [17], [18] et [19], ce dernier temps l'intérêt grandissant est placé dans les plantes à effets insecticides afin de trouver de nouvelles sources potentielles de contrôle naturel des insectes [20]. Certaines substances chimiques contenues dans les plantes présentent des effets insecticides [20], [21] et [22]. Parmi ces produits, les alcaloïdes, les saponines, les terpènes, les stéroïdes et les quinones sont reconnus plus efficaces [20], [23], [24].

Dans la région du Sud Kivu, certaines plantes sont utilisées par la population pour protéger les denrées stockées contre les ravageurs. Parmi ces plantes *Capsicum frutescens* L a été plus cité par les agriculteurs paysans exploitant les petites superficies pour les cultures vivrières ainsi que les cultures industrielles d'exportation dans la région de Kabare Nord (communication personnel). Dans l'optique de trouver des substances alternatives aux pesticides de synthèse susceptibles de résoudre ces problèmes épineux sus évoqués et de contribuer à une gestion durable de l'environnement, il nous a semblé convenable de tester l'activité insecticide des alcaloïdes, saponines, terpènes et stéroïdes extraits de *Capsicum frutescens* L contre la punaise du cafier. Ceux-ci sont généralement des insecticides sélectifs, non dangereux pour l'homme, biodégradables, non dangereux pour l'environnement et moins couteux que les insecticides de synthèse [25], [15], [26] et [20].

2 MATERIEL ET METHODES

2.1 RECOLTE DES PLANTES ET PREPARATION DES EXTRAITS

Les fruits de *Capsicum frutescens* L ayant fait l'objet de la présente étude ont été récoltés à Lwiro (1750 m d'altitude), territoire de Kabare, province du Sud Kivu, Est de la République Démocratique du Congo au cours du mois d'avril 2013. La plante a été identifiée avec les références de l'herbarium du laboratoire de Botanique du Département de Biologie, Centre de Recherche en Sciences Naturelles de Lwiro (CRSN-Lwiro) où les spécimens sont gardés.

Ces fruits dont il est question ont été séchés à l'air libre au laboratoire de phytochimie du Département de Biologie, Centre de Recherche en Sciences Naturelles de Lwiro puis réduits en poudre dont une partie a été utilisée pour préparer les

extraits totaux ayant servis au pré test et une autre partie a été exploitée pour l'extraction des insecticides d'origine végétale et le screening phytochimique.

Après broyage et tamisage, 3kg de poudre ont été obtenus. Ensuite 20g de ceux-ci ont été macérés pendant 24 heures dans respectivement 250 ml d'éthanol à 70%, de l'eau distillée, de l'éther de pétrole, de benzène et l'hexane selon le cas. Après filtration au moyen du papier filtre Whatman et évaporation des solvants, les résidus représentant 15 à 20% des matières sèches ont été obtenus. Ces derniers ont été respectivement récupérés par 2 ml d'eau distillée afin de constituer la solution mère. Pour préparer la première dilution (10^{-1}), nous avions transvasé 9 ml d'eau distillée dans 1ml de chaque solution mère.

La deuxième dilution (10^{-2}), a été obtenue en transvasant 9 ml d'eau distillée dans 1 ml de la première dilution de chaque solution. Afin de répondre aux exigences des tests de toxicité, beaucoup d'extraits et solutions ont été préparés.

2.2 RÉCOLTE DES INSECTES

Les insectes (*Antestiopsis orbitalis ghesquierei*) ont été récoltés sur des plants des cafiers dans la plantation Bwengehera (latitude : $2^{\circ}16'9,125''$ Sud, longitude : $28^{\circ}48,25'44,65''$ Est, altitude : 1688 mètres) située à environ 500 mètres du CRSN-Lwiro et gardés au laboratoire d'entomologie agricole du Centre de Recherche en Sciences Naturelles pendant 48 heures pour raison d'acclimatation aux conditions de laboratoire.

2.3 PRÉ TEST D'ACTIVITÉ INSECTICIDE

A l'issue de la préparation des extraits éthanoliques et aqueux totaux tel que décrit ci-haut, 1ml de chaque solution de concentration 2g/ml a été déposé sur un quart de papier filtre au moyen d'une micropipette. Après évaporation du solvant à l'air libre, le papier filtre a ensuite été introduit dans un tube d'expérimentation de l'OMS (125 mm de long et 44 mm de diamètre ou 16 cm de long et 6 cm de diamètre) [23].

Nous avons ensuite placé respectivement 6 individus d'*Antestiopsis orbitalis ghesquierei* dans chaque tube de l'OMS contenant les extraits.

Pour éviter la fuite des insectes, le tube a été fermé par un couvercle en toile métallique afin d'éviter la mort des insectes par asphyxie. Les tubes ont été gardés dans un endroit bien aéré. Le temps d'exposition a été fixé à 24 heures.

Un échantillon témoin a été constitué pour chaque pré test sans extraits de *Capsicum frutescens* L. Lors du dépouillement, les insectes ont été considérés morts si après la durée du pré test (24 heures), ils deviennent incapables de se mouvoir. Pour chaque extrait les essais ont été répétés trois fois.

2.4 SCREENING PHYTOCHIMIQUE DES FRUITS DE *CAPSICUM FRUTESCENS* L.

Les résidus ainsi obtenus lors de la préparation des extraits ont servi à l'identification des familles des substances chimiques contenues dans les fruits de *Capsicum frutescens* L. comme les alcaloïdes, saponines, flavonoïdes, terpènes, stéroïdes, glucosides, caroténoïdes, phénols, quinones, tanins et les lipoïdes selon les méthodes classiques [27], [28], [29], [24] et [30].

Les alcaloïdes ont été identifiés en se basant sur leur solubilité dans l'eau. Ainsi leur détection a été faite respectivement par les tests aux réactifs de Mayer (HgCl₂, KI et H₂O), de Dragendorff [Bi(NO₃)₂, KI et H₂O], et de Wagner (KI, I₂ et H₂O) sur les extraits aqueux. L'apparition d'un précipité rouge-orange (pour les réactifs de Mayer et Dragendorff) et brun, rouge ou noir pour le réactif de Wagner témoigne la présence des alcaloïdes.

Quant aux saponines, les tests au dichromate de potassium (1%) acidifié par l'acide sulfurique (98%) et à la mousse réalisés sur l'extrait aqueux ont été utilisés pour les identifier. D'un côté, l'apparition de la coloration vert-sale pour le premier test et de la mousse persistante suite à une agitation vigoureuse pour le second test témoignent la présence des saponines.

Les glucosides ont été identifiés à partir des extraits aqueux par le test au réactif de Fehling (CuSO₄.5H₂O + tartrate double de potassium et de sodium+ H₂O) acidifié par HCl à 1%. La formation d'un précipité rouge-brique témoigne la présence des glucosides.

Les flavonoïdes quant à eux ont été détectés par le test à la soude caustique (1%) et à l'acide chlorhydrique (1%) réalisés sur l'extrait aqueux. La formation de coloration bleu-verdâtre indique la présence des flavonoïdes.

L'identification des terpènes a été faite sur base du test au réactif de Hurschson (acide acétique) effectué sur l'extrait organique étheré. La présence de la couleur jaune virant au rouge indique la présence des terpènes.

Les stéroïdes ont été également identifiés par le test au réactif de Lieberman-Burchard (acide acétique+acide sulfurique) réalisé sur l'extrait aqueux. L'apparition de la coloration mauve et vert témoigne la présence des stéroïdes.

Les tanins ont été recherchés au moyen du test au réactif de Stiasny (chlorure ferrique à 1%) réalisé sur l'extrait aqueux. La formation de coloration bleue, bleue-verte, bleue- sombre ou verte, témoigne la présence des tanins.

Les quinones ont été identifiées par le test à l'ammoniaque (1%) réalisé sur l'extrait organique benzénique. L'apparition de la coloration rouge-rosâtre indique la présence des quinones.

Les phénols ont été détectés par le test à FeCl_3 (1%) et à l'acide sulfurique (98%) mené sur l'extrait organique éthanolique. La formation de la couleur rouge- foncée, indique la présence des phénols.

Les caroténoïdes ont été recherchés sur l'extrait organique étheré par le test à l'acide chlorhydrique à (1%) et à l'acide sulfurique (98%). L'apparition de la couleur vert-bleue, indique la présence des caroténoïdes.

Enfin les lipoïdes ont été détectés par le test à l'acide sulfurique (98%) réalisé sur l'extrait organique à base de l'hexane. La formation de la couleur violette témoigne la présence des lipoïdes.

2.5 EXTRACTION DES SUBSTANCES ORGANIQUES INSECTICIDES

Les résidus obtenus durant la préparation des extraits tant organiques qu'aqueux ont servi à l'extraction des substances organiques insecticides telles que les alcaloïdes, les saponines, les terpènes et les stéroïdes selon les méthodes classiques [24], [31] et [32]. Les terpènes et les stéroïdes ont été extraits en se basant sur leur solubilité dans l'éthanol. Après filtration des extraits organiques et évaporation à sec de la phase liquide, le résidu noir obtenu a été récupéré avec un mélange hexane-eau (2/1). Il apparaît deux phases : une phase aqueuse claire contenant les terpènes et une phase sombre contenant les stéroïdes qui sont ensuite séparées par décantation dans une ampoule à décanter. La première phase à récupérer est celle qui contient les stéroïdes, elle a été évaporée à sec et le résidu de stéroïdes ainsi obtenu a été récupéré dans 2 ml d'eau distillée pour le test d'activité. La phase aqueuse terpénique a été de même évaporée et le résidu sec de terpènes obtenu a été récupéré dans 2 ml d'eau distillée pour le test d'activité.

Quant aux alcaloïdes, ils ont également été extraits en se basant sur leur solubilité dans l'eau. Après filtration des extraits aqueux et évaporation à sec du filtrat, le résidu huileux noirâtre obtenu a été récupéré par 250 ml de l'hydroxyde de sodium 2N pendant. En suite, après filtration de la solution huileuse basifiée et évaporation à sec de la solution aqueuse de la base, le résidu jaunâtre ainsi obtenu a été également récupéré avec le réactif de Prollius (un mélange diéthyléther-chloroforme-eau-ammoniaque dans les proportions 25/8/2/2,5). Puis après agitation vigoureuse durant 2 minutes en vue de favoriser un meilleur contact entre les alcaloïdes libérés par la base et le solvant récupérateur ainsi qu'un repos de 24 heures pour une récupération optimale des alcaloïdes, il y a apparition de deux phases dont une organique claire surnageant contenant les alcaloïdes et une phase aqueuse sombre contenant les déchets qui sont ensuite séparées par décantation dans une ampoule à décanter. La phase organique alcaloïdique a été enfin évaporée à sec et le résidu sec d'alcaloïdes obtenu a été récupéré dans 2 ml d'eau distillée pour le test d'activité.

En dernier lieu, les saponines ont été aussi extraites en se basant sur leur insolubilité dans l'eau et leur solubilité dans l'éthanol. Après filtration des extraits organiques et évaporation à sec de la phase liquide, le résidu brun noir ainsi obtenu a été dégraissé avec 20 ml d'hexane et ensuite évaporé à sec. Ce résidu nouvellement obtenu a été de nouveau dissout dans le mélange méthanol-eau en proportion (4/1). Puis les saponines contenues dans cette solution ont été précipitées par 25 ml de diéthyléther. Après une troisième évaporation du solvant organique ajouté précédemment, un résidu brun noir a été une fois de plus obtenu auquel le mélange méthanol-diéthyléther a été ajouté dans les rapports (2/1). Cette dernière solution ainsi obtenue a été transvasée dans les tubes à essai lesquels étaient déposés dans des tubes à Godets et soumis à la centrifugation pendant cinq minutes à raison de 3000 tours par seconde puis reposé pendant 24 heures avant de séparer la phase trouble se trouvant au fond de la phase surnageant contenant les saponines. Enfin l'évaporation à sec de cette dernière a donné un résidu sec des saponines de couleur brun-noir lequel a été récupéré dans 2 ml d'eau distillée pour le test de toxicité.

2.6 TEST D'ACTIVITÉ INSECTICIDE

Après extraction des principes actifs sus évoqués, diverses doses d'ordre de 0,636 g/ml ; 0,0636 g/ml et 0,00636 g/ml ont été préparées tel que décrit ci-haut. 1ml de chaque solution à dose donnée a été déposé sur un quart de papier filtre à l'aide d'une micropipette. Après évaporation du solvant à l'air libre, le papier filtre a ensuite été introduit dans un tube d'expérimentation de l'OMS (125 mm de long et 44 mm de diamètre ou 16 cm de long et 6 cm de diamètre) [23].

Ainsi, nous avions placé respectivement 6 individus d'*Antestiopsis orbitalis ghesquierrei* dans chaque tube de l'OMS contenant les principes actifs. De même, 6 individus d'*Antestiopsis orbitalis ghesquierrei* ont été introduits dans des tubes ou cylindres contenant chacun le papier filtre sec préalablement imbibé dans l'eau distillée ainsi que dans les solutions de Dimethoate et Supadip aux doses respectives de 1ml/l ; 0,1 ml/l et 0,01 ml/l. Ces deux pesticides de synthèse ont servi comme témoins positifs, tandis que l'eau distillée a joué le rôle du témoin négatif.

Afin d'éviter la fuite desdits insectes, le cylindre a été fermé par un plastique troué par une aiguille pour éviter la mort des insectes par asphyxie. Les tubes ont été gardés dans un endroit bien aéré. Le temps d'exposition a été fixé à 24 heures.

Lors du dépouillement, les insectes ont été considérés morts si après la durée du test (24 heures), ils deviennent incapables de bouger. Le taux de mortalité corrigée a été calculé par la formule d'Abott [33] ci-après :

$$Mc = \frac{Mo-Mt}{100-Mt} \times 100$$

Avec Mc = taux de mortalité corrigée ; Mo = taux de mortalité observée chez les insectes traités ; Mt = taux de mortalité naturelle observée chez les témoins

Après dépouillement, les données ainsi obtenues ont été soumises à l'analyse pour déterminer les doses létales DL₅₀ et DL₉₀ c'est-à-dire les doses nécessaires qui tuent respectivement 50% et 90 % des insectes à une durée donnée. Elles ont été calculées pour chaque pesticide d'origine végétale après la durée du test d'activité insecticide. Ainsi la méthode de Probit et la régression linéaire ont été utilisées [34], [35] et [36].

3 RESULTATS

3.1 PRÉ-TEST D'ACTIVITÉ INSECTICIDE

Les résultats du pré-test d'activité insecticide des extraits aqueux et éthanoliques totaux des fruits de *Capsicum frutescens L* après 24 heures de contact sont présentés dans le tableau 1 ci-dessous.

Tableau 1. Taux de mortalité après 24 heures pour les extraits de Capsicum frutescens L (2 g/ml) et de témoin négatif (eau)

Extrait	Taux de mortalité en %
Extrait aqueux	100
Extrait organique	100
Témoin	0

Comparativement au témoin négatif, il ressort des résultats présentés dans le tableau 1 que tous les extraits totaux ont présenté après 24 heures de contact une très grande activité insecticide à l'égard d'*Antestiopsis orbitalis ghesquierrei*, ravageurs des cafiers.

Cela étant, nous avions opté pour la recherche des substances chimiques contenus dans les fruits de *Capsicum frutescens L*. ainsi qu'à leur test d'activité insecticide à l'égard de la punaise du cafier.

3.2 SCREENING PHYTOCHIMIQUE DES FRUITS DE *CAPSICUM FRUTSCENS L.*

Les résultats relatifs à l'identification des familles des principes actifs naturels contenus dans les fruits de *Capsicum frutescens L*. sont présentés dans le tableau 2.

Tableau 2. Résultats globaux de la recherche des substances actives dans les fruits de *Capsicum frutscens* L.

Familles de substances chimiques naturelles recherchées	Résultats obtenus
Saponines	++
Alcaloïdes	+++
Glucosides	+
Flavonoïdes	+++
Tanins	+
Terpènes	+++
Stéroïdes	+++
Quinones	+
Phénols	+++
Caroténoïdes	+++
Lipoïdes	+++

Légende

+++ : Fortement présent ; ++ : Moyennement présent ; + : Faiblement présent

Au vu des résultats présentés dans le tableau 2 relativ au screening phytochimique des fruits de *Capsicum frutscens* L, il sied de signaler ce qui suit :

- Les alcaloïdes, les phénols, les flavonoïdes, les terpènes, les stéroïdes, les caroténoïdes et les lipoïdes sont fortement présents ;
- Les saponines sont moyennement présentes ;
- Les tanins, les quinones et les glucosides sont faiblement présents.

Signalons que ce test a été réalisé afin de vérifier si la plante *Capsicum frutscens* L cultivée dans la région de Kabare Nord possède les substances actives semblables à celles observées dans d'autres plantes de *Capsicum frutscens* L cultivées dans d'autres régions différentes de celle de Sud Kivu car selon [37], la présence des composés phytochimiques dans les fruits de diverses espèces de plantes, peut être affectée par le génotype, les conditions du développement et de croissance, la maturité, le conditionnement, les conditions de stockage, etc.

3.3 ACTIVITES INSECTICIDES DES ALCALOÏDES, SAPONINES, TERPENES ET STEROÏDES APRES 24 HEURES D'EXPOSITION

Les résultats du test d'activité insecticide des alcaloïdes, saponines, terpènes et stéroïdes extraits des fruits de *Capsicum frutscens* L à l'issue des temps d'exposition sont repris dans le tableau 3.

Tableau 3. Taux de mortalité moyenne corrigée (en %, \pm écart-type) relevée 24 heures après traitement avec des alcaloïdes, saponines, stéroïdes, terpènes extraits de *Capsicum frutescens* L et les pesticides synthétiques (Supadip et Diméthoate)

Substances organiques insecticides testées					Témoins positifs			Témoin négatif
Dose en g/ml des substances organiques testées	Alcaloïdes	Saponines	Stéroïdes	Terpènes	Dose	Supadip	Diméthoate	Eau
Solution mère	0,636	100 \pm 0	33,3 \pm 1,247	57 \pm 0,816	16 \pm 1,699	1 ml/l	100 \pm 0	100 \pm 0
Première dilution	0,0636	44 \pm 3,266	16,7 \pm 1,699	16,7 \pm 1,699	16,7 \pm 2,449	0,1 ml/l	100 \pm 0	0 \pm 0
Deuxième dilution	0,00636	16 \pm 1,633	0 \pm 0	0 \pm 0	0 \pm 0	0,01 ml/l	50 \pm 1,633	0 \pm 0

Au vu des résultats présentés dans le tableau 3 et la figure 1, il s'avère qu'à l'exception du témoin négatif (eau distillée), toutes les substances insecticides testées ont été différemment actives contre *Antestiopsis orbitalis ghesquierei* proportionnellement aux doses utilisées. Afin de savoir si les activités de ces produits insecticides différaient statistiquement ou pas, un test d'analyse de la variance a été réalisé.

Le tableau 4 ci-dessous présente les résultats de l'analyse de la variance de la mortalité par rapport au traitement, à la concentration et à leurs interactions.

Tableau 4. Analyse de la variance de la mortalité selon le traitement; la concentration et leurs interactions

	dl	SC	MC	F	P	Decision
Ord.Orig.	1	74000,02	74000,02	35488,46	0,000000	Hs
Traitement	5	33093,87	6618,77	3174,19	0,000000	Hs
Concentration	2	29691,37	14845,69	7119,60	0,000000	Hs
traitement*concentration	10	13639,07	1363,91	654,09	0,000000	Hs
traitement*repetitions	10	30,19	3,02	1,45	0,230527	Ns
concentration*repetitions	4	6,52	1,63	0,78	0,550387	Ns
Erreur	20	41,70	2,09			
Total	51	76522,98				

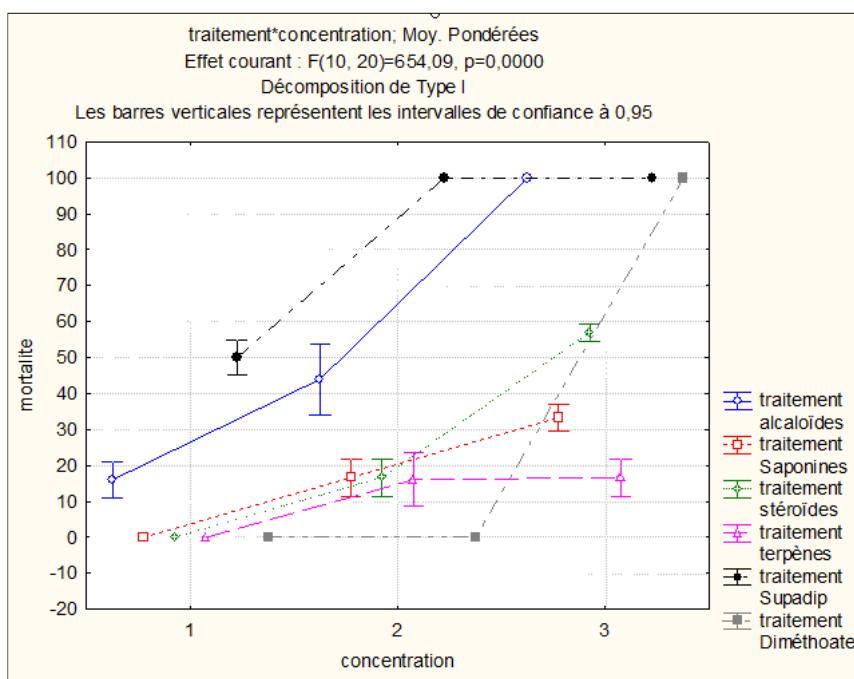
Legend

hs= hautement significatif, ns= non significatif, F= Fischer calculé,

dl= degré de liberté, Probabilité, SC= somme des carrés des écarts, MC= carré moyen, ord.orig= ordonnées à l'origine

Au regard des résultats présentés dans le tableau 4, il s'avère que la mortalité des individus d'*Antestiopsis orbitalis ghesquiere* varie très significativement selon le traitement, la concentration ainsi qu'avec l'interaction des traitements et les concentrations (doses) des substances insecticides testées.

Concernant les solutions à forte dose (0,636g/ml pour les pesticides d'origine végétale et 1ml/l pour les pesticides synthétiques), les alcaloïdes, le Supadip et le Diméthoate présentent une toxicité identique, mais la plus élevée à l'égard d'*Antestiopsis orbitalis ghesquiere* (100% de mortalité), ils sont suivis respectivement des stéroïdes (57% de mortalité), des saponines (33,3%) et enfin des terpènes (16%) (Figure 2). Quant aux solutions à dose moyenne (0,0636g/ml pour les pesticides d'origine végétale et 0,1ml/l pour les pesticides synthétiques), les effets insecticides du Supadip à l'endroit de la punaise du cafier ont été supérieurs à ceux d'autres substances testées (100% de mortalité). Les alcaloïdes viennent en deuxième position (44% de mortalité) et sont suivis de trois autres insecticides d'origine végétale ayant les mêmes effets insecticides dont les stéroïdes les saponines et les terpènes (16,7% de mortalité). A cette dose, le Diméthoate ne présente aucune toxicité sur *Antestiopsis orbitalis ghesquiere* (0% de mortalité) (figure 3). A propos des solutions à faible dose (0,00636g/ml pour les pesticides d'origine végétale et 0,01ml/l pour les pesticides de synthèses), seuls le Supadip et les alcaloïdes se sont révélés toxiques contre la punaise du cafier. Toutefois, l'activité insecticide du Supadip était supérieure à celle des alcaloïdes (respectivement 50% et 16% de mortalité) (figure 4). Particulièrement, pour les insecticides d'origine végétale testés, les résidus d'alcaloïdes semblent être plus actifs que les résidus d'autres extraits des fruits de *Capsicum frutscens L* suivis des stéroïdes puis des saponines et enfin des terpènes.

**Fig 1.Evolution du taux de mortalité corrigée d'*Antestiopsis orbitalis ghesquiere* selon différentes concentrations (doses) des traitements**

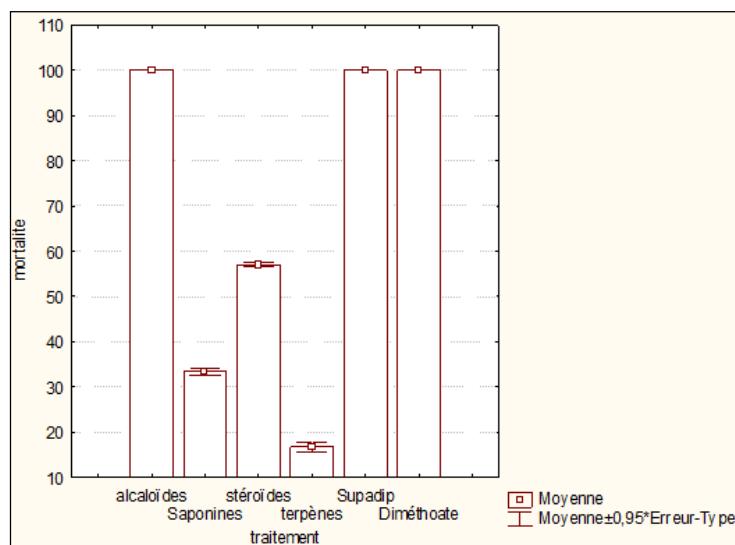


Fig 2. Evolution du taux de mortalité corrigée d'*Antestiopsis orbitalis ghesquiere* selon les solutions à forte dose (concentration 3) des traitements

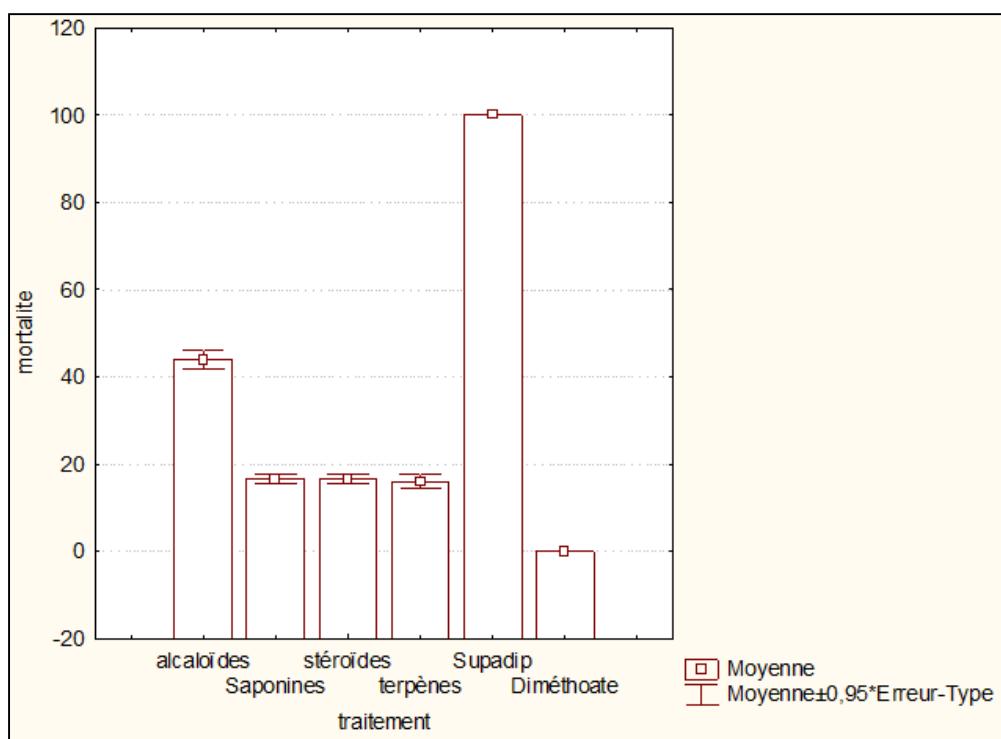


Fig 3. Evolution du taux de mortalité corrigée d'*Antestiopsis orbitalis ghesquiere* selon les solutions à dose moyenne (concentration 2) des traitements

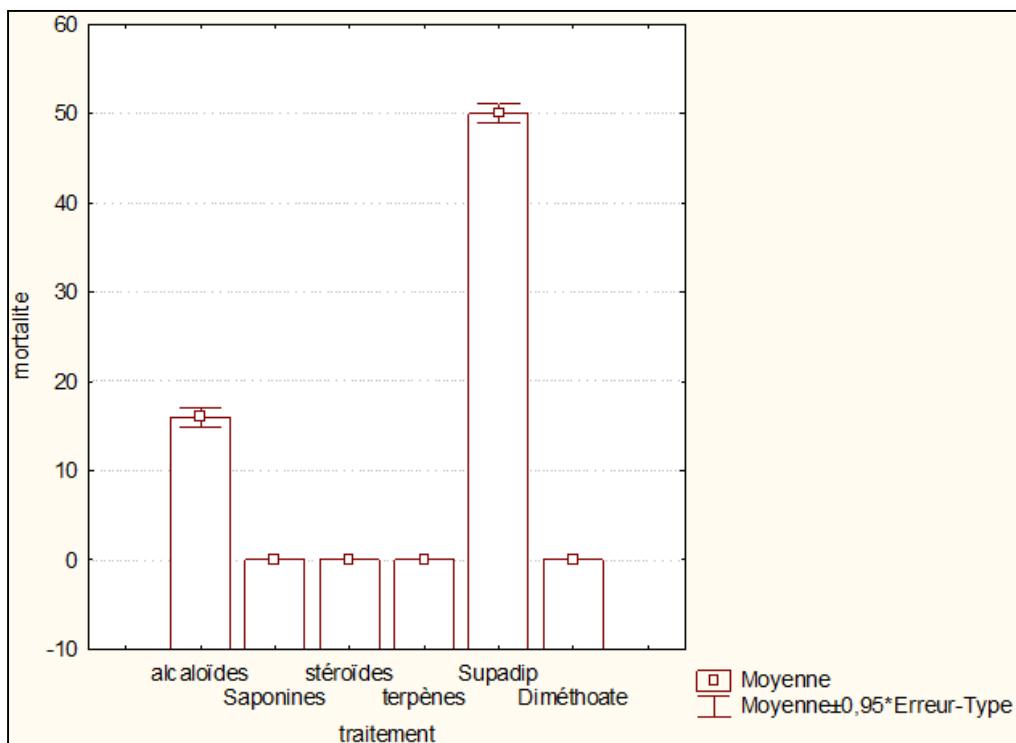


Fig 4. Evolution du taux de mortalité corrigée d'*Antestiopsis orbitalis ghesquierei* selon les solutions à faible dose (concentration 1) des traitements

3.4 DETERMINATION DES DOSES LETALES DL_{50} ET DL_{90} DES SUBSTANCES ORGANIQUES INSECTICIDES EXTRAITES DE *CAPSICUM FRUTESCENS L* ET TESTEES CONTRE *ANTESTIOPSIS ORBITALIS GHESQUIEREI*

Les résultats relatifs aux doses létales des extraits des alcaloïdes, des saponines, des terpènes et stéroïdes sont repris dans le tableau 5 ci-dessous :

Tableau 5. Doses létales (en g/ml, \pm écart-type) des résidus des alcaloïdes, des saponines, des terpènes et stéroïdes extraits des fruits de *Capsicum frutescens L* testés sur *Antestiopsis orbitalis ghesquierei* après 24 heures de contact

Résidus des substances extraites et testées	Doses létales DL_{50}	Doses létales DL_{90}
Alcaloïdes	$0,21 \pm 0,015$	$0,53 \pm 0,008$
Saponines	$0,93 \pm 0,054$	$1,77 \pm 0,092$
Stéroïdes	$0,54 \pm 0,012$	$1,01 \pm 0,019$
Terpènes	$1,70 \pm 0,277$	$3,19 \pm 0,497$

Au regard des résultats présentés dans le tableau 5, il s'avère que les doses létales DL_{50} varient d'une substance organique insecticide à l'autre. Cependant, les alcaloïdes présentent une faible dose létale DL_{50} par rapport aux autres principes actifs des fruits de *Capsicum frutescens L* testés. Cela étant, il s'avère que les alcaloïdes seraient les insecticides d'origine végétale les mieux recommandés pour cette étude dans la lutte contre les individus d'*Antestiopsis orbitalis ghesquierei*, insectes ravageurs des cafériers du fait qu'un bon insecticide de contact devrait réagir efficacement à faible dose.

4 DISCUSSION

Le tableau 2 signale une forte présence des alcaloïdes, des phénols, des flavonoïdes, des terpènes, des stéroïdes, des caroténoïdes et des lipoïdes; la présence moyenne des saponines et enfin la faible présence des tanins, des quinones ainsi que des glucosides dans les fruits de *Capsicum frutescens L*. Cette présence quoiqu'elle soit forte, moyenne ou faible confirme la vertu thérapeutique de *Capsicum frutescens L* [38], [39], [40], [41], [42], [43], [44], [45], ainsi que le pouvoir répulsif affiché par les poudres des fruits de *Capsicum frutescens L* à l'égard de certains insectes nuisibles aux cultures

comme *Callosobruchus maculatus* F [46], [47] et [48], *Rhyzopertha ominica* L [49], *Sitophilus zeamaïs* Motsch et *Tribolium castaneum* (Herbst) [50], [51].

Les résultats relatifs à la présence des alcaloïdes, flavonoïdes et stéroïdes dans la présente étude sont conformes à ceux obtenus par [30], [52], [53], [54], [55] ainsi que [20]. Quant aux phénols, ces résultats sont similaires à ceux trouvés par [55].

La présence moyenne des saponines dans les fruits de *Capsicum frutescens* L concorde avec les résultats des études réalisées par [56], [57], [45], [58] ainsi que [59].

La faible présence des tanins ainsi constatée, est analogue aux résultats de l'étude menée par [60].

En plus de la présence des alcaloïdes, flavonoïdes, stéroïdes, saponines et tanins ci-haut évoquée dont les recherches réalisées par nos prédecesseurs ont également révélées, la présente étude signale la présence des terpènes, des stéroïdes, des caroténoïdes, des lipoïdes, des quinones et des glucosides dans les fruits de *Capsicum frutescens* L cultivé dans la région de Kabare Nord. Ces substances organiques constituent de nouvelles sources potentielles de contrôle des insectes ravageurs des cultures ou des denrées stockées.

Les résultats présentés dans le tableau 3 et la figure 1 montrent qu'à l'exception du témoin négatif (eau distillée), toutes les substances insecticides testées ont été différemment actives contre *Antestiopsis orbitalis ghesquierei* proportionnellement aux doses utilisées. Selon les résultats contenus dans le tableau 4, il s'avère que la mortalité des individus de la punaise du caféier varie très significativement selon le traitement, la concentration ainsi qu'avec l'interaction des traitements et les concentrations des substances insecticides testées.

En général, l'activité insecticide de Supadip a été supérieure à celle de tous les autres produits insecticides testés respectivement aux doses faible équivalente à 0,01ml/l (figure 4) et moyenne d'ordre de 0,1ml/l (figure 3). Par contre à la dose forte d'ordre de 0,636mg/ml, les alcaloïdes extraits de *Capsicum frutescens* L ont un effet similaire à celui des insecticides industriels Supadip et Diméthoate (mortalité équivalente à 100%). Les stéroïdes quant à eux, ont une mortalité de 57 % à la forte dose (0,636g/ml) ; tandis que les saponines et les terpènes avaient un effet minimal (mortalité respective de 33,3% et 16 %) à ladite forte dose (figure 2). Le Supadip a été plus actif que les autres insecticides pour toutes les doses utilisées, il a été suivi des alcaloïdes. A propos des insecticides d'origine végétale testés, les résidus d'alcaloïdes ($DL_{50} = 0,21 \pm 0,015$ g/ml : voir tableau 5) semblent être plus actifs que les résidus d'autres extraits des fruits de *Capsicum frutescens* L suivi des stéroïdes ($DL_{50} = 0,54 \pm 0,012$ g/ml : voir tableau 5) puis des saponines ($DL_{50} = 0,93 \pm 0,054$ g/ml : voir tableau 5) et enfin des terpènes ($DL_{50} = 1,70 \pm 0,277$ g/ml : voir tableau 5). L'activité insecticide remarquable des alcaloïdes a été également observée chez *Bemisia tabaci* [20] et chez *Callosobruchus maculatus* [13]. Quant aux stéroïdes et terpènes extraits de *Capsicum frutescens* L, leur activité insecticide signalée dans ce travail a été aussi constatée chez *Acanthoscelides obtectus* pour les stéroïdes et terpènes extraits respectivement de *Haumaniastrum galeopsifolium*, *Chenopodium ugandae*, *Occimum gratissimum*, *Artemisia annua* et *Tagetes minuta* [61]. L'effet toxique de saponines extraites de *Capsicum frutescens* L a aussi été observé chez *Bemisia tabaci* [20], chez *Ostrinia nubilalis* [62] et chez *Callosobruchus chinensis* [63]. Comme tout invertébré exposé aux substances naturelles extraites des plantes, la mortalité observée chez *Antestiopsis orbitalis ghesquierei* serait due à la toxicité induite par les alcaloïdes, les stéroïdes, saponines et les terpènes [49], [64] et [51].

Compte tenu de l'efficacité des alcaloïdes extraits de *Capsicum frutescens* L à l'égard d'*Antestiopsis orbitalis ghesquierei* tant pour les doses forte (0,636 g/ml) et moyenne (0,0636 g/ml) que pour la faible dose (0,00636 g/ml), vu que les insecticides naturels sont facilement disponibles et leurs préparations ne coûtent presque rien contrairement aux insecticides de synthèse, de plus étant donné que les produits naturels ne sont généralement pas toxiques pour les êtres humains et se dégradent rapidement dans l'environnement [26], il serait nécessaire d'utiliser les alcaloïdes extraits de *Capsicum frutescens* L dans la lutte contre la punaise du caféier comme substances alternatives aux pesticides synthétiques pollueurs de l'environnement.

5 CONCLUSION

La présente étude avait pour objectif d'évaluer les effets insecticides des alcaloïdes, saponines, terpènes, les stéroïdes extraits de *Capsicum frutescens* L sur *Antestiopsis orbitalis ghesquierei*, insectes ravageurs des cafiers.

Au terme des investigations il a été constaté ce qui suit :

- Le pré-test d'activité insecticide a indiqué que comparativement au témoin à blanc, tous les extraits totaux (aqueux et éthanoliques) ont présenté après 24 heures de contact une activité insecticide à l'égard d'*Antestiopsis orbitalis ghesquierei* (100% de mortalité).

- Le screening phytochimique a révélé que les alcaloïdes, les phénols, les flavonoïdes, les terpènes, les stéroïdes, les caroténoïdes et les lipoïdes sont fortement présents dans les fruits de *Capsicum frutscens L*; les saponines sont moyennement présentes dans les fruits de *Capsicum frutscens L* et enfin les tanins, les quinones et les glucosides sont faiblement présents dans les fruits de *Capsicum frutscens L*.
- Le test d'activité insecticide réalisé à base des alcaloïdes, saponines, terpènes et stéroïdes extraits de *Capsicum frutscens L* ainsi que les pesticides de synthèse (Supadip et Diméthoate) dénotent que la mortalité des individus d'*Antestiopsis orbitalis ghesquiere* varie très significativement selon le traitement, la concentration (dose) ainsi qu'avec l'interaction des traitements et les concentrations des substances insecticides testées. Globalement, à l'exception du témoin négatif (eau), l'activité insecticide de Supadip a été supérieure à celle de tous les autres produits insecticides testés respectivement aux doses faible d'ordre de 0,01ml/l et moyenne équivalente à 0,1ml/l. Par contre à la dose forte (0,636mg/l), les alcaloïdes extraits de *Capsicum frutescens L* ont un effet similaire à celui des insecticides industriels Supadip et Diméthoate (mortalité équivalente à 100%). Les stéroïdes quant à eux, ont une mortalité de 57 % à la forte dose (0,636g/ml); tandis que les saponines et les terpènes avaient un effet minimal (mortalité respective de 33,3% et 16 %) à ladite forte dose.
- Les doses létales DL₅₀ varient d'un insecticide d'origine végétale à l'autre. Cependant, les alcaloïdes présentent une faible dose létale DL₅₀ par rapport aux autres principes actifs extraits des fruits de *Capsicum frutescens L* et testés sur la punaise du cafier.

Tenant compte de ce qui précède et étant donné la nécessité de contribuer à l'atténuation de la pollution de l'environnement due aux pesticides synthétiques, les alcaloïdes extraits de *Capsicum frutescens L* seraient recommandés comme insecticides alternatifs aux pesticides de synthèse pollueurs de l'environnement dans la lutte contre *Antestiopsis orbitalis ghesquierei*, insectes ravageurs des cafiers du fait qu'un bon insecticide de contact devrait réagir efficacement à faible dose.

Dans l'optique de compléter cette étude, il serait intéressant de mener les études similaires sur les autres insectes ravageurs des cafiers ainsi que les organismes non cibles.

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Les causes de disparition de la flore ligneuse de la région de Katana, Kabare, Sud-Kivu, RDC

[The causes of woody flora disappearance in Katana region, Kabare, South-Kivu, DRC]

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ABSTRACT: A research has been made in Katana area in order to know the causes of woody flora disappearance in the occidental part of Kivu Lake in the Democratic Republic of Congo. Investigation method and free observations helped us on the ground. The obtained results confirmed that the woody flora have been damaged by human activities. 100% of population from the area has agreed the flora damage. Agriculture takes the first place as the cause of woody flora disappearance about 36% followed by the research of the live embers and firewood which takes 20%, building is concerned about 17%; sawmill about 15% and the brickworks take 12%.

KEYWORDS: Causes, Woody flora, Disappearance, Katana region.

RÉSUMÉ: Une étude a été menée dans la région de Katana dans le but de déterminer les causes de disparition de la flore ligneuse sur cette partie occidentale du lac Kivu en République Démocratique du Congo. Les méthodes d'enquête et d'observation libre nous ont servi sur terrain. Les résultats obtenus nous ont confirmé que la diversité floristique ligneuse connaît une pression par les activités anthropogéniques. 100% de la population enquêtée confirment la dégradation de cette flore. L'agriculture occupe le premier rang soit 36% comme activité étant à la base de disparition de la flore ligneuse suivie de la recherche des braises et bois de chauffe qui occupe 20%, la construction en est responsable à 17% , la scierie 15% et l'activité de briqueterie qui en est responsable à 12%.

MOTS-CLEFS: Causes, Disparition, Flore ligneuse, Région de Katana.

1 INTRODUCTION

Les problèmes liés à la gestion de l'environnement et plus particulièrement à la déforestation constituent des défis majeurs qui se posent au monde face aux problèmes de réchauffement climatique [1]. L'exploitation illégale du bois joue également un rôle important dans la déforestation. Et l'Europe a une forte responsabilité dans cette dégradation puisque près d'un quart de ses importations de bois sont présumées d'origine illégale. La France quant à elle importerait 39 % de bois tropicaux d'origine illégale selon le WWF.

La France est un acteur majeur dans la déforestation tropicale humide primaire notamment en Afrique centrale et en Afrique de l'Ouest [2]. Les recherches du PNUE et d'Interpol soulignent qu'entre 50 et 90 pour cent de l'exploitation forestière dans les pays tropicaux clés du bassin de l'Amazone, d'Afrique centrale et d'Asie du Sud-Est, est le fait du crime organisé. Le déboisement détruit également les sols, rendant les terres improductives, particulièrement en zones tropicales et les exposant au lessivage, source d'inondations. De plus, les forêts jouent un rôle essentiel dans le cycle de l'eau, qu'elles stockent et régulent.

Des données globales indiquent que le rythme de la déforestation annuelle mondiale qui se chiffrait à 8,868 millions d'hectares entre 1990 et 2000 est évalué en 2007 à 13 millions d'hectares par an en tant que résultat de la conversion sur les terres agricoles [3]. D'après [4], la biomasse fournit 13% de la consommation énergétique du monde et constitue la plus importante source d'énergie pour les pays en développement et principalement d'Afrique. Les espèces de la flore ligneuse sont soumises à une pression conjuguée de différents acteurs, notamment les briquetiers, les producteurs des braises, les marchants des sticks d'échafaudage et autres chasseurs des bois d'énergie [5].

De plus, les forêts abritent de nombreux points chauds de biodiversité et jouent un rôle prépondérant dans la fixation du CO₂ que nous émettons massivement et qui perturbe dangereusement notre climat : 40% du carbone terrestre est stocké dans la végétation et les sols des forêts. En 2005, les forêts couvraient 30% de la surface terrestre et renfermaient plus de la moitié du carbone accumulé par les écosystèmes terrestres, soit plus de mille milliards de tonnes de carbone. Toutes les forêts sont des réservoirs de carbone : elles retiennent le carbone à la fois dans la biomasse vivante et morte, dans les matières organiques en décomposition et dans les sols.

Ce sont les processus de photosynthèse, de respiration, de transpiration, de décomposition et de combustion qui entretiennent la circulation naturelle du carbone entre la forêt et l'atmosphère. Ce mode de fonctionnement dynamique des écosystèmes forestiers leur permet de recycler le carbone. Ils jouent donc un rôle important dans le cycle mondial du carbone : lorsque le stock de carbone augmente, le flux net de l'atmosphère vers l'écosystème forestier est positif et on parle alors de puits de carbone ; dans l'autre sens, on parle de source de carbone.

Il y a 4 siècles, 2/3 des terres étaient recouvertes de forêt, aujourd'hui, seulement un tiers.

D'après les conclusions d'une enquête mondiale par télédétection, la superficie totale des forêts du monde totalisait 3,69 milliards d'hectares en 2005, soit 30 pour cent de la superficie mondiale. Malheureusement, selon le World Resources Institute, 80% de la couverture forestière mondiale originelle a été abattue ou dégradée, essentiellement au cours des 30 dernières années.

Le but de ce travail est d'étudier les causes qui sont responsables de disparition de la flore ligneuse à Katana afin de prévenir les dégradations environnementales sur cette partie occidentale du lac Kivu en République Démocratique du Congo. Il fournira en plus des bases l'éducation écologique dans la gestion durable et rationnelle de la flore du milieu.

2 MILIEU D'ETUDE

La région de katana se situe sur la rive occidentale du lac Kivu entre 2°et 2°30'de latitude sud et 28°30'et 29°de latitude Est. Elle est inclue dans le Territoire de Kabare, province du Sud Kivu en République Démocratique du Congo et se situe à 40km au Nord de la ville de Bukavu. Le relief de la côte occidentale du lac Kivu est en général caractérisé par l'alternance des collines, de larges dépressions fermées ou des vallées qui empêchent l'écoulement de l'eau et qui facilitent la rétention ainsi que l'accumulation de l'humidité excédante des nombreux marais où prédomine une végétation de *Cyperus latifolius*. Cette région fait partie de hautes terres de l'Est de la RD Congo, son relief est dans son ensemble marqué par des mouvements tectoniques qui ont affecté l'Afrique Orientale. Le relief côtier se présente avec une côte très découpée et caractérisée par d'étroites baies, des presqu'îles comme Kadjucu et Bugarura/Cifinjo de Kabamba au bord du lac Kivu. Le climat de notre région d'étude est fortement marqué par l'altitude, l'proximité du lac, les températures y sont fraîches partout. La moyenne annuelle varie entre 18° et 20° avec une faible amplitude thermique d'1°C [6]. Cette région bénéficie d'énormes quantités d'eau de pluie et comprend deux saisons à savoir :la saison de pluie qui est très longue allant de septembre à mai avec des pluies suffisantes toute l'année d'une moyenne supérieure à 1500mm et la saison sèche qui est très courte se situant entre les mois de juin et aout. La démographie galopante et les activités anthropiques influencent la dégradation de la biodiversité dans la région.

3 METHODOLOGIE

3.1 ENQUÊTE SUR TERRAIN

Des enquêtes basées sur les interrogations directes qui portent sur les causes de disparition de la flore ligneuse de Katana ont eu lieu sur cette zone située à la côte occidentale du lac Kivu en République Démocratique du Congo (RDC). Ainsi, un questionnaire d'enquête a été élaboré et soumis à la population se trouvant dans sept villages (kahungu, kabushwa, Katana centre, Kabamba centre, Mwanda, kadjucu et Cegera) choisis au hasard dans la région d'étude, avec des questions ouvertes, traduites et expliquées en langue locale pour faciliter la compréhension et la communication entre enquêteurs et enquêtés. Les réponses fournies par nos enquêtés étaient écrites sur fiches moyennant des crayons.

3.2 COLLECTE ET TRAITEMENT DES DONNÉES

Les données recueillies sur terrain ont été collectées sur les fiches d'enquête pour être dépouillées au Laboratoire de Gestion des Ressources Naturelles (GRN) au Département d'Environnement du Centre de Recherche en Sciences Naturelles (CRSN-LWIRO). Chaque question a été interprétée sur l'ensemble de tous les sites choisis dans la région. Le pourcentage a été calculé par la formule :

$$P = \frac{N.E \times 100}{T.E}$$

Où P= pourcentage

N.E= nombre d'enquêtés et

T.E= total des enquêtés.

Les logiciels Word et Excel nous ont servi à analyser et traiter les données pour ensuite passer à leurs interprétations et discussions.

4 RESULTATS

Pour accéder aux données, nous sommes passés dans sept villages de la région d'étude et la répartition de nos enquêtés est consigné dans le tableau 1.

Tableau 1. Répartition des enquêtés par village et par sexe

Nombre d'enquêtés par village								
Sexe	kahungu	kabushwa	Katana centre	Kabamba centre	Mwanda	Kadjucu	Cegera	total
M	49	29	72	54	43	25	56	328
F	48	48	103	67	62	39	68	435
Total	97	77	175	121	105	64	124	763

M= personne de sexe masculin, F= personne de sexe féminin.

Le tableau ci-haut nous renseigne que, sur 763 personnes enquêtées dans la région de Katana dont 435 femmes et 328 hommes tous répartis dans sept villages dont : Kahungu 97 personnes échantillonées (48 femmes et 49 hommes), pour Kabushwa 77 personnes (48 femmes et 29 hommes), pour Katana centre 175 personnes (103 femmes et 72 hommes), pour Kabamba centre 121 personnes (67 femmes et 54 hommes), pour le village Mwanda 105 personnes (62 femmes et 43 hommes), pour Kadjucu 64 personnes (39 femmes et 25 hommes) et pour le village Cegera 124 personnes enquêtées (68 femmes et 56 hommes). Dans l'ensemble des sites d'étude, la population qui a constaté la disparition de la flore ligneuse dans la région de Katana est consignée dans la figure 1 ci-dessous :

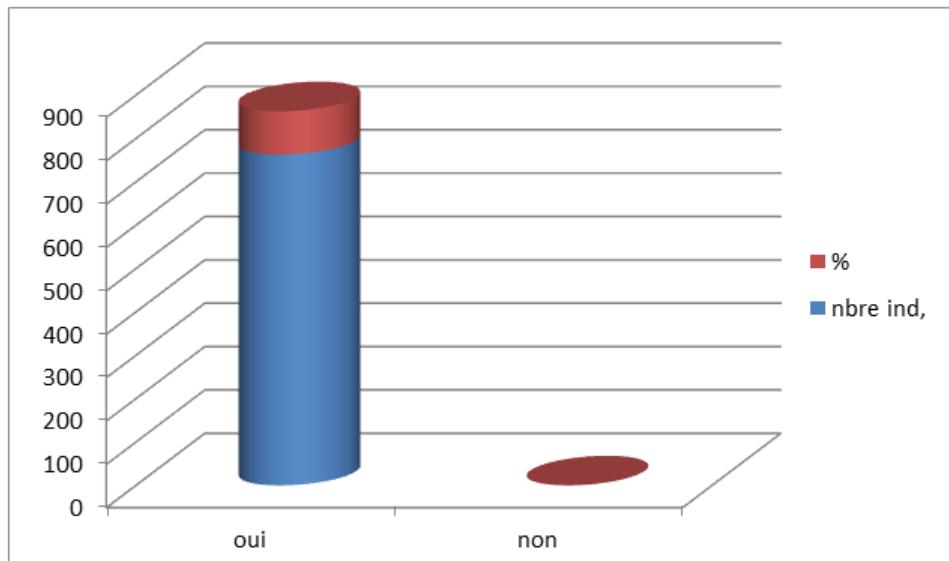


Figure 1. Population qui a constaté la dégradation de la flore ligneuse dans la région de Katana

Il ressort de ce graphique que 100 pourcent de la population enquêtée (763/763) ont répondu avoir constaté la disparition de la flore ligneuse dans la région d'étude et zéro pourcent a répondu n'avoir pas constaté la dégradation de cette ressource. La dégradation de cette ressource floristique est due aux activités anthropiques exercées sur cette contrée. La figure 2 nous précise les activités humaines qui sont à la base de disparition de la flore ligneuse dans la zone d'étude.

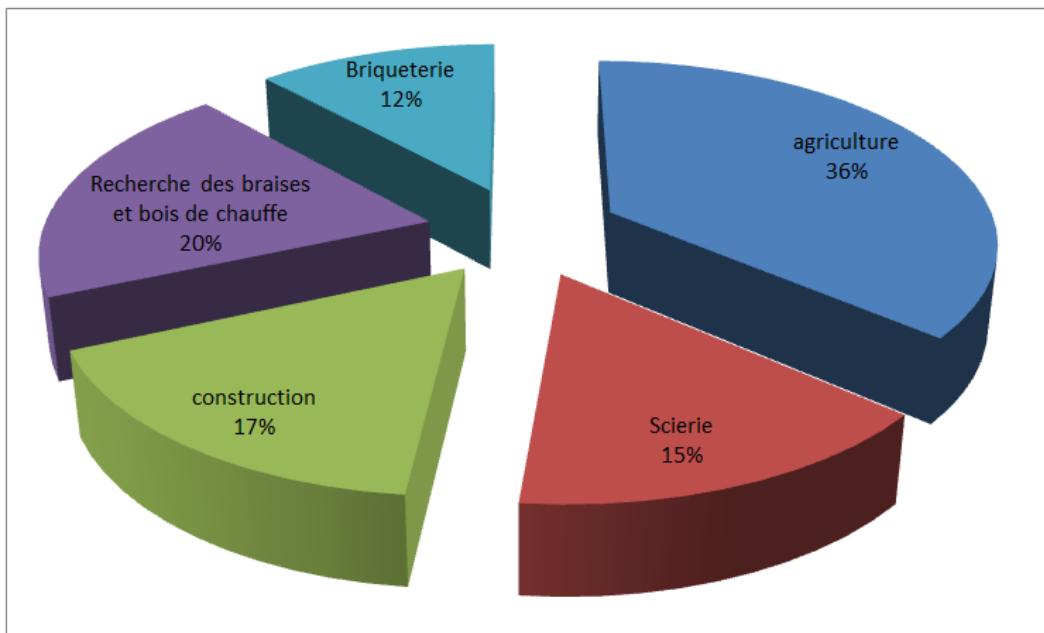
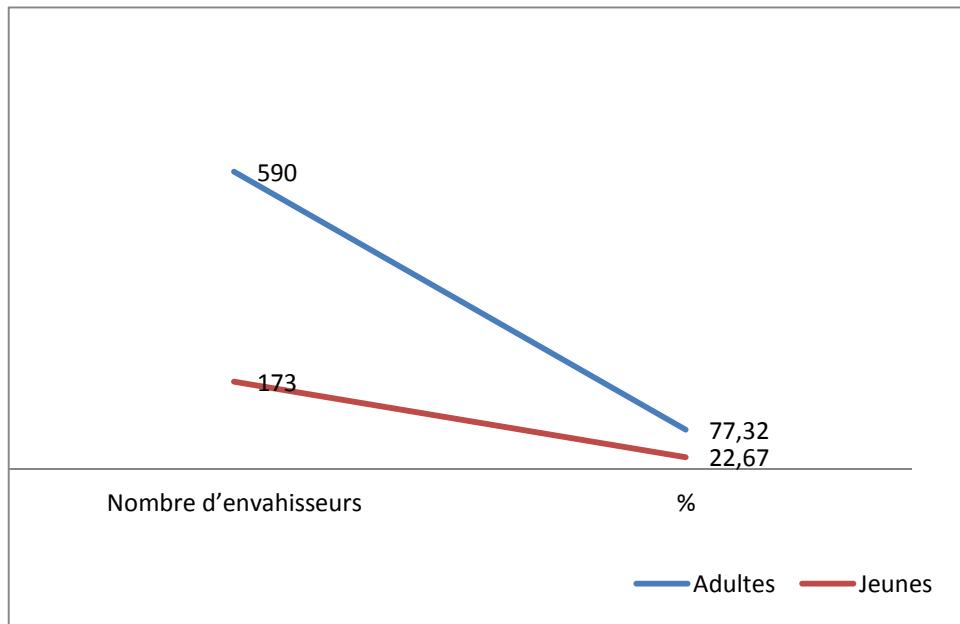


Figure 2. Les activités anthropiques responsables de disparition de la flore ligneuse dans la région de Katana.

Cette figure nous montre que l'agriculture occupe le premier rang soit 36% comme activité étant à la base de disparition de la flore ligneuse suivie de la recherche des braises et bois de chauffe qui occupe 20%, la construction qui en est responsable à 17%, la scierie 15% et l'activité de briquetterie qui en est responsable à 12%.

Les catégories de la population qui font plus de pressions sur la diversité floristique ligneuse à Katana sont consignées dans le graphique 1 ci-dessous :

Graphique1. catégorie de la population qui envahit plus les espèces de la flore ligneuse.



Il ressort de ce graphique que, sur un total de 768 individus enquêtés, les personnes adultes envahissent plus les essences ligneuses de la région d'étude car 590 enquêtés l'ont affirmé soit 77,32% par rapport aux jeunes qui sont reconnus comme envahisseurs de cette flore à 22,67%, affirmé par 173 enquêtés de notre échantillon. La figure 3 nous présente les destructeurs de la végétation de la région par rapport au sexe.

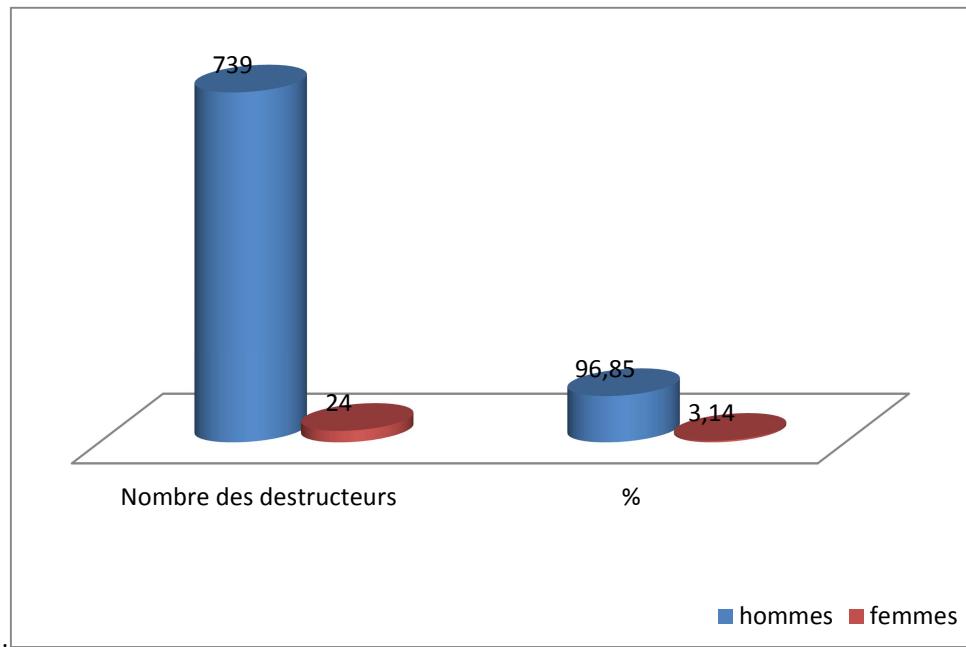


Figure 3 : destruction de la végétation par rapport au sexe

La figure 3 nous montre que les hommes sont les grands destructeurs de la végétation ligneuse car 739 enquêtés soit 96,85% le confirment et 24 enquêtés soit 3,14% seulement affirment que les femmes détruisent cette végétation. Les effets de la déforestation de la flore ligneuse dans la région de Katana sont présentés dans la figure 4 ci-dessous :

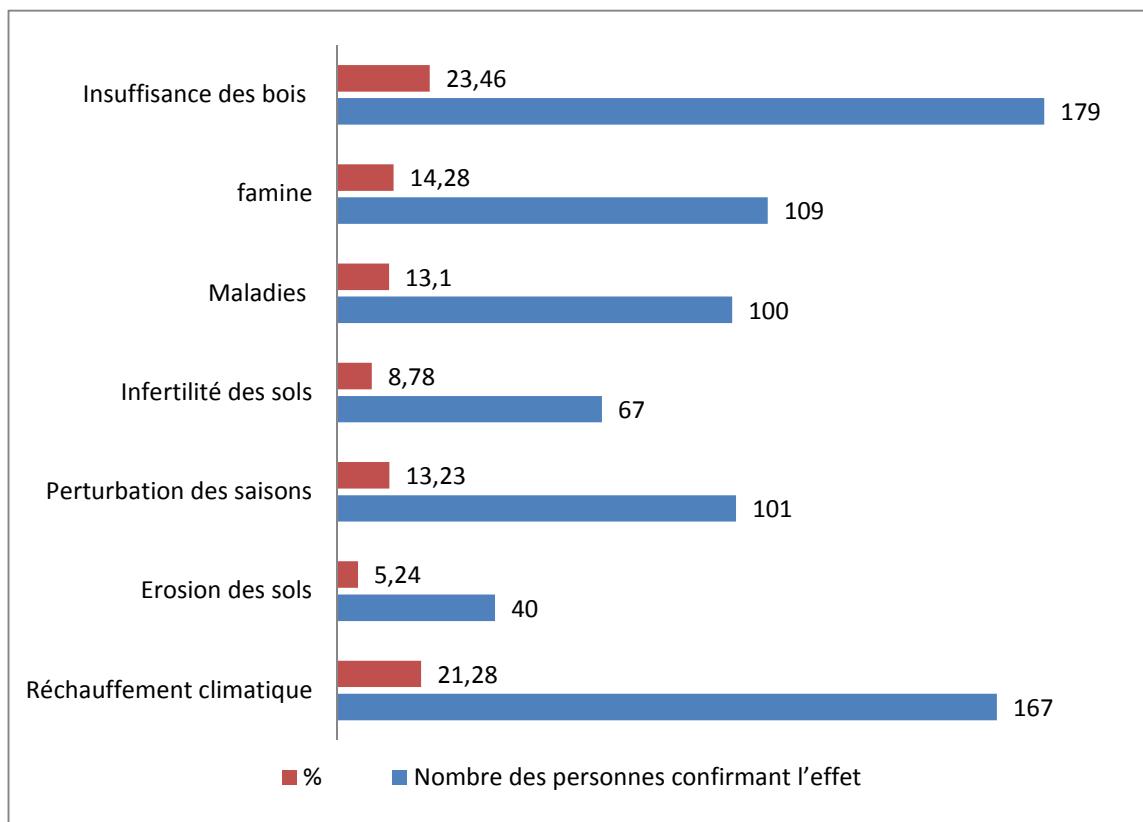


Figure 4 : Les effets de la déforestation dans la région de Katana.

Cette figure nous renseigne que l'insuffisance des bois de chauffe est un effet de la déforestation remarquée dans la région car affirmée par 179 individus soit 23,46%, le réchauffement climatique reconnu par 167 enquêtés soit 21,28% comme effet de la déforestation, 109 personnes soit 14,28% reconnaissent la famine comme effet de la déforestation, 101 personnes soit 13,23% enquêtés affirment que la perturbation des saisons est un effet de la déforestation observée, 100 individus soit 13,10% reconnaissent les maladies comme effet de la déforestation, 67 personnes soit 8,78% affirment que l'infertilité des sols est un effet de la déforestation et 40 personnes soit 5,25% reconnaissent que l'érosion des sols est un effet de la déforestation observée dans la région de katana.

Tableau 2. Reconnaissance du service de réglementation sur l'exploitation des espèces de la flore ligneuse.

Existence	Effectif	%
Oui	546	71,55
Non	217	28,44
Total	763	100

Ce tableau montre que 546 soit 71,55% de nos enquêtés ont affirmé reconnaître l'existence du service de réglementation de la flore tandis que 217 enquêtés soit 28,44% l'ont nié.

5 DISCUSSIONS

Nous référant aux résultats du tableau 1 et de la figure 1 et 2, Selon [7], le foret a régressé de 36% à 25% entre 1997 à 2001, quand il a mené son étude sur l'efficacité de la réduction de pollution par le marais : cas de Ciranga et Kabamba dans le bassin Ouest du lac kivu. La destruction des habitats forestiers pour de nombreuses espèces facilite la transmission des maladies infectieuses à l'homme, par le contact affirmé avec les moustiques, singes, rongeurs porteurs de virus ou de bactéries potentiellement dangereux pour l'homme. Tel a été le cas de l'apparition des maladies tropicales comme le paludisme, la fièvre Ebola, voire le Sida [8].

Les recherches de [9] et celles de [10] ont montré aussi que plus de 25% des maladies dues aux problèmes de dégradation de l'environnement et plus de 80% du reste des maladies qui menacent la population sont indirectement associées. Le paludisme, les helminthes, les infections respiratoires, la grippe, la schistosomiase, la dysenterie bacillaire, l'hépatite, la tuberculose, la rougeole et la méningite sont des maladies liées à l'état de l'environnement [11], [12], [13], [14], [15].

Il existe des impacts d'un changement climatique sur la forêt, [10] affirment que la forêt est un lieu d'échange d'énergie, d'eau, de chaleur et de composés chimiques. Elle est donc un élément important de la machine climatique. Il est connu depuis longtemps que le CO₂ (la fertilisation carbonique) a une influence sur la physiologie des arbres. Ceux-ci se transforment par photosynthèse en carbone organique et, associé à une augmentation de la température et de la durée de la période de croissance, cela semble expliquer par exemple que les épicéas et les hêtres du Nord de la France grandissent aujourd'hui nettement plus vite qu'au XIX^e siècle. L'augmentation de la concentration en CO₂ résultant de l'activité humaine peut donc être profitable aux forêts si l'arbre est en bonne santé et si ces autres besoins sont disponibles. Cela est confirmé par des études dendro-écologiques montrant que la croissance radiale des arbres a augmenté depuis une centaine d'années. Même si toutes les causes expliquant la croissance ne semblent pas encore suffisamment comprises et notamment celles qui pourraient expliquer qu'au-delà d'un certain seuil climatique, la productivité pourra baisser.

La perturbation des saisons et le réchauffement climatique sont parmi les effets de disparition de la flore ligneuse de la région d'étude, [16] affirme que depuis un peu plus de 150 ans, l'utilisation des combustibles fossiles est largement responsable de l'augmentation d'environ un tiers de la concentration en gaz carbonique (CO₂) qui joue un rôle majeur dans ce que l'on appelle « *l'effet de serre additionnel* ». Ce gaz n'est pas le seul en cause : la teneur en méthane (CH₄) a plus que doublé, sur la même période, essentiellement à cause du développement de l'agriculture (fermentation anaérobie des ruminants, riziculture inondée...) et une bonne part de l'accroissement d'environ 15 % de la teneur en protoxyde d'azote (N₂O) s'explique par la combustion des combustibles fossiles, ainsi que par la fertilisation azotée des sols.

Pour estimer l'évolution possible du climat sous l'effet de l'augmentation des GES, les physiciens de l'atmosphère et les climatologues utilisent des Modèles de Circulation Générale (MCG, appelés aussi GCM suivant l'abréviation anglophone) permettant de simuler « au mieux » le fonctionnement de l'atmosphère et l'évolution possible des paramètres du climat en fonction de divers scénarios d'évolution sociale et économique de la population mondiale qui emmènera les GES additionnels dans le futur. Dans ce travail, il sera fait allusion, suivant les exemples présentés, aux scénarios d'évolution les plus couramment utilisés par le *Groupe d'experts Intergouvernemental sur l'Evolution du Climat* (GIEC, connu aussi sous l'abréviation anglophone de « IPCC »). Soit du plus optimiste vers le plus pessimiste, en terme de rejets de GES pour le XXI^e siècle, les scénarios GÉRARD BELTRANDO 18

Suivants : B1 (+ 1,8°C de différence moyenne entre la fin du XX et la fin du XXI^e siècle), B2 (+ 2,4°C), A1B (+ 2,8°C), A2 (+ 3,4°C).

[17] donne le bilan en chiffres quant en ce qui concerne la disparition de la flore ligneuse en disant que les forêts tropicales couvraient au début du XIX^e siècle dans le monde une superficie de 16 millions de km² environ. Aujourd'hui, moins de la moitié subsiste. Chaque année, la déforestation fait disparaître quelque 13 millions d'hectares de forêts dans le monde. Néanmoins, le taux de perte nette de forêts ralentit grâce aux nouvelles plantations et à l'expansion naturelle des forêts existantes. Entre 2000 et 2005, ces pertes se sont élevées à 7,3 millions d'hectares/an, soit une superficie équivalant à la Sierra Leone ou à Panama. Ce chiffre correspond quand même à une perte nette annuelle de 0,18 % des forêts du monde. Au rythme de destruction actuel, les enfants qui naissent au début du XXI^e siècle devraient assister avant la fin de leur vie à la disparition totale des forêts primaires du monde, à l'exception de rares espaces difficilement accessibles. Ces forêts primaires, c'est-à-dire, les moins anthropisées, sont dans la situation la plus critique car, au rythme de déforestation actuel, elles auront disparu en Afrique dans 10 ans, en Asie du Sud-Est dans 15 ans et en Amazonie dans 40 ans maximum. Concernant la forêt amazonienne, on estime sa perte de superficie à près de 5 millions d'hectares par an et, à ce rythme, les études scientifiques ne garantissent pas le cycle de vingt-cinq à trente ans nécessaires pour sa régénération [18].

6 CONCLUSION ET RECOMMANDATIONS

Les activités anthropiques influencent la dégradation et la disparition de la biodiversité ligneuse dans la région. En effet, à l'issue de la présente étude ; l'agriculture, la recherche des braises et bois de chauffe, la construction, la scierie et l'activité de briqueterie sont les principales causes de disparition de cette flore.

Le reboisement et la gestion durable de la flore ligneuse représenteraient une petite partie de la solution à la lutte contre le changement climatique et autres effets de la déforestation cités dans le présent travail, pour réduire rapidement le problème de l'effet de serre. Ces solutions recouvrent trois grandes tendances pour la gestion rationnelle des ressources de la flore ligneuse que nous offre l'environnement de la région :

- préservation : cesser de détruire la flore du monde (en particulier celles qui sont le plus menacées aujourd’hui, les forêts tropicales), c'est limiter les émissions dues à la déforestation, protéger les forêts contre les incendies (car, lorsque la forêt brûle, elle rejette du dioxyde de carbone, CO₂) ;
- exploitation durable : avoir des pratiques d'exploitation durables à impact limité, améliorer la valorisation des déchets forestiers (par exemple les utiliser comme matières combustibles ou biocarburants) ; valoriser le bois coupé et ne pas le brûler sur place.
- plantation : boiser, reboiser et remettre en état des terres dégradées, c'est capter du carbone, c'est donc réduire les émissions.

Une gestion durable des forêts peut devenir un outil important (même s'il n'est pas suffisant) de la lutte contre le changement climatique.

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In vitro activity of imipenem combination with colistin or rifampicin against clinical isolates of *Acinetobacter baumannii* and his antimicrobial susceptibility profil

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ABSTRACT: *Background:* *Acinetobacter baumannii* (*A. baumannii*) is one of the most important nosocomial pathogens, Increasing resistance coupled with the fact that few novel antibiotics are currently available or in the pipeline, leaves patients and physicians with a very limited armamentarium against these pathogens. Combination therapies are considered as effective options to overcome this matter. *Materials and methods:* Fifty *A. baumannii* isolates were collected from clinical specimens, from patients in ICU at Ibn Sina Hospital in Rabat, Morocco during the January 2011– January 2012 period. Antimicrobial susceptibilities to amikacin, ceftazidime, ciprofloxacin, amoxicillin-clavulanic-acid and imipenem were determined by disk diffusion and the E-test method was used to determine antimicrobial susceptibility and the MIC for colistin, imipenem, rifampicin and for the combinations tests. *Results:* 76% of *A. baumannii* isolates were MDR to antibiotics (amoxicilline + clavulanic acid, imipenem, ciprofloxacin, amikacin, ceftazidim, rifampicin) unless colistin. 100%, 26%, and 14% of isolates were susceptible to colistin, imipenem, and rifampicin, respectively. The MIC50 and MIC90 of imipenem were 24 μ g/ml and >32 μ g/ respectively. The MIC50 and MIC90 of rifampicin were 4 μ g/ml and 6 μ g/ml, respectively. Imipenem associated with rifampin or with colistin and imipenem alone had the percentages of the rate sensitivity; 28%, 28% and 26%, respectively. *Conclusion:* the findings of this study indicate that colistin has the best activity against *A. baumannii*, whereas imipenem in combination with colistin or rifampicin still a good choice to treat nosocomial infections due to multiresistant *A.baumannii*.

KEYWORDS: Imipenem, colistin, rifampicin, combination, *Acinetobacter baumannii*.

1 INTRODUCTION

Acinetobacter baumannii (*A. baumannii*) is one of the most important nosocomial pathogens because of its longevity in the hospital environment and ability to resist various antimicrobial agents, such as resistance to broad-spectrum B-lactam antibiotics by B-lactamases production [1]; he has emerged in the last decades as a major cause of healthcare-associated infections and nosocomial outbreaks. [2]

The incidence of multidrug-resistant (MDR) *A. baumannii* is increasing worldwide, including Europe, North America, Latin America, and Asia. [3]

MDR *A. baumannii* is a rapidly emerging pathogen in healthcare settings, where it causes infections that include bacteremia, pneumonia, meningitis, and urinary tract and wound infections. Antimicrobial resistance poses great limits for therapeutic options in infected patients, especially if the isolates are resistant to the carbapenems. [2]

Increasing resistance coupled with the fact that few novel antibiotics are currently available or in the pipeline, leaves patients and physicians with a very limited armamentarium against these pathogens. [4]

Combination therapies are considered as effective options to overcome this matter.

Colistin (also called polymyxin E) belongs to the polymyxin group of antibiotics [5]. Colistin is a bactericidal drug that binds to lipopolysaccharides and phospholipids in the outer cell membrane of Gram-negative bacteria. It competitively displaces divalent cations from the phosphate groups of membrane lipids, which leads to disruption of the outer cell membrane, leakage of intracellular contents, and bacterial death. [6] [7] [34]

Imipenem is a beta-lactam antibiotic derived from thienamycin with broad spectrum activity used, in combination with colistin, to treat various infections. Classified as a carbapenem antibiotic. [9]

Rifampicin is a bactericidal antibiotic drug of the rifamycin group. It is a semisynthetic compound derived from streptomyces spp that is used as a first line drug for the treatment of tuberculosis worldwide. [10]

Antimicrobial agents such as imipenem, colistin and rifampicin have been used for *A. baumannii* treatment. [3] [11]

However, colistin-resistant and imipenem-resistant *A. baumannii* have emerged and these isolates are often multidrug-resistant. [3] [12] [8]

This is why the combination therapies are considered as effective options to overcome this problem of multiresistance.

The aim of this study was to determine the in vitro activity of colistin, imipenem, and rifampicin alone and in double combinations against *A. baumannii* isolated from patients at Ibn Sina Hospital in Rabat, Morocco.

2 MATERIALS AND METHODS

2.1 BACTERIAL STRAINS

Fifty *A. baumannii* isolates were collected from clinical specimens such as sputum (24), blood (13), urine (11), and pus (2) from patients in ICU at Ibn Sina Hospital in Rabat, Morocco during the January 2011–January 2012 period. Each isolate was collected from a different patient. Bacterial isolation and identification were performed using standard laboratory methods. [13]

2.2 ANTIMICROBIAL SUSCEPTIBILITY TESTING AND MIC DETERMINATION

Antimicrobial susceptibilities to amikacin, ceftazidime, ciprofloxacin, amoxicillin-clavulanic-acid and imipenem were determined by disk diffusion as recommended by the Clinical and Laboratory Standards Institute (CLSI) guidelines. [14]

The E-test method was used to determine antimicrobial susceptibility and the MIC.

Colistin: susceptible $\leq 2 \mu\text{g/ml}$, resistant $\geq 4 \mu\text{g/ml}$; imipenem: susceptible $\leq 4 \mu\text{g/ml}$, resistant $\geq 16 \mu\text{g/ml}$; rifampicin: susceptible $\leq 2 \mu\text{g/ml}$, low-level resistant 4–8 $\mu\text{g/ml}$ and high-level resistant $\geq 256 \mu\text{g/ml}$ (CLSI, 2011).

A reference strain of Escherichia coli (E. coli) was used as a control strain.

2.3 ANTIMICROBIAL COMBINATION TESTING

The antimicrobial combination tests were made by the E-test method.

E-test strips of the two antimicrobial agents have been placed at an angle of 90 ° on a Mueller Hinton agar plate inoculated with a strain of *A. baumannii*.

The MIC combination is the inhibition area of each antimicrobial agent cutting the E-test strip.

3 RESULTS

3.1 ANTIMICROBIAL SUSCEPTIBILITY

Our study indicates that 76% of *A. baumannii* isolates were MDR to antibiotics (amoxicilline + clavulanic acid, imepenem, ciprofloxacin, amikacin, ceftazidim, rifampicin) unless colistin.

Among all the antimicrobial agents tested, 100%, 26%, and 14% of isolates were susceptible to colistin, imipenem, and rifampicin, respectively. The antimicrobial susceptibility of 50 *A. baumannii* isolates against three antimicrobial agents is shown in Table 1.

Table 1: Antimicrobial susceptibility of 50 *A. baumannii* isolates against Colistin, Imipenem, Rifampicin

Antimicrobial agents	Number of susceptible strains	Rate sensitivity (%)	MIC50	MIC90
Colistin	50	100	0.75	2
Imipenem	13	26	24	>32
Rifampicin	7	14	4	6

The MIC50 and MIC90 values of these three antimicrobial agents showed that all isolates were susceptible to colistin; it had the highest antimicrobial activity (100%).

The MIC50 and MIC90 of imipenem were 24 μ g/ml and >32 μ g/ respectively. The MIC50 and MIC90 of rifampicin were 4 μ g/ml and 6 μ g/ml, respectively.

ANTIMICROBIAL COMBINATION

The effects of combinations of antimicrobial agents; colistin, imipenem and rifampicin against *A. baumannii* isolates are shown in Table 2.

Table2: Effects of combinations of antimicrobial agents against fifty *A.baumannii*

Antimicrobial agents	Number of susceptible strains	Rate sensitivity (%)	MIC50
Imipenem	13	26	24
Imipenem+Colistin	14	28	16
Imipenem+Rifampicin	14	28	12

Imipenem associated with rifampin or with colistin and imipenem alone showed remarkable activity against MDR isolates; the percentages of the rate sensitivity was 28%, 28% and 26%, respectively. The results demonstrated that the combination of imipenem and rifampicin reduced the MIC50 of imipenem from 24 to 12 μ g/ml, and the combination of imipenem and colistin from 24 to 16 μ g/ml.

4 DISCUSSION

This study reveals that colistin has a very higher activity against *A. baumannii* rate (100%) than imipenem or rifampicin (Table1).

The same result was obtained from a study done at the University Hospital of Chiang Mai in northern Thailand where it was indicated that colistin has a higher antibacterial activity against *A.baumannii* than imipenem (of 132 isolates of *A. baumannii*, 96% and 64% were susceptible to colistin and imipenem, respectively). [15] .

Another study was done at Songklanagarind Hospital in Songkhla Province, confirmed that the Also, the study made in the clinics and intensive care units of Uludağ University Medical School showed that in all studied *A. baumannii* strains ,

susceptibility to colistin was determined to be 100% with E-test methods. [16]

Monotherapy based on Colistin showed the problem of nephrotoxicity, neurotoxicity, and a problem of resistance in Gram-negative bacteria. [17] [18]

When colistin is administered to patients with a history of chronic renal failure, in this case, nephrotoxicity presents a major health problem. [19]

In order to prevent the emergence of resistance to colistin during processing and to reduce the effect of nephrotoxicity, colistin combination therapy may be beneficial.

Our results indicate that 76% of isolates of *A. baumannii* was MDR and 100% of isolates were susceptible to colistin. At roughly the same result was found in China, Greece and Turkey which showed that 84% of isolates of *A. baumannii* strains were MDR and 100% of these strains were susceptible to colistin. [20] [21] [22]

This indicates that the colistin was an effective antimicrobial agent against MDR and non-MDR *A. baumannii*.

Imipenem has generally been used in *A. baumannii* treatment [12]. Our data also affirm that imipenem are good choice for the eradication of *A. baumannii* isolates (MIC50=24).

Based on the results of in vitro studies, rifampicin has been proposed as an alternative antimicrobial agent for the treatment of infections due to *A. baumannii*. [23] [24] [25]

While our results show that rifampicin has a low antimicrobial activity against strains of *A. baumannii*, with a rate of sensitivity equal of 14%.

In this study the MIC50 and MIC90 of rifampicin were 4 µg / ml and 6 µg / ml, respectively, to compare results with a study made by GiamarellosBourboulis et al who reported a MIC50 and MIC90 values higher than 2µg/ml. [11]

The problem of multiresistance pushes clinicians to consider a combination antimicrobial therapy as an alternative to treatment of infections due to multidrug *A. baumannii*. The presence of synergy could potentially reduce toxicity and improve outcomes for patients with multiresistant bacteria infection. [26]

The combination of imipenem and colistin decreased the MIC50 of imipenem from 24 to 16 µg / ml, which reflects a positive result of the synergy between the two antimicrobial agents, in contrast to another study in Thailand was found no synergistically to combinations of these two antibiotics. [27] The same result has been proved after an in vitro study of the combination Colistin / Carbapenem that is associated with an improvement in MIC, in the majority of the cases, this improvement has suggests synergistic combination or an additive effect. [28] .

A study found that the synergy rate between colistin and imipenem was 53.8 µg / ml determined by broth microdilution [29] while our study found 28% by the E-test method.

Rifampicin is a hydrophobic antibiotic with a large molecular weight, negatively charged, this makes it unable to effectively penetrate only through the outer bacterial membrane of *A. baumannii*. [30]

To improve the penetration of rifampicin, it is then combined with other antibiotics which can be related to substantial changes in the outer membrane isolates of *A. baumannii*. [31]

The degree of sensitivity and specific mechanism of resistance of different *A. baumannii* isolates, are two parameters can influence the effectiveness of rifampicin when combined with another antimicrobial agent. [30]

In our study the combination of imipenem and rifampicin decreased the MIC50 of imipenem from 24 to 12 µg / ml, which reflects a very positive result of the synergy between the two antimicrobial agents.

Contrary to a study made by Saballs et al which had results which go against the use of a combination rifampicin / imipenem against isolates of *A. baumannii*.[32]

Another study made by Piotr et al confirmed that the use of this combination in the treatment of infections caused by strains of *A. baumannii* with high levels of resistance (MIC> 64 mg / l) is not recommended, by cons, in vitro synergy between rifampicin and imipenem is most likely produced in *A. baumannii* strains with moderate resistance to imipenem (MIC ≤ 64 mg / l). [33]

After all these results we suggest that, in patients suffering from MDR *A. baumannii* nosocomial infection that is not responsive to colistin, the combination of imipenem/colistin or imipenem/rifampicin might be beneficial.

5 CONCLUSION

In conclusion, the findings of this study indicate that colistin has the best activity against *A. baumannii*, whereas imipenem in combination with colistin or rifampicin still a good choice to treat nosocomial infections due to multiresistant *A.baumannii*.

LIST OF ABBREVIATIONS

A. baumannii: *Acinetobacter baumannii*

CLSI: Clinical Laboratory Standards Institute

E.coli: Escherichia Coli

MDR: Multidrug resistance

MIC: Minimum inhibitory concentration

MIC50: Minimum inhibitory concentration that inhibits 50% of bacterial isolates

MIC90: Minimum inhibitory concentration that inhibits 90% of bacterial isolates

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Psychosocial Factors as Determinant of Examination Malpractice among Secondary School Students in Ondo State

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ABSTRACT: This study investigates psychosocial factors as determinant of examination malpractice among secondary schools' students in Ondo State. The study adopted descriptive research design of the survey method. A total of 200 respondents were selected from 5 secondary schools using simple random sampling technique for the study. Four hypotheses were generated. The major instrument utilized for collection of data was a self- constructed questionnaire titled "Students Psychosocial factors on examination malpractice (SPFEM). Chi-square statistics was used to analyze the data collected. All hypotheses were tested at 0.05 level of significance. The findings of the study revealed that there was a significant relationship between psychosocial factors (that environment, self-efficacy, anxiety and parental pressure) and examination malpractice. Based on the findings of the study, it was recommended that guidance programme be organized on study habits and preparation for examination for students in secondary schools.

KEYWORDS: Psycho-Social Factors, Examination Malpractice, Academic Cheating, Anxiety, self-efficacy, environment, intelligence, parental pressure.

1 INTRODUCTION

Examination is the main source through which the knowledge and skills acquired is determined in the school. It is organized in order to evaluate, assess and test the cognitive, affective and psychomotor domains of the learners.

In the past examination were strictly and ethically conducted, but these days there are lapses in the system resulting into examination malpractice among students. Evidence abounds of increasing incident of cheating in examination by students at schools, colleges, which conflict with the core purpose of education (Murdock, Hale and Weber, 2001).

Examination malpractice has been defined by various researchers. According to Fasasi (2008), examination malpractice is any wrong doing before, during or after any examination. Salami (1994) defines examination malpractice as an improper and dishonest act associated with examination with the view of obtaining an unmerited advantage. Omotosho (1990) sees examination malpractice as a dishonest use of position of trust for personal gain. The Centre for Academic Integrity (CAI, 2007) defines examination malpractice as dishonest behavior related to academic achievements that include any form of advantage by one student over the others. Oloruntoba (2002) refers to examination malpractice as all forms of cheating during an examination, which covers the leakage of question papers, provision of answer during an examination and so on.

The issue of examination malpractice has been of most concern to educators, psychologist, parents, government and other agencies that are concern with education in Nigeria. The rate of There is an alarming rate of cheating in examinations of which some psychosocial factors are determinant of this unethical behavior.

The foregoing indicates that examination malpractice is a deliberate act of wrong doing or an unethical behavior employed by an individual to undermine the integrity of an examination and the examination body.

PSYCHOSOCIAL FACTORS

Psychosocial refers to one's psychological development in an interaction with a social environment. Psychosocial factors are psychological and social factors that can influence behaviors. Some of such factors are, anxiety, attitude of learners, environment, low self-efficacy of students, self-concept, peer group influence, parental pressure, the society, the teachers and the government. These factors can influence students' decisions.

Ezezorob, (2003) and Adekale, (2003) ascertained that cheating has perpetrated through the primary to secondary schools and to higher institutions of learning. Adelusi (2008) lamented that examination malpractice is a social menace that has become one of the contemporary issues in all the institutions of learning in the country. Salami (1994) observed that this menace exists in primary, secondary, as well as tertiary institutions.

FACTORS RESPONSIBLE FOR EXAMINATION MALPRACTICE

Many factors had been advanced for the wide spread of examination malpractice in Nigeria. Some of these factors include: lack of self-confidence by students, improper preparation of students for examination by teachers, lack of mastering skills by teachers, overcrowding of the examination hall, encouragement to cheat by parents (Daniel,1998), poor handling of examination materials, and poor supervision.

Others are self-efficacy (Bandura,1986, 1994, 1997), poor study habit, anxiety, lack of motivation and low academic ability (Adeyemi, 2010), interaction with peer who have inclination for cheating, lack of essential facilities in schools such as furniture, and equipment for the conduct of smooth examination thereby giving room for examination malpractice. The fact remains that, Nigeria orientation on education is on high grade intensiveness. Hence, students, parents, school management by all means want to secure employment, while others prefer to manipulate scores to get admitted into higher institution of learning (Oduwaiye, 2004).

PARENT FACTORS

Ojerinde (2002) listed among some causes of examination malpractices to include parental problems, improper home training, defective supervision, inadequate provision of necessary materials for learning which affect the students self-confidence, leading to low level of commitment to study. Thus, the only way for such a student to pass is to cheat during examination in order to satisfy the ambition of their parents, however, resulting into examination malpractice. Many parents want their children to pass out of school with very high grades by all means. Some parents are ready to offer money to the school authority to assist their children during examination. Therefore, pressures from parents have been known to be a cause of cheating by students.

Ijaya (2001) argued that divorce has been a growing menace in the society; the effect of which has serious degenerate children mental development. When parent separate, most of the children will end up being drop-out and become truant. This can cause social menace in the society among the students and their peers. Eventually, most of them would not be able to study well and through this involve in all sort of examination malpractices in school.

STUDENT FACTORS

It is obvious that many students who cheat in examination do so because they lack the ability to achieve their desired goal through their own ability personal efforts. Where certificates serve as the index of educational attainment and examination is the only means of obtaining certificates, the students tends to see examination as a war of survival and cheating as an effective means of winning the war. Olaewe (2003) viewed cheating to be motivated by factors such as pressure to obtain high grades, needs to avoid failure, un-conducive school environment, insufficient time spent in school work and non-condemnatory attitude towards cheating from parents.

A number of empirical studies have shown that there were motives behind examination malpractice among students in schools. McCabe as cited in Olaleye (2006) noted that to get good grades was a primary motive for cheating among students. McCabe and Trevino (1993) found that over 80% students in his sample admitted that the desire to get a good grade is the most frequent reason for this unethical behavior. From a motivational perspective, some students cheat because students perceive from their teachers and parents and other external sources that to get good grade and to do well in school are determinant factors of engaging in cheating behavior Oduwaiye, (2004).

Adeyemi (2010) investigated the relationship between achievement motivation and academic cheating behaviour of some undergraduate students in a Nigeria University. Findings revealed that academic cheating behavior index had significant negative relationship with achievement motivation and all its components. This indicates that students who are high on achievement motivation are less likely to cheat in their academic work because they are high on achievement behavior, whereas, subjects with low achievement motivation are more likely to cheat as they are not willing to strive hard because of their un-willingness to face challenges.

McCabe, Trevino and Butterfly (2001) noted that when students perceive that the ultimate goal of learning is to get good grades, they are more likely to see cheating as an acceptable justifiable behavior. Bandura (1986; 1994; 1997) also outline low self-efficacy as a determinant of examination malpractice. Self- efficacy refers to the knowledge of one's own ability to successfully accomplish a particular task with no need for comparisons with others' ability.

According to Bandura, self-efficacy is a social cognitive theory which states that human achievement depends on interactions between one's behavior, personal factors and environmental conditions.

Thus, academic self- efficacy refers to an individual's belief (conviction) that he can successfully achieve at a designated level on an academic task or attain a specific academic goal is demonstrating high self-efficacy.

Students with higher levels of self-efficacy are more confident in their abilities to achieve their goals and persist more in the face of difficulty; nevertheless, students with low self-efficacy are less confident (Pajares, 1996). Cheating is more likely among students with low academic self- efficacy. Low self-efficacy which is psychological in nature is related to low academic motivation such as lower levels of confidence resulting in poor performance of student (Hale and Weber (2001). Duyilemi (2003) opined that anxiety, lack of confidence and fear of failure contributed to the increasing rate of cheating by students during examination in Nigerian schools.

TEACHERS FACTOR

In his own contribution, Ojerinde (2002) viewed some causes of examination malpractices to include poor teaching methods, teacher lacking subject matter, inadequate teachers textbook, unqualified teachers and teachers inability to cover up the stipulated syllabus for the period been stated before an internal or external examination thereby encouraging examination malpractice. This indicates that the success or failure of any educational programme hinges largely on the adequate availability of well qualified, competent and dedicated teachers.

A teacher is a very significant figure in the school environment where he works and so his attitude to work tends to have significant implications which cannot be dismissed if academic excellence is to be achieved in our educational institutions. It is very clear that teachers' way of thinking and beliefs, guide his/her behavior in decision making in or outside the classroom.

ENVIRONMENTAL FACTOR

This is another factor that basically led students to examination malpractice and misconduct. According to Oluyeba and Daramola (1993), the environmental factor include the crowded nature of the classroom as well as examination halls with few invigilators during examination, poor sitting arrangement, especially where students are sandwiched together in the examination hall, resulting to mass cheating. Location of examination centers in remote areas where accessibility for thorough supervision is poor. Therefore, this study is aimed at determining factors influencing examination malpractice in Ondo State.

2 METHODOLOGY

The study is a descriptive design of the survey type. Questionnaires were administered to collect data from the students on psychosocial factors determinant on examination malpractice among secondary schools' students. The sample for the study consisted of 200 (two hundred) students selected from 5 (five) secondary schools. 40 (forty) students were selected from each of the schools using simple random sampling technique. A self- constructed questionnaire titled "Students Psychological factors and examination malpractices Scale (SPFEMS)" was used to collect data for the study. The instrument was divided into two sections A and B. Section A consists of items that measured the demographic data of the respondents such as name of the school, class, sex, and age. Section B consisted of 25 items which focused on psycho-social factors of examination malpractice. The instrument was subjected to both face and content validity. A pilot testing was carried out on the instrument. The questionnaire was administered on 20 students out of the study sample and outside the area of study. Data collected were analyzed using Cronbach Alpha and a coefficient value of 0.62 was established. The reliability coefficient

of 0.76 was obtained through test-retest method. The items of the instrument were responded to by ticking agree (A) or disagree (D). The psychosocial factors of determinant under this study include students' factors, parents' factors, teachers' factors and environmental factors. Chi-square statistics was employed to analyze the data and hypotheses tested at 0.05 level of significance.

RESEARCH HYPOTHESES

- Ho1: There is no significant influence of students' factors as a determinant of secondary school student's examination malpractice.
- Ho2: There is no significant association between the opinion of students on the influence of teachers factors on examination malpractice.
- Ho3: Parental factors have no significant influence in the involvement of secondary school students' examination malpractice.
- Ho4: Environmental factors have no significant impact on examination malpractice among secondary school students.

METHOD OF DATA COLLECTION

Questionnaires were administered on the 200 students selected for the study. The questionnaires were collected and subjected to statistical analysis.

DATA ANALYSIS

Chi-square was used to analysis the data collected and to determine the significance of the generated hypotheses. The hypotheses were tested at 0.05 level of significance.

3 RESULTS

- Ho1: There is no significant influence of students' factors as a determinant of secondary school student's examination malpractice.

Table 1: Chi-square analysis of the influence of students' factors on examination malpractice of secondary school students.

Variable	No	Df	x2cal	X2crit	P
Student Factors	200	3	15.66	7.81	0.05

Table 1 shows that the calculated value of 15.66 is greater than the critical value of 7.81 at df =3, P>0.05. Therefore, the hypothesis which states that there is no significant relationship between students' factors and examination malpractice is hereby rejected. This indicates that students' factors are determinant of examination malpractices.

- Ho2: There is no significant association between the opinion of students on the influence of teachers factors on examination malpractice.

Table 2: Chi-square analysis of the influence of teachers' factors on examination malpractice among secondary school students.

Variable	No	Df	X2cal	X2crit	P
Teachers factors	200	3	21.12	7.81	0.05

Table 2 shows that the result is significant at 0.05 level df =3 with calculated value of 21.12 which is greater than critical value of 7.81. Since the t-cal is greater than t-crit, the hypothesis which states that there is no significant relationship between teachers factors and examination malpractice among students is hereby rejected. This indicates that teachers encourage their children to cheat during an examination.

Ho3: Parent factors have no significant influence in the involvement of secondary school students' examination malpractice.

Table 3: Analysis of parental factors on examination malpractices of secondary school students.

Variable	No	Df	X2cal	X2crit	P
Parental Factors	200	3	12.76	7.81	0.05

The calculated value of 12.76 is greater than the table value of 7.81 at df =3. This implies that the result is significant at 0.05 level. Therefore, the hypothesis which states that there is no significant relationship between parents' factors and examination malpractice is rejected. This indicates that parents encourage their children to cheat during examination.

Ho4: Environmental factors have no significant impact on examination malpractice among secondary school students.

Table 4: Analysis of impact of environmental factor on examination malpractices of secondary school students.

Variable	No	df	X2cal	X2crit	P
Environmental Factors	200	3	12.62	7.81	0.05

Table 4 indicates that there is significant relationship between environment and examination malpractice at t-cal= 12.62, t-critical= 7.81 at df= 3 ($P < 0.05$). Since the t-calculated is greater than t-critical, the hypotheses of no significant relationship between environment and examination malpractice is hereby rejected. This indicates that a crowded examination hall enables students to be involved in mass cheating.

4 DISCUSSION

The results have established various determinants of examination malpractice among secondary school students in Ondo State. The results established that most students exhibit cheating in examinations to avoid failure while desperate to obtain educational certificates.

Hypothesis one was rejected. This result indicates that student factors have significant influence on examination malpractice. The findings of the study indicates that students' factors such as low cognitive ability, low self-efficacy, lack of motivation, anxiety, attitude to study, poor study habit, peer influence, and other psychological and social factors influence examination malpractice. The study further revealed that improper preparation for examination and fear of failure force students to indulge in cheating during examination. This could happen as a result of negative attitude of students towards learning. This is in agreement with Duyilemi (2003) who affirmed that anxiety, lack of confidence, fear of failure and attitude to learning contribute immensely to the increasing rate of cheating during examination in Nigerian schools. Students engage in one form of examination malpractices or the other because they do not prepare enough to face the demands of examination.

Hypothesis two was rejected. The result revealed that teachers are determinant of examination malpractice. The National Policy on Education (2004) stipulated that no educational system can rise above the quality of its teachers. Thus, the success of any programme depends greatly on the quality of the teachers. A teacher is a very significant figure in the school environment where he works and so his attitude to work tends to have significant implications which cannot be dismissed if academic excellence is to be achieved in our educational institutions. It is very clear that teachers' way of thinking and beliefs guide his/her behavior in decision making in or outside the classroom. The major forms of examination malpractice are exchange of answer scripts, collusion in the examination hall to copy, mass organized cheating involving assistance from teachers and other officials. This finding is in agreement with the findings of Ojerinde (2002) who asserted that the success or failure of any educational programme hinges largely on the adequate availability of well qualified, competent and dedicated teachers.

Table 3 of the study indicated that many students indulge themselves in cheating in an examination because most parents believed that only students that cheat during an examination have high scores, therefore, encourage their children in cheating. Thus, hypothesis three was also rejected. This finding is in consonant with the early finding of Olaleye (2006), Hale and Weber (2001) and Olaewe (2003) that affirmed that parental pressure is a major determinant of examination malpractice.

Hypothesis four was rejected due to the fact that the results on table 4 ascertained the significant relationship that exists between environmental factor and examination malpractices among secondary school students. This result corroborates the finding of Okpala (2006) and Afe, (2001) who affirmed that the important media of realizing the educational objectives is the appropriate teaching\learning environment.

5 CONCLUSION

This study focused on the psycho-social factors as determinant of student examination malpractice. Psychologically, many students who cheat during examinations do so because they lack the ability to achieve their desired goal through their personal efforts.

Based on the results of the finding, examination malpractices are being practice in schools due to some problems facing the students which are: lack of proper preparation for examinations, attitude to study, poor study habits, anxiety, parental pressure, low achievement motivation, and so on. No educational system can rise above the quality of its teachers. . For high quality education, a high level of educated teachers become very important if academic excellence is to be achieved in our educational institutions.

The result has indicated that tendency to cheat during examinations is influenced by psychological factors that are either related to the society, nature of the child, or ambition of the parents. Therefore, the study has established that teachers, parents, students and the environment are factors leading to examination malpractice among secondary school students in Ondo State.

RECOMMENDATIONS

The hope and aspirations of Nigeria in building up a virile, prosperous, self-reliant and stable nation may be utterly negated if cases of examination malpractices are allowed to continue. The following recommendations are suggested at curbing cases of examination malpractices among secondary school students. Final examinations as a means of measuring students' achievement should be stopped, rather, more emphases should be given to the adoption of properly conducted continuous assessment which will discourage the use of a single final test to decide the future of the students.

Parents and communities should train –up their children to imbibe the traditional values of honesty, hard-work, and unrighteousness at home and in schools.

There is need for the provision of Guidance and Counseling service in the schools. Students should be counsel to go into the professions they have abilities for. The counselor should help the students to develop their self-concept, to enable them view themselves as achieves and not as failures. Counsellors should provide adequate guidance to the students mainly on how to prepare and write examinations.

In order to ensure good performance of students, instructional content must be well selected, relevant material must be used and good method must be adopted. Teachers should prepare the students for the examination by teaching all topics and covering the syllabus as much as possible. Teachers, parents, counselors and the government should try as much as possible to motivate students to learn.

Student should develop more positive attitude towards their studies by making sure they attend classes regularly, be punctual at lessons, manage their time appropriately and work hard to achieve success at the expiration of their educational career. Students must have confidence in their abilities to pass through hard work. While choosing career, students should choose subjects they are capable of coping with and stop being influence by peers.

Finally, students need to be remained regularly the consequences of examination malpractice.

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Particulate Emission from Agricultural Waste Fired Boiler

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ABSTRACT: In the current overview paper, particulate emissions from the combustion of agricultural residues are discussed. The influence of operating parameters and fuel quality was investigated. Studies on the mass concentration, number concentration and size distribution of particles emitted from agricultural waste fired boiler are presented. Mass concentrations of particles in the flue gas from small scale combustion appliances reported in the literature to be in the range of 8 - 2095 mg/Nm³, while particle number concentrations in the range of 7.0 x 10⁻² to 1.8 x 10⁸ particles/cm³. The dominating chemical compositions of the particle emissions were Ca followed by K, Mn and Mg. Organic Carbon (OC), Elemental carbon (EC), Elemental emission, Poly-cyclic Aromatic hydrocarbon (PAH) and emission of different size particles (PM<0.1 to PM10) were also reported. Combustion temperature is the most important factor in determining PAH composition.

KEYWORDS: Particulate Matter, Combustion technologies, Fly-ash, Agricultural wastes.

1 INTRODUCTION

Agricultural waste is a kind of agro-waste from agricultural or related industries like bagasse, rice husk, coffee husk, macadamia nuts, palm shell, groundnut shell, coconut shell, cotton waste, briquettes etc. Conversion of agricultural waste is a well established technique for generating heat and power. The impact of this conversion is of wide concern due to its adverse effects on air quality and human health, especially in the many developing countries where agricultural waste is often used in industrial boiler and other heating systems. The emission content more than 350 chemical species, including volatile and semi volatile organics from C₂ to C₂₀, particle-phase organics such as (PAHs), methoxylated phenols, organic and elemental carbon, inorganic species, elements, and carbon-14 [1]. Particulate matter (PM), one of many pollutants emitted from agricultural waste combustion contain organic and elemental carbon or black carbon. There are different characteristics between particles emitted from various sources according to their size, density and emission rate. For example, particulate emission rates of a boiler of a palm oil mill plant equipped with a multi-cyclones particulate arrestor varied from 8.51 g/s to 126 g/s with an average of 44.3±31.6 g/s [2]. Residential wood combustion boiler emits a range of 4-9 g/kg dry fuel of particulate matter (<2.5 μm) and 5-22 g/kg volatile organic compounds. Utilization of high quality wood fuel, such as wood pellets produced from natural, uncontaminated stem wood, would generate the least PM compared to other wood fuel types. The impact of particulate matter on atmosphere is also depends on the size of particulates. It is known that sub-micron-sized particle (e.g., 0.1–1 μm) whether in the form of solid or droplet plays a role to decrease visibility [3]. Exposure to ultra-fine particulates (PM0.01 – PM2.5) could increase the risk of severe respiratory diseases [4]. Control techniques of particle emission also vary according to the types of waste. For example, kaolin can be used for the reduction of the particle

emission from residential combustion of oat grain. However, applying kaolin addition to combustion increases the emissions of acidic gases such as HCl and SO₂ as a side-effect [5].

Many review papers have been published that discussed biomass as a fuel for boiler or on the characteristics of PM emitted from different large scale biomasses combustions [6], [7], [8]. There is not enough report available that describes briefly about characteristics of PM specifically from agricultural wastes sources. The aim of this paper is to analyze the properties of particle emissions of different agricultural waste fired furnaces. In addition size segregated particulate matter emitted from agricultural waste fired boiler found in literature are summarized in this paper.

2 PARTICULATE MATTER

Solid particles and liquid droplets like dust, dirt, and smoke found in air and originate from a variety of anthropogenic and natural sources are called particulate matter (PM). PM is also referred as a pollution of a number of components, including acids (such as nitrates and sulfates), organic chemicals, metals, and soil or dust particles. These elements have adverse effect on human health and also have impacts on climate and precipitation. Size is an important property of particles. Atmospheric particulates can be categorized as suspended particulate matter (SPM), Respirable Suspended Particle (RSP, those found near roadways and dusty industries, are larger than 2.5 micrometers and smaller than 10 micrometers in diameter), fine particle (FP, those found in smoke and haze, diameter of 2.5 micrometer or less), ultrafine particles (UFPs, less than 100 nanometers in diameter) and Soot (impure carbon particles resulting from the incomplete combustion of hydrocarbons).

Particles diameter that are 10 micrometers or smaller are dangerous for human health, because those are the particles that generally pass through the throat and nose and enter directly the lungs. These particles are readily emitted from sources such as forest fires, or they can form when gases emitted from power plants, industries and automobiles react in the air [9]. PM is usually formed from chemical reactions in the atmosphere and through fuel combustion (e.g., motor vehicles, power generation, industrial facilities, residential fire places, wood stoves and agricultural burning). PM has a significant effect on human health. If these particles are inhaled, it may affect the heart and lungs and cause serious health effects. Exposure to PM has been associated with hospital admissions and several serious health effects, including premature death. People with asthma, cardiovascular or lung disease, as well as children and elderly people, are considered to be the most sensitive to the effects of fine particulate matter. Adverse health effects have been associated with exposure to PM over both short periods (such as a day) and longer periods (a year or more). Fine particulate matter is also responsible for environmental effects such as corrosion, soiling, and damage to vegetation and reduced visibility. The main constituents of airborne particulate matter are UFPs. These particulates are occurred both naturally and by artificially. Natural sources of UFPs are hot volcanic lava, ocean spray, and smoke. Manmade sources of UFPs are byproducts, like emissions, from specific processes, combustion reactions, or equipment such as printer toner and automobile exhaust [10], [11]. The main exposure to UFPs is through inhalation. UFPs can easily be inhaled due to its size. Comparing to the behavior of inhaled PM10 and PM2.5, ultrafine particles are deposited in the lungs [12], and also they have the ability to penetrate tissue or to be absorbed directly into the bloodstream. It's therefore not easy to remove from the body and may have serious effect [6]. Exposure to UFPs, even if components are not very toxic, may cause oxidative stress, inflammatory mediator release, and could induce lung disease and other systemic effects [13]. Soot is restricted to the product of the gas-phase combustion process but it is also extended to include the particles that become airborne during pyrolysis which are more properly identified as cokes or chars. Soot is also pyrolysed fuel particles of coal, cenospheres, charred wood, petroleum coke, and so on theorized to be the second largest cause of global warming [14], [15]. Sources of soot is coal burning, internal combustion engines, power plant boilers, hog-fuel boilers, ship boilers, central steam heat boilers, waste incineration, local field burning, house fires, forest fires, fireplaces, furnaces, etc. Soot has also some indoor environment sources such as smoking of plant matter, cooking, oil lamps, candles, quartz/halogen bulbs with settled dust, fireplaces, defective furnaces, etc. Soot those found from ventilation system is capable of darkening surfaces or making particle agglomerates. Long-term exposure to urban air pollution containing soot increases the risk of coronary heart disease, according to a major study published in New England Journal of Medicine in 2007 [12].

2.1 AMBIENT AIR LIMIT OF PM

World Health Organization (WHO) has an Air Quality Guideline (AQG) to achieve air quality that protects human health. WHO encourages every country to consider adopting an increasingly stringent set of standards, tracking progress through the monitoring of emission reductions and declining concentrations of particulate matter. The guideline and interim target (IT) values of the AQG shows the concentrations at which increased mortality responses due to particulate matter air pollution. Fig. 1 shows the current data on PM reported by WHO proposed for annual and daily mean concentrations. Three ITs were

defined since countries may find these ITs particularly helpful to understand progress over time in the process of steadily reducing population exposures to PM [16].

Table 1. Standard particulate matter (Daily average, Yearly average and Allowed no. of exceedence/yr) of different countries according to the WHO guideline (2006)

Name of the country	Allowed no. of exceedence/yr	Daily average	Yearly Average			
	PM 10	PM 2.5($\mu\text{g}/\text{m}^3$)	PM 10 ($\mu\text{g}/\text{m}^3$)	PM2.5 ($\mu\text{g}/\text{m}^3$)	PM 10	PM 2.5 ($\mu\text{g}/\text{m}^3$)
Australia	None	None	None	8	50	25
China	None	None	70	35	150	75
EU	35	None	40	25	50	None
Hong kong	9	9	50	35	100	75
Japan	None	None	None	15	100	35
South Korea	None	None	50	25	100	50
USA	1	None	None	15	150	35
Malaysia	None	None	50	-	150	-
Bangladesh	None	None	150	65	50	15

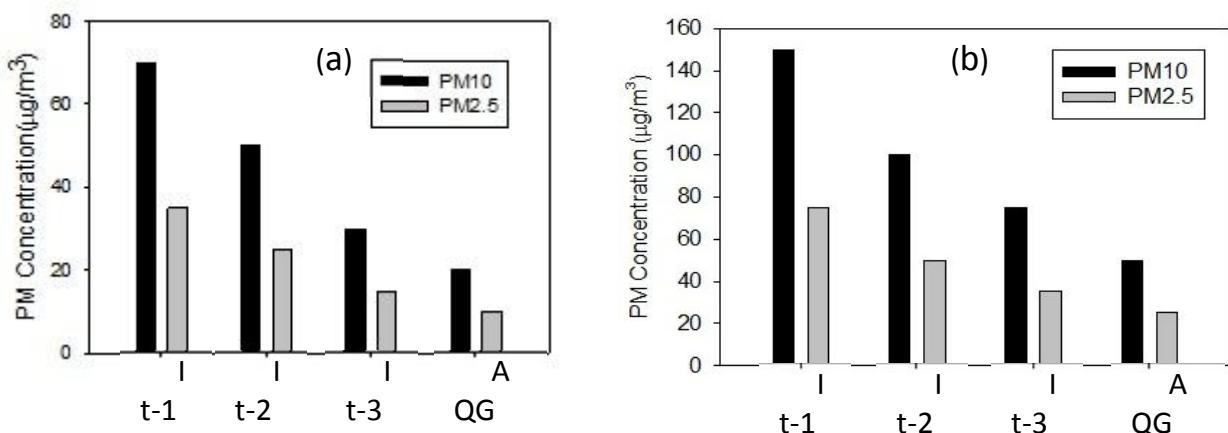


Fig.1. Comparison of PM_{10} and $\text{PM}_{2.5}$ concentration according to WHO air quality guidelines (2006), interim target (IT) and Air Quality Guidelines (AQG). (a) Annual mean concentration, (b) 24 hour concentration

The European Commission and the United States Environmental Protection Agency have revised their air quality standards for particulate matter according to the WHO Air Quality Guideline. Table-1 presents the ambient air quality guidelines adopted by selected countries in the world where recent emphasize is given on PM emission [17].

3 AGRICULTURAL WASTE AS BOILER FUEL

There are large quantities of residues available, associated with agricultural production and processing industries that can be used as a fuel of many industrial boilers. The combustion of these residues in boiler seems to be a promising technique for the future to contribute both the reduction of greenhouse gases and the solution of the waste disposal problems. The use of these renewable wastes becomes popular as sources of energy or an alternative fossil-based feedstock.

Rice husk and straw are the most important agricultural residues in quantity (657,680 million tones per year), amounting to 43% of the total residues. Rice is cultivated in more than 75 countries in the world. Over 97% of the rice husk are generated in the developing countries. The worldwide annual husk output is about 80 million tones. China alone generated some 54 million tones of rice husks every year. Spain generates about 618,000 tones of rice husk per year [18]. Some 4.7 million tones of this agricultural residue are produced in Thailand, which corresponded to 70.5×10^9 MJ of energy potential (as estimated based on the fuel calorific value of 15 MJ/kg). Significant amount of energy, equivalent to about one million tones of crude oil, has been annually recovered from rice husk and used for heat and power generation in Thailand [19].

Coffee is one of the most important agricultural commodities in the world and is the second largest traded commodity after petroleum. After harvesting, coffee cherries are dried to separate the coffee bean from outer skin, pulp, parchment and silver skin. After processing (wet and dry process), the resulting solid waste is collectively termed parchment husks. For every one ton of clean coffee produced, 0.28 tons of parchment husks, 2 tons of pulp would be generated [20]. Spent coffee ground is also a solid residue with fine particle size, high humidity (in the range of 80–85%), organic load, and acidity, obtained during the treatment of raw coffee powder with hot water or steam for instant coffee preparation. Coffee husks have been used as a main feed stock for biomass briquettes in East African region.

The husk and shell of coconut is a good source of charcoal and can be used as fuel in industrial boiler. Activated carbon manufactured from coconut shell is considered extremely effective for the removal of impurities. In Thailand, the coconut husk is used as a potting medium to produce healthy forest tree saplings. The process of husk extraction from the coir bypasses the retting process, using a custom-built coconut husk extractor. In parts of South India, the shell and husk are burned for smoke to repel mosquitoes that seriously pollute the environment.

Peanuts and tamarind are popular food products in many of the Asian countries. Annually, about 25 million tons of peanuts (or about 70% of the world crop) are produced in Asia, whereas some 400 thousand tones of tamarind fruits are produced. As with many other shell-type biomasses exhibiting excellent combustion properties (high reactivity and substantial calorific value), both peanut and tamarind shells can be considered as potential fuels for small-scale heat and power plants.

Palm oil is one of the main agricultural products in some ASEAN countries such as Malaysia and Indonesia. Palm fiber and shell are generated abundantly as waste materials during palm oil extraction process. In Malaysia, for example, 31 million tones of fresh fruit bunch is produced annually and 7 million tones of oil palm empty brunch, 4.5 million tones of fiber and 1.9 million tones of fruit shell are generated as solid wastes. These materials are burned in the mill boiler as fuel to supply energy to the mill on a day to day operation. Some parts of fiber and fruit shell wastes are utilized as boiler fuels for steam generation in some palm oil mills. Palm fruit shell wastes are also utilized as a feedstock of activated carbon. However, these resources have a low calorific value (about half that of petroleum oil) because of a large amount of oxygen functional groups such as -COOH, -OH, etc [21].

Sugarcane has an important potential for the human sustainable development and modernization on a larger scale in developing countries. It also has rich typologies of high energetic content by-products like leaves and tops, bagasse and molasses. Among that bagasse is abundantly generated in the sugar mill process, is used as fuel of combustion boiler. Combustion of bagasse generates heat and power that meet at least the great part of the electricity for the mill. However the potential of bagasse base cogeneration, considering high-efficiency energy production.

3.1 LIMITATION OF AGRICULTURAL WASTE AS FUELS

Large amount of crop residues are produced in the world every year. The amount of crop residues produced in 2001 was estimated at $\sim 0.5 \times 10^9$ Mg/yr in the USA (Table 2) and $\sim 4 \times 10^9$ Mg/yr in the world (Table 3). About 75% of the residues produced, both in the USA and world and elsewhere, is that from cereals (e.g., corn, rice, wheat, sorghum, millet, barley, rye). For example, the data in Table 4 show that rice and rice-based cropping systems produce $\sim 0.6 \times 10^9$ Mg/yr of crop residues in the tropics [22], [23]. Despite the large generation of agricultural residues, their utilization as fuel is still low. For example, in Finland, some 4 million tones of different types of agricultural waste are produced annually and about 2.2 million tones could be potentially collected and used as a source of energy. However, only 15–20% is utilized mainly as cattle and the rest is either ploughed back into the soil or burnt on the field [24]. In Kenya, only 35% of total agricultural residue is used for energy production, mainly bagasse in the sugar processing industries [25]. The uses of agricultural residues also depend on some physical and chemical properties of the residue like Moisture content, Bulk density, Ash content, volatile matter, Pollutant emission etc.

In many cases, the moisture contents of the residues are determined by the process of separating the residues from the crop product. The lower the content of moisture in residue is better as a fuel of boiler. High moisture content is the cause of

poor ignition, reduce the combustion temperature, which in turn hinders the combustion of the reaction products and finally affects the quality of combustion. Densities of agricultural residues have impacts on their processing, transportation, storage and firing. Most agricultural residues have low bulk density that complicates their use as fuel. Ash content of agricultural residues is an important parameter. For the combustion of agricultural residues with high ash contents required efficient ash removal equipment which increase the operation cost. Some agricultural residues content low melting properties of ash due to the presence of potassium oxide that cause of scaling, fouling and corrosion of the heat transfer surface of boiler. Content of high volatile matter in agricultural waste indicates that the residues are easier to ignite and to burn that affect the overall combustion process. It's very important to ensure complete combustion of volatile matter to decrease low emission of CO, hydrocarbon and other hydrocarbons. The other important criteria related to the combustion of agricultural residues are the contents of sulphur, nitrogen, chlorine etc, which are expected to lead the formation of gaseous pollutants.

Table 2. Estimates amount of residues produced in the U.S. in 1991 and 2001

Estimates of Residues (10 ⁶) Mg/yr		
Crop	1991	2001
Cereals	325	367
Legume	58	82
Oil crops	17	20
Sugar crops	25	14
Tubers	5	5
Total	430	488

Table 3. Estimates the amount of residues produced in the World in 1951 and 2001

Estimates of Residues (10 ⁶) Mg/yr		
Crop	1991	2001
Cereals	2563	2802
Legumes	238	305
Oil crops	162	108
Sugar crops	340	373
Tubers	148	170
Total	3448	3758

Table 4. Estimates of crop residues reduction in the rice and rice based cropping system in the tropics and the world

Region	Estimates of Residues (10 ⁶) Mg/yr
Asia	166
Africa	39
South America	55
Sub-Total Tropic	250
World Total	604

4 THERMAL EMISSION PROCESS OF PM

4.1 THERMOCHEMICAL CONVERSION OF AGRICULTURAL FUELS

Inorganic species from agricultural waste exhibit large variations in compositions and amounts, depending on the source of the waste. Using different thermal conversion processes (combustion, pyrolysis, gasification or other) and various technologies (grate furnace, fixed or fluidized bed, entrained flow reactor) give biomass a wide variety of operating conditions with differences in atmosphere, pressure and temperature [26].

4.1.1 COMBUSTION

Combustion is the simplest method in which agricultural waste can be used for energy and has been used for millennia to provide heat include space heating, water heating, steam rising for electricity generation or motive force etc. Combustion has a great variety of phenomena with wide application in industry, the sciences, professions, and home, and the application is based on knowledge of physics, chemistry and mechanics. Major amounts of particulate matter are released to the atmosphere by the combustion of solid wastes. Agricultural waste fuels content atoms in different quantities and some of these too can be oxidized, with the oxide released as gas in the flue gasses, or as solid ash or slag. Other atoms potentially

found in biomass include Nitrogen (N), Phosphorous (P), Potassium (K), Silicon (Si) and Sulphur (S). Some other trace elements such as some heavy and alkali metals may also be present in some agricultural wastes. The features of various combustion methods are shown in Table 5 [27]. Combustion heat is usually used for power generation and heat production by recovering heat through heat transfer devices such as steam and hot water using boilers and heat exchangers.

Table 5. Combustion type and feature of agricultural fuels

Combustion method	Combustion type	Features
Fixed bed combustion	Horizontal grate water cooling grate Dumping grate	Grate is level or sloping. Used in small scale batch furnace for biomass containing little ash.
Moving bed combustion	Forward moving grate, Reserve moving grate	Grate moves gradually and is divided into combustion zone and after combustion zone. Can be applied to wide range of fuels from chip type to block type.
Fluidized bed combustion	Bubbling fluidized bed combustion, Circulation fluidized bed combustion	Used sand for bed mineral, keep fuel and sand in furnace in boiling state with high pressure combustion air. Suitable for high moisture fuel
Rotary hearth furnace combustion	Klin furnace	Used for combustion of high moisture fuel. Restricted to fuel size on its fluidity.
Burner combustion	Burner	Burns wood powder and fine powder

4.1.2 GASIFICATION

Gasification is a form of pyrolysis carried out at high temperatures in order to optimize the gas production. It is also a partial oxidation or partial combustion process whereby a carbon source is broken down resulting in the production of a hot, dirty, low calorific value gas like CO and CO_2+H_2 and possibly methane (CH_4). The resulting gas known as producer gas, consists huge number of particulates including carbon monoxide, hydrogen and methane, together with carbon dioxide and nitrogen. Gasification technology can be used for:

- Heating water in central heating, district
- Heating or process heating application
- Steam for electricity generation
- Internal combustion engine

If the gasification takes place at a relatively low temperature, such as 700 °C to 1000 °C, the product will have a relatively high level of hydrocarbon. This type of gasification is called low temperature gasification. On the contrary, high temperature gasification is (1200 °C to 1600 °C) leads to few hydrocarbons in the product gas, and a higher proportion of CO and H_2 . Gasification methods are classified according to combinations of conditional factors shown in Table 6 [27].

Table 6. Classification of Gasification Method

Classification	Conditional fact
Gassification pressure	Normal pressure (0.1-0.012 MPa), High pressure (0.5-2.5 MPa)
Gassificaton temperature	Low temp (700°C and below), High temp (700°C and above)
Gassification agent	Air, oxygen, steam and combination of them. Carbon dioxide.
Heating	Direct gasification, Indirect gasification.
Gasifier type	Fixed bed, flow bed, circulating flow bed, entrained bed, mixing bed.

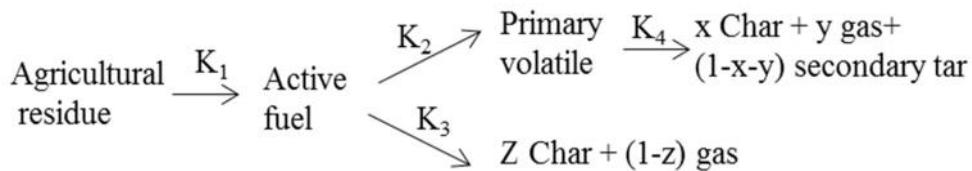
In order to convert solid biomass into inflammable gas, a substance to accelerate the chemical reaction is necessary. This substance is called the gasification agent. Gasification agents mainly include air (N_2 , O_2), oxygen (O_2), water H_2O , or CO_2 are applied as an appropriate mixture.

4.1.3 PYROLYSIS

Agricultural waste fuels are consisted mainly of carbon, hydrogen and oxygen. Pyrolysis is the precursor to gasification, and takes place as part of both gasification and combustion. It is a thermal destruction of organic materials in the absence of oxygen. The products of pyrolysis include liquid (bio-oil or bio-crude), charcoal and non-condensable gasses, acetic acid, acetone and methanol by heating to about 750 K. There are two types of pyrolysis, such as lower temperature pyrolysis (around 400 °C), which produce more solid char (slow pyrolysis) and higher temperature pyrolysis (around 500 °C) that produce much higher proportion of bio-oil. Pyrolysis of wood has been studied as a zonal process. [28]. The main chemical components of agricultural fuels are cellulose, hemicellulose and lignin. The cellulose, hemicellulose and lignin are decomposed by increasing the temperature. Solid residue is char in the yield of 10 to 25%. Thermal degradation properties of hemicelluloses, celluloses and lignin can be summarized as follows, thermal degradation of hemicelluloses > of cellulose > of lignin [29]. Thermal degradation of cellulose occurred through two types of reaction: a gradual degradation, decomposition and charring on heating at lower temperatures: and a rapid volatilization at higher temperatures [30]. The pyrolysis gas contains CO_2 , and CO , H_2 , C_{1-5} hydrocarbon as combustible gas. The char has the higher heating value of 32 MJ/kg, and it is useful as a feedstock for activated carbon.

4.1.4 CARBONIZATION

Carbonization (or carbonisation) is a term for the conversion of an organic substance into carbon or a carbon-containing residue through pyrolysis or destructive distillation. It is often used in organic chemistry with reference to the generation of coal gas and coal tar from raw coal. By carbonization process, charcoal can be obtained as main product by heating such solid fuels as wood, bark, bamboo, rice husks, etc. at 400-600 °C in the almost or complete absence of air or oxygen. In case of discrimination from 'dry distillation' aiming at the recovery and utilization of liquid products, 'charcoal making' is used as the terminology. Carbonization customarily means charcoal making, although it is the general term including dry distillation. The overall scheme of carbonization reaction is represented in Fig 2.

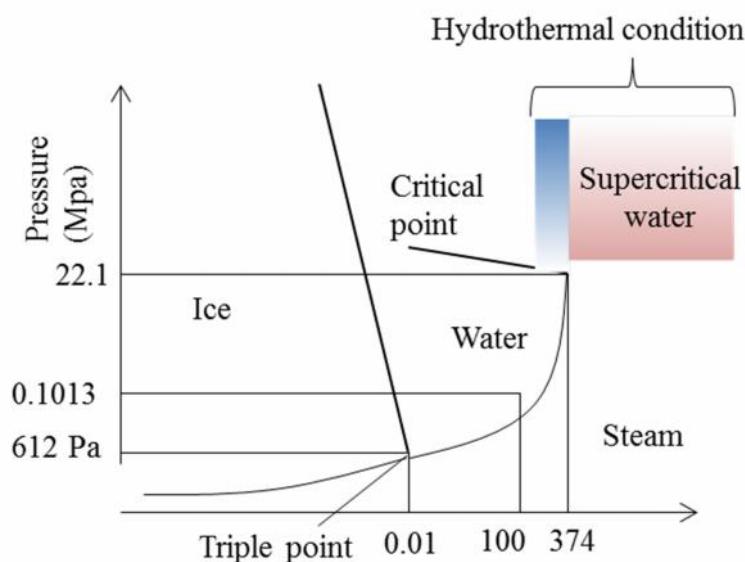
*Fig. 2. Overall carbonization scheme, K_1-K_4 : rate constant; x,y,z : fraction*

4.1.5 HYDROTHERMAL GASIFICATION

Hydrothermal designates an aqueous system at elevated temperatures and pressures. It is a treatment of agricultural residue in hot compressed water, usually above 350 °C and above 20 MPa to obtain combustible gas. Fig 3 shows a phase diagram of water, at which gas-liquid equilibrium line starts from the triple point and ends at the critical point. Hydrothermal condition is found around the critical point. When both temperature and pressure is higher than critical temperature and critical pressure is also high, the state is called supercritical water, gasification in supercritical water is called “supercritical water gasification”. This hot compressed water enjoys high reactivity, and when agricultural fuel is placed in this water, it is gasified by hydrolysis and pyrolysis reactions. This process has multiple stages. In the first stage solid waste converts into gases, then gases are condensed into oils. In the final stage the oil are conditioned and synthesized to produce syngas. Chemical composition and properties of syngas are of different samples are summarized in Table 7 [31].

Table 7. Chemical composition and properties of syngas of different agricultural waste samples

Chemical composition and properties of syngas from different samples.				
	Syngas yield (g)	Hydrogen yield (g)	Energy yield (kJ)	Apparent thermal efficiency (-)
Oil palm	52.4	2.86	685	1.11
Mangrove	47.6	2.48	668	0.91
Paper	38	1.64	411	0.85
Food waste	29.3	1.56	477	0.9
Polystyrene	36.8	3.03	677	0.47

*Fig.3. Phase diagram of water*

4.1.6 HYDROTHERMAL LIQUEFACTION

Hydrothermal liquefaction, which is also referred to as hydropyrolysis, is a thermochemical conversion process in which high temperatures and pressures are used to decompose complex organic material, including biomass. It is a kind of pyrolysis in hot compressed water of around 300 °C and 10 MPa. Since hydrothermal liquefaction proceeds in water, many kinds of reaction can be taken place at different reaction temperatures. Fig. 4 shows the reactions which are occurred in the hot compressed water.

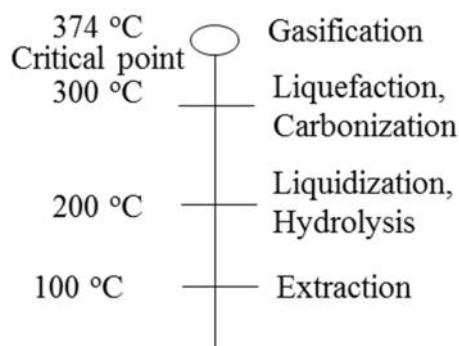


Fig.4. Reaction which occur in the hot-compressed water

4.2 MEASUREMENT TECHNIQUES OF PM

An in-depth epidemiological and toxicological analysis of PM should involve a wide and complete characterization focused on several aspects: (i) physical parameters (dimension, shape, surface area, concentration, etc.), (ii) chemical parameters (chemical composition, surface reactivity, etc.), and (iii) epidemiological parameters (organs or tissues involved, personal subjectivity, assumption rate) [32]. PM can be classified as a function of the aerodynamic equivalent diameter (da), which is defined as the diameter of a unit density sphere having the same terminal settling velocity as the particle in question [33]. Airborne PM presents a diameter da ranging from few nanometers to tens of micrometers. Particles size less than few hundreds of nanometers are better characterized in terms of number concentration rather than mass (or volume) concentration, which is more significant for large particles. The basic method to measure mass concentrations of PM off-line in flue gases is discontinuous gravimetric sampling on quartz or glass fiber filters, which have been in a desiccator or a room with controlled humidity prior to sampling. In the case of continuous measurements of PM₁₀ and PM_{2.5}, Tapered element oscillating micro-balance is a well established instrument. Various analytic methods are used to measure particle number and particle mass distribution. For measurements of mass size distribution, low pressure cascade impactors are frequently used. There are several instruments available for on-line measurements of particle number. Some of these instruments are Scanning mobility particle sizer (size range from few nanometer to 1 μm), Electric low pressure impactor (size range 7 nm to 10 μm), Aerodynamic particle sizer (size range 0.5 μm to ~ 10 μm), Fast mobility particle sizer (size range 5.6nm to 0.56 μm). Fig. 5 shows the most common methods for continuous and discontinuous measurement of particulate emission. In air pollution studies UFPs, PM and PM₁₀ are used to indicate particles with a da smaller than 0.1, 1, 2.5 and 10 μm respectively, whereas the total mass of particulate matter is defined total suspended particulate (TSP).

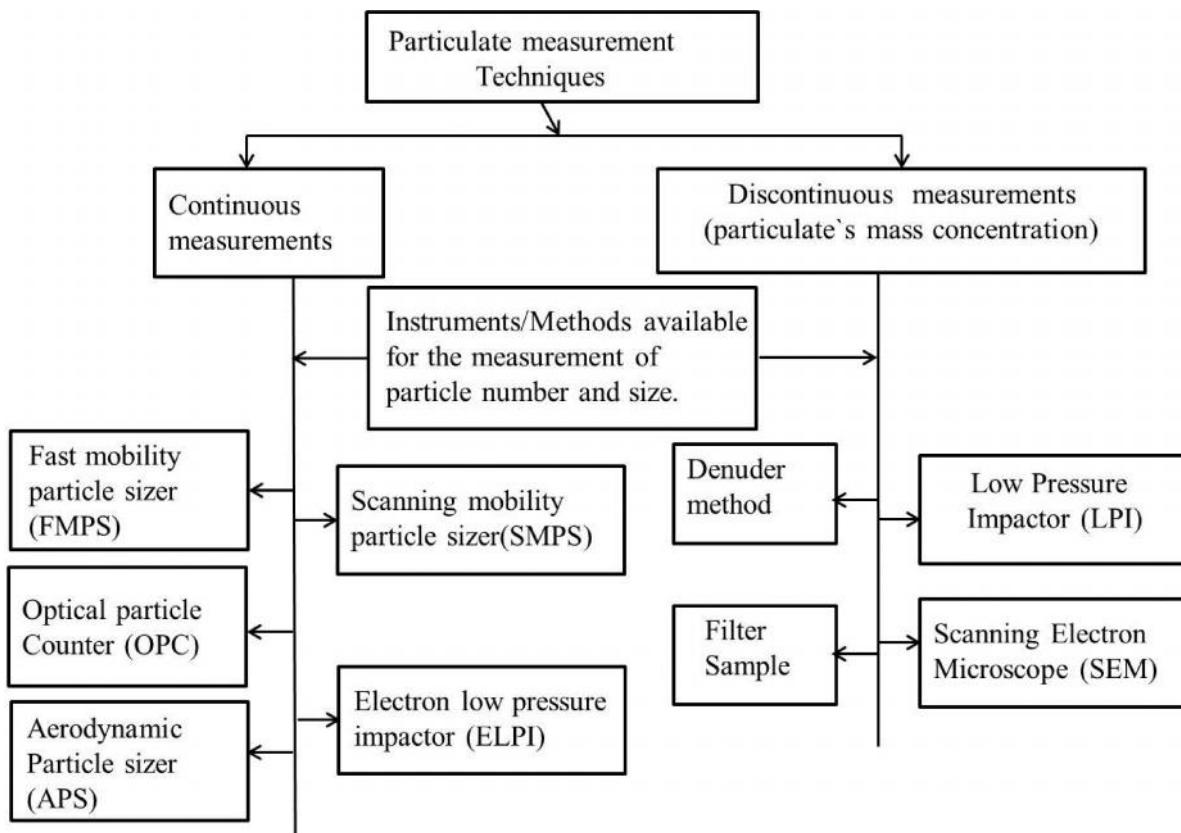


Fig. 5. Flow diagram of the different measurement techniques for particle number size distributions, particle concentration

5 PARTICULATE EMISSION FROM AGRICULTURAL WASTE FIRING BOILER

This Section reviews the findings or results published in the research article available related to the particle emission for agricultural waste fired boiler.

Kaivosoja, et al. [34] had a comparative study on emission and toxicological of fine particles from wood and oil boilers in small (20-25KW) and medium (5-10MW) scale. Aim of their study was to compare four alternatives for providing decentralized energy production in small communities in terms of their flue gas emissions and toxicological properties of the emissions. This experiment showed that the lowest PM emission was 0.1 mg M/J from small-scale light fuel oil combustion. In the case of medium-scale wood combustion, PM emission values from a grate fired wood combustion boiler (10 MW) without particulate filtration were the highest (264 mg M/J). But the value substantially reduced down to 0.6 mg M/J after using an electrostatic precipitator (ESP). From their point of view the heavy fuel combustion was found to be the worst energy production option, because it produced large amount of SO and PAH emissions and its PM₁₂emission contained harmful metals such as vanadium and nickel. They have a proposal to the environmental license or the legislation authority that in the long term, in addition to the emission amounts, also the toxicity of the emissions should be taken into account when regulating the emission limits for the plants.

Guofeng, et al. [7] studied about the Emission factors of parent PAHs, nitrated PAHs and oxygenated PAHs for indoor corn straw burned in a brick cooking stove under different burning conditions. According to their observation, fuel charge size had not much influence on the pollutant emissions, gas-particle partitioning of freshly emitted organics was mainly controlled by the absorption and fuel burning rate, air supply amount, and modified combustion efficiency were the three most significant influencing factors for emission.

Wang, et al. [35] analyzes the behavior of pollutant gas emissions during the firing of wheat straw and coal blends by using thermogravimetric analysis. The emission characteristics of gas pollutants such as HCl, SO₂, CO₂ and NO_x were determined by coupled Fourier transform infrared (FTIR) measurements. Their experimental result revealed that the emissions of HCl, SO₂, CO₂ and NO were closely related to the volatile combustion and char reacting stages. HCl emission was

mainly released during the volatile combustion at the temperature between 220 and 450 °C. The analysis showed that the blended sample with 40% coal and 60% straw by mass produced the lowest levels of HCl, NO_x, and SO₂ gas emission. So they come to an end with a decision that combining the straw and coal can produce better emission control.

Oanh, et al. [36] characterize the properties of PM emission from open burning of rice straw. PM size distribution was measured across 8 size ranges (from <0.4 mm to >9.0 mm). The largest fractions of PM were associated with PM_{2.5}. The most significant components they found were PM_{2.5} and PM₁₀ include water soluble ions and levoglucosan. Relative abundance of some methoxyphenols (e.g., acetylsyringone), PAHs (e.g., fluoranthene and pyrene), organochlorine pesticides also served as additional signatures for the PM emission at their experiment. This study also gives a lesson that the presence of these toxic compounds in PM of burning smoke increases the potential toxic effects of the emission. The emission factor obtained in this study can be used to estimate the emission from rice straw burning in other countries in Asia where comparable conditions exist.

Guofeng, et al. [37] had a field study in rural China to find actual Emission factors (EFs) after combustion of residential wood. In their experiment, they combusted 17 wood fuels and one bamboo in a typical residential stove in rural China to measure the EFs of PM, organic carbon (OC) and elemental carbon (EC), as well as to investigate the influence of fuel properties and combustion conditions on the EFs. Their study explained that Shrubby biomass combustion produced higher EFs than tree woods, and both species had lower EFs than those of indoor crop residue burning. By using a nine-stage cascade impactor, they found that size distributions of PM emitted from tree biomass combustions were unimodal with peaks at a diameter less than 0.4 μm (PM0.4), much finer than the PM from indoor crop residue burning. Approximately 79.4% of the total PM from tree wood combustion was PM with a diameter less than 2.1 μm (PM_{2.1}). PM size distributions for shrubby biomasses were slightly different from those for tree fuels. On the basis of the measured EFs, total emissions of PM, OC, and EC from residential wood combustion in rural China in 2007 were estimated at about 303, 75.7, and 92.0 Gg.

Saidur, et al. [38] reported about the development of a fluidized bed combustor (FBC) for the combustion of Rice husk in a lab scale and observed the PM emission. They used river sand as the bed material. The Fluidized bed was operated at 15–25 kg/h of rice husk feed for various excess air factors (20-100%) and for the different fuel particle sizes. They investigate the effect of fuel feed rate , excess air factor and fuel particle size on the concentration profiles of the major gaseous emissions (CO and CO₂), combustion efficiency , as well as the temperature profiles along the combustor height. By increasing the excess air, the combustion efficiency is decrease due to unburnt carbon and incomplete combustion. The concentration of CO have a maximum value at active combustion zone. Based on CO emission and unburned carbon content in fly ash, the maximum combustion efficiency of the rice husk FBC was found to be 95%.

Johansson, et al. [39] studied particle emissions from an old type wood log boiler, a modern wood boiler and a pellet boiler. Number concentrations and size distributions were measured by ELPI, while mass size distribution done by DLPI. There result revealed that the mass concentration of particles was 180 times higher in old type wood boiler compared to the pellet boiler. They also observed that old type wood log boiler emitted larger number of particles than from wood pellet boiler. So it is important to pay attention to the old type combustion appliances. It was seen from experimental data that the variation in number size distribution was small with maximum around 130 nm (nanometer) from the flue gas of pellet combustion.

Obernberger, et al. [40] investigated particle emissions from a moving grate boiler (440 kW) fired with various agricultural waste such as spruce and bark. Characterization of particle emissions was done on the basis of Berner low pressure impactor. Elemental analysis was done with the combination of SEM/EDX. The mass concentrations of fine particles for spruce were 20 mg/Nm³, while and 60 mg/Nm³ for bark fuel. Particle mass concentrations were dominated by fine mode (PM₁> 90% of PM10) with an aerodynamic diameter between 0.1 μm and 0.5 μm for all cases and was highly correlated with the K, S and Cl content of the fuel.

6 PARTICULATE CHARACTERISTICS

Many studies have been focusing on direct measurement and characterization of particulate emissions from agricultural waste burning district energy systems in order to quantify and explain the levels and parameters affecting the formation of air pollutants. Characterization of particulate matter emitted from firing of agricultural residues has been investigated in this chapter. Parameters concerned in this study are comprised of total number concentration, total mass concentration, chemical composition and particle morphology.

6.1 MASS CONCENTRATION

Table 8 presents the summary of the particle mass concentrations and from various combustion appliances in different agricultural wastes fuels available in the literature [8], [37], [38], [39], [40], [41], [42], [43], [44], [45]. The value of mass concentrations of particles from combustion of different agricultural wastes (rice husk, bagasse, pine pellets, rice straw, willow, forest residues, straw etc.) were found between 8 and 2095 mg/Nm³. The lowest mass concentration was obtained from the bagasse based fuel burner. The highest mass concentrations were reported during the combustion of 12 different types of straw at 18-25MW boiler output. From the mass concentration data, it's been found that particle mass concentrations are affected by both combustion appliances and fuel parameters. The mass concentration increases under unsatisfactory combustion conditions due to particles originating from incomplete combustion. For example, unsatisfactory combustion conditions can be a result of low combustion rate due to high moisture content in the fuel or low excess air ratio. Fig. 6 shows a graphical comparison of the particle mass concentrations against various combustion appliances, it showed that mixer of 12 different types of straw and wood log boilers give higher emissions of particle mass concentrations compared to pellet boilers.

Table 8. Mass concentration of particle emissions from different agricultural waste combustion appliance

Heating appliance	Sample	Thermal Output	Measuring techniques	Fuel/Moisture (m,%)	Mass Concentration(mg/Nm ³)	Ref
Fixed bed combustor (FBC)	Rice husk	-	ELPI	8.5	8	[37]
Fixed bed combustor	Baggase	-	ELPI	14.2	6.5	[37]
Pellet boiler (PB)	Pine Pellet					
		16KW	LPI, TCI	7.3	160	[40]
Pellet boiler	Pine Pellet	11KW	LPI, TCI	7.3	490	[40]
Straw fired boiler (SFB)	Rice straw		Cascade impactor	13.2	502-902	[38]
Fluidized bed combustor (FBC)	Willow	3-5MW	BLPI	55±5	600	[39]
	Wood pellets	2MW	-		57.8-99.1	[43]
Pellet boiler	Wood briquettes	2.5MW	-	25	85	[8]
Pellet boiler	Wood Chips	70KW	-	60	92-107	[45]
-	Wood logs (hard wood)	-	-	-	2000	[45]
Grate fired boiler (GFB)	Swedish forest residues	35MW	DLPI	-	230-320	[44]
Grate fired boiler	Swedish willow	35MW	ELPI	-	530-620	[41]
Lab. Scale boiler	Straw (12 types)	18-25 MW	ELPI	-	75-2095	[42]

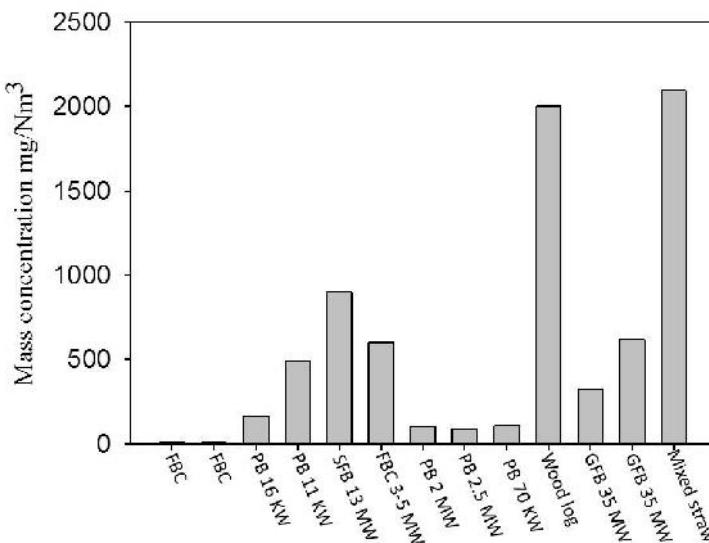


Fig. 6. Comparison of particle mass concentrations against combustion appliances

6.2 NUMBER CONCENTRATION

Combustion of agricultural wastes typically leads to particle emissions dominated by submicron particles, and with unimodal size distributions for number concentrations. Particle number concentrations are related to the particle size. Incomplete combustion produces lower number emissions but larger particle sizes than complete combustion. Particle number concentrations in the flue gas from agricultural wastes combustion appliances reported in the literature are in the range of 7.0×10^2 to 1.8×10^8 particles/cm³ (Table 9) [41], [42], [46], [47], [48], [49], [50]. Particle number distributions were mainly dominated by fine particles but dependent on combustion conditions. As shown in Table 9 the particle number concentration and their size distribution depend on combustion appliances and fuel properties. There were also significant differences in the particle number concentration emissions from different combustion appliances. The number concentration and size distribution mode strongly depend on the phase of combustion.

Table 9. Number concentration of particle emissions from different agricultural waste combustion appliance

Heating appliance	Sample	Thermal Output	Measuring techniques	Fuel,Moisture (m,%)	Number Concentration (particles/cm ³)	Ref.
Fixed bed boiler	Rice husk	-	ELPI	8.5	1.6×10^4	[41]
Fixed bed boiler	Baggase	-	ELPI	14.2	1.5×10^5	[41]
Straw fired boiler	Rice straw	13KW	SMPS	13.2	1.1×10^7	[42]
Wood boiler	Wood logs	35KW	-	-	7.0×10^2	[46]
Wood boiler	Wood chips	-	-	60	0.085 (7.9% O ₂), 0.060 (11.6% O ₂)	[50]
Wood boiler	Wood chips	-	-	60	0.087 (2.7% O ₂), 0.080 (6.2% O ₂)	[50]
Lab scale boiler	Straw (12 types)	18/25MW	-	-	1.2×10^7	[47]
Grate fired boiler	Dry wood pellets	0.8-1.5MW	-	-	~ 0.9	[49]
Grate fired Boile	Wet forest Residues	0.8-1.5MW	-	-	~ 0.10	[49]
Lab. Scale Reactor	Wood logs	20 KW	-	-	1.8×10^8	[48]

6.3 CHEMICAL COMPOSITION

The fuel composition and content of inorganic ash-forming matter varies from fuel sources, conversion techniques etc. For example, forest residue, hay and straw normally contain larger amounts of ash, and larger concentration of chlorine and sulphur, than wood pellets and wood briquettes. These fuels also contain larger amounts of water than the refined fuels, pellets and briquettes. Woody fuel has relatively low alkali content as well as a low chlorine concentration. Dayton, et al. [47] proposed that during combustion of fuel with a high concentration of alkali as well as chlorine, alkali compounds are released primarily through vaporization and decomposition. Arnsfeld, et al. investigated that agricultural wastes fuels have low concentrations of alkali, chlorine and sulphur, and the main alkali compound was found in the fly-ash was potassium sulphate [46]. Paulino, et al. developed an unique method for the quantitative measurement of the elemental composition of particulate matter (PM) by wavelength dispersive X-ray fluorescence (WDXRF) analyzing. [51] Chemical compositions of fine particle emissions from agricultural wastes combustion chamber reported in the literature are presented in Table 10. [45], [48], [49], [52], [53], [54] The dominating chemical compositions of the particle emissions were Ca followed by K, Mn and Mg. Fine particle formation and chemical compositions are influenced by fuel properties.

Table 10. Elemental composition of fine particle emission from agricultural waste combustion appliances

Parameter	Unit	Wood Pellet	Saw dust	Wood fired boiler with fuel oil (plant E)	Wood fired boiler with fuel oil (plant F)	Willow pellets	Wood nace (Excess air 1.4)	Wood nace (Excess air 1.8)	Palm mill ss air 1.4)	Palm mill ss air 1.8)	Palm Oil boiler
Moisture	Wt%	7	50	-	-	-	-	-	-	-	-
Ash	Wt%	<0.50	0.3	0.03	-	-	-	-	-	-	-
Bulk density	Kg/M3	591	240	0.9875 gcm-3	0.9969	-	-	-	-	-	-
Cl	Wt%	0.005	0.01	0.04	0.006	-	-	-	0.49	-	-
S	Wt%	0.027	0.02	0.91	0.89	-	-	9.2	4.8	-	-
K	mg/KG	493	400	-	-	13.2	6.8	53	32.5	9.52	-
Cd	mg/KG	0.14	0.1	-	-	104	16	-	-	-	-
Zn	mg/KG	13.2	10	-	<0.1	-	-	0.12	0.061	1.22	-
Pb	mg/KG	0.43	2	2.9	<0.1	29	38	-	-	-	-
Cr	mg/KG	0.6	1	0.9	14	-	-	-	-	0.342	-
Cu	mg/KG	1.1	2	-	<0.1	-	-	-	-	-	-
Ca	mg/KG	900	900	-	-	25.6	29.9	3	6	-	-
Mg	mg/KG	150	150	0.008	-	2.2	2.8	0.23	0.72	-	-
Mn	mg/KG	147	147	0.54	2.1	0.3	2	0.048	0.058	0.079	-
Hg	mg/KG	0.02	0.02	<0.2	<0.01	-	-	-	-	-	-
As	mg/KG	<0.1	<0.1	<0.1	<0.1	-	-	-	-	0.0179	-
P	mg/KG	60	60	-	-	-	-	0.1	0.18	-	-
Na	mg/KG	20	20	-	-	-	-	-	-	-	-
Ref.		[49]	[48]	[54]	[54]	[45]	[45]	[52]	[52]	[53]	

6.4 ULTIMATE COMPOSITION

Table 11 summarizes the ultimate analysis data of different types of agricultural wastes reported in literature. By evaluating the value of C,H,O we can estimate the heating value of these fuels. The percentage of N, S and Cl data helps to study of the environmental impact of these fuels [3], [37], [38], [44], [55], [56], [57], [58], [59].

Table 11. Ultimate analysis of different types of agricultural waste (wt %, dry basis)

Sample	C	H	N	O	S	Ref.
Wheat straw	39.9	5.74	0.22	46.59	0.11	[56]
Corn Straw	42.11	5.58	0.55	47.12	0.03	
Pine wood	50.4	6.28	0.13	42.8	-	
Palm Kernel Shell	53.9	6.24	0.37	37.3	-	[52]
Palm Kernel Shell	61.3	5.46	0.56	37.3	-	
Palm Kernel Shell	62.9	5.21	0.54	28.9	-	
Almond shell	60.9	5.14	0.2	32.4	-	
Charcoal	84	2.93	0.58	10.1	-	
Palm empty fruit bunch	40.7	5.4	0.3	47.8	1.2	
Pine Pellets	46	6.2	0.5	47.3	<0.01	[53]
Chinese Pine	49.1	6.32	0.18	44.41	-	
Bamboo	48.75	5.98	0.26	45.02	-	[34]
Oats	46.8	5.82	0.31	-	0.09	
Barley	44.9	5.51	0.54	-	0.19	[41]
Coffee husk	45.4	4.9	1.1	48.3	0.35	
Cotton husk	50.4	4.9	1.1	39.8	0.01	[55]
Tea waste	48	5.5	0.5	44	0.06	
Rice husk	38.1	4.7	1.5	29.3	0.1	[2]
Pine Pellets	46.2	6.2	0.5	<0.01	-	
Industrial wood wastes	45.5	5.9	3.5	45.1	-	[54]
Peach stone	47.7	5.9	1.3	45.1	-	
Peanut shell	48.1	5.48	1.3	30.04	0.08	[2]
Rice husk	36.4	4.84	0.44	25.11	0.17	[35]

6.5 PROXIMATE COMPOSITION

Table 12 shows proximate analysis data of different types of agricultural waste from literatures [3], [55], [57], [58], [60], [61], [62], [63] which presents the percentage of volatile matter, fixed carbon and ash contents. To study the combustion phenomenon of agricultural waste fuel, this analysis is very important. For example, ash contents in biomass fuels can cause ignition and combustion problems. If melting point of the dissolved ash is low, this causes fouling and slagging problems. High volatility of the fuel offers many advantages as a combustion feedstock. Moreover, high fixed carbon and volatile matter increase the heating value of any agricultural waste fuels.

Table 12. Proximate analysis of different types of agricultural waste (wt %, dry basis)

Sample	Temp/Level	Moisture	Ash	Volatile matter, %	Fixed Carbon
Wheat straw	-	4.81	7.1	79.52	8.57
Corn Straw	-	4.38	4.39	81.94	9.31
Pine wood	Low	-	0.41	-	-
Palm Kernel Shell	Raw	-	2.17	-	-
Palm Kernel Shell	Medium	-	2.27	-	-
Palm Kernel Shell	High	-	2.5	-	-
Almond shell	High	-	1.36	-	-
Charcoal	500-6000C	-	2.38	-	-
Pine Pellets	150	7.3	1.3	-	-
Chinese Pine	-	9.1	0.25	84.77	14.98
Bamboo	-	8.18	0.51	84.94	14.55
Oats	150	9.2	4.67	80.7	-
Barley	150	8.1	9.39	74.3	-
Palm empty fruit bunch	-	-	4.6	67.5	27.9
Coffee husk	-	-	2.8	76.5	20.7
Cotton husk	-	-	17.3	62.9	19.9
Tea waste	-	-	1.5	85.5	13
Rice husk	-	-	19.5	606	19.9
Pine Pellets	-	7.3	1.3	80.5	10.9
Industrial wood wastes	-	6.3	1.8	76.9	15
Peach stone	-	7.1	1.4	75.6	15.9
Peanut shell	-	-	5.7	65.4	19.6
Rice husk	-	6.1	20.6	58.4	14.9

6.6 ASH ANALYSIS

The composition of agricultural waste ash is strongly dependent on the species of the plant. The content of potassium, sodium, chlorine and phosphorous in fuel depend on the available nutrients, soil quality, fertilizers and weather condition. Table 13 shows the composition of fly ashes of different types of agricultural waste fuels. [3], [57], [58], [60], [63] Agricultural waste fuels can be divided into three different types according to the content of the calcium, potassium and silicon.

Table 13. Ash analysis of some biofuels (mass basis % ash)

Sample	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	CaO	SO ₃	MgO	P ₂ O ₅	K ₂ O	Na ₂ O	Cl	others
Pine Pellets	20.9	6.2	21.6	26.2	0.3	4.3	4.2	11.5	2.5	0	2.3
Palm empty fruit bunch	11.04	0.29	6.93	12.67	2.35	2.16	4.02	53.07	-	5.8	1.93
Wood pellets	4.3	1.3	1.5	55.9	1.3	8.5	3.9	-	0.6	-	0.1
Ricestraw	77.2	0.55	0.5	2.46	0.83	2.71	0.98	12.59	1.79	-	0.04
Industrial wood waste	15.6	7.4	3.7	40.6	3.7	11.5	2.2	2.4	2.1	-	1.3
Peach stone	5.5	2.3	6	12.1	2.4	12.3	25.7	30.4	1.9	-	1.1
Peanut shell (feed rate=60kg/h)	50.49	11.14	5.27	8.52	-	3.21	-	9.85	0.02	-	-
Peanut shell (feed rate=45kg/h)	51.46	10.67	4.96	8.37	-	3.11	-	10.66	0.02	-	-
Peanut shell (operating time 10h)	14.11	80.33	0.38	0.87	-	0.51	0.19	1.54	-	-	0.24
Peanut shell (operating time 20h)	28.26	62.78	0.89	1.54	-	0.74	0.34	3.77	-	-	0.16
Peanut shell (operating time 30h)	33.64	56.15	1.19	1.72	-	0.76	0.39	4.62	-	-	0.13

6.6.1 CA, K RICH AND SI LEAN ASH FUEL

Table 14 is the examples of this type of agricultural waste fuel. These types of fuel are rich in calcium, potassium and low content of nitrogen (0.3–0.7 w-% in dry solids), sulphur (0.03–0.05 w-% in dry solids) and ash (0.1–6 wt% in dry solids). Moisture contents of these fuels are often high, up to 50–80 %, reducing net calorific value of fuel.

Table 14. Calcium and Potassium rich and silicon lean ash agricultural wastes

Elements	Forest residue	Peat
SiO ₂	11.6	32.1
Al ₂ O ₃	2.0	17.3
Fe ₂ O ₃	1.8	18.8
CaO	40	15.1
MgO	4.8	2.5
K ₂ O	9.2	1.4
Na ₂ O	0.6	0.5

6.6.2 SI AND CA RICH AND K LEAN ASH FUEL

Most of the fuels in this type belong to herbaceous or agricultural biofuels. Some of the fuels, like straws of cereals have also relatively high potassium (K) and chlorine (Cl) contents. Rice straw and peanut shells have very high SiO₂ contents in ash as shown in Table 15.

Table 15. Silicon rich and Calcium and Potassium lean ash agricultural wastes

Elements	Peanut shell	Rice straw
SiO ₂	50.49	77.2
Al ₂ O ₃	11.14	0.55
Fe ₂ O ₃	5.27	0.5
CaO	8.52	2.46
MgO	3.21	0.83
K ₂ O	9.85	1.79
Na ₂ O	0.02	0.04

6.6.3 CA, K, AND P RICH ASH FUEL

Sunflower stalk ash and rapeseed expeller ash from food production are examples of the third type of agro-waste fuel ash (Table 16), having K₂O, CaO and P₂O₅ as the major ash components [64]. These agro-waste fuels contain some chlorine that increase the risk of chlorine induced high temperature corrosion of super heaters. Composition of fly ashes in for the same fuel also varies on the feed rate as well as different periods of combustor operation. For example, Table 17 shows the composition of fly ashes (as the weight percentage of representative oxides) generate when firing peanut shells at 60 kg/h and 45 kg/h for similar excess air, about 40% [8]. For these two ash analyses, the total sum of oxide percentages was below 100%, which indicated the presence of some amount of carbonates in the ashes. A comparison of the ash compositions revealed quite weak effects of operating conditions (via the bed temperature and residence time) on the percentage of individual constituents in the analysis. Table 18 shows the composition of alumina sand (prior to testing) and that of the reused bed material after different time periods of combustor operation [8]. Here we see that the content of SiO₂ and K₂O in the alumina-based bed material were found to be significantly increased with time, whereas other components presented in the fly ash at noticeable levels (such as CaO, MgO, Fe₂O₃ and P₂O₅) exhibited a moderate/weak time increment of their contents in the grains.

Table 16. Examples of ash composition of sunflower stalk and rapeseed expeller

Elements	Sunflower stalk	Rapeseed expeller
SiO ₂	3.1	0.0
Al ₂ O ₃	0.1	0.0
Fe ₂ O ₃	0.2	0.3
CaO	6.6	15.0
MgO	4.3	9.0
K ₂ O	27.5	22.8
Na ₂ O	0.0	0.0
P ₂ O ₅	18.5	41.1
other	39.7	11.8

Table 17. Examples of ash composition of peanut shell firing boiler in excess of air at different feed rate

Elements	Peanut shell(feed rate=60kg/h)	Peanut shell(feed rate=45kg/h)
SiO ₂	50.49	51.46
Al ₂ O ₃	11.14	10.67
Fe ₂ O ₃	5.27	4.96
CaO	8.52	8.37
MgO	3.21	3.11
K ₂ O	9.85	10.66
Na ₂ O	0.02	0.02

Table 18. Examples of ash composition of peanut shell firing boiler in excess of air at different time instants

Elements	Peanut shell (operating time 10h)	Peanut shell (operating time 20h)	Peanut shell (operating time 30h)
SiO ₂	14.11	28.26	33.64
Al ₂ O ₃	80.33	62.78	56.15
Fe ₂ O ₃	0.38	0.89	1.19
CaO	0.87	1.54	1.72
MgO	0.51	0.74	0.76
K ₂ O	0.19	0.34	0.39
Na ₂ O	1.54	3.77	4.62

6.7 SIZE SEGREGATED PARTICLE EMISSION

The particle size distribution is important, since this physical parameter determines the mass and number density, lifetime and atmospheric transport, or optical scattering behavior of the particles in the atmosphere. Epidemiological studies shown that particulate matter can pose adverse health effects such as respiratory, cardiovascular, allergic and lung cancer diseases. These health issues associated with airborne particulate matter depend on the concentration, size, and chemical composition of particles. Particle size determines where particles are deposited in the respiratory tract. Agricultural wastes emissions constitute a highly variable fraction of the atmospheric aerosol. This fraction is predominantly found in the fine size mode in concentrations ranging from 20 to 50% of the total fine particle mass [65]. The total carbonaceous aerosol comprises is classified in two main fractions: organic carbon (OC) and elemental carbon (EC). The OC fraction is composed of a huge variety of organic compounds, ranging from low molecular-weight compounds [66]. On the other hand, the EC fraction can be pictured as more or less disordered stacks of graphene layers or large polycyclic aromatics with a surface coverage by oxygen-containing functional groups and nitrogen species [67]. While EC is essentially a primary pollutant, emitted directly during the incomplete combustion of biomass and, principally, fossil carbonaceous fuels. Primary OC is directly emitted into the atmosphere as liquid phase, solid particle phase or as semi-volatile vapours, which condense under the atmospheric conditions [68]. Secondary OC is developed in-situ by chemical reactions of gas-phase compounds, or by condensation of gaseous species on existing particles [69]. Tables-19 [36], [60], [70], Table-20 [36], [60], Table-21 [36], [70], [71] and Table-22 [36] shows size segregated emission factors for PM, OC, EC, elemental emission, PAH from different emissions sources. Combustion temperature is the most important factor in determining PAH composition. Burn temperature depends primarily on the combustion air supply, but is also influenced by the amount of fuel burning, fuel moisture content and type of burn. Hot flames generally produce a lower amount of particulate matter as well as lower organic pollutants such as polycyclic aromatic hydrocarbons. However, flames with higher temperatures tend to produce relatively more particles in the ultrafine range.

Table 19. EC, OC and TC values of size segregated particulate matter emitted from various sources

Element	Rice Straw (g/Kg)	Almond Pruning (mgKg ⁻¹)			Rice straw (mgKg ⁻¹)			Air of Yukohama city (µg/m ³)			
EC	PM _{2.5} 57.7±27.9	PM ₁₀ 56.9±25.3	PM _{<0.1} 0.04	PM _{0.1-1.8} 0.13	PM _{>1.8} -	PM _{<0.1} 0.07	PM _{0.1-1.8} 0.42	PM _{>1.8} -	PM _{2.5} 1.94±1.2	PM _{2.5-10} 0.25±0.10	PM ₁₀ 0.22±0.20
OC	335.4±88	328±84.7	0.98	1.39	-	0.16	0.67	-	3.75±1.5	1.27±0.60	0.72±0.40
TC	393±64	385.5±63.3	-	-	-	-	-	-	-	-	-

Table 20. Mean concentrations of particulates of different sizes and their chemical compositions from rice straw burning boiler and air of an industry densely city of Japan

Ion	Rice Straw (g/Kg)		Air of Yukohama city ($\mu\text{g}/\text{m}^3$)		
	PM _{2.5}	PM ₁₀	PM _{2.5}	PM _{2.5-10}	PM ₁₀
Na ⁺	2.56±2.77	3.53±3.84	0.25±0.20	0.68±0.50	0.22±0.30
K ⁺	50±34	47.3±33.6	0.13±0.10	0.05±0.10	0.06±0.20
NH ₄ ⁺	23.8±11.7	22.8±9.2	2.27±2.0	0.28±0.30	0.22±0.30
Mg ²⁺	0.11±0.22	0.18±0.28	0.05±0.02	0.06±0.10	0.02±0.0
Ca ²⁺	0.15±0.41	1.08±1.06	0.02±1.0	0.17±0.40	0.05±0.01
F ⁻	2.45±3.28	2.48±3.17	-	-	-
Cl ⁻	69.3±31.6	68.6±30.7	0.21±0.40	0.44±0.40	0.23±0.20
NO ₃ ⁻	2.93±3.72	15.53±13.06	0.96±1.5	1.01±0.80	0.17±0.20
SO ₄ ²⁻	9.82±7.21	15.53±13.06	3.80±2.6	0.22±0.40	0.04±0.10

Table 21. PAH emission factors from different sources of emissions

PAH	Rice Straw (g/Kg)		Almond Pruning (mg/Kg)			Rice straw (mg/Kg)			Diesel Dominating free ways in Los Angeles (ng/m ³)	
	PM _{2.5}	PM ₁₀	PM _{<0.1}	PM _{0.1-1.8}	PM _{>1.8}	PM _{<0.1}	PM _{0.1-1.8}	PM _{>1.8}	(Ultra fine mode)	(Accumulat ion mode)
Fluoranthene	-	-	0.19	0.46	0.35	0.47	0.33	0.2	-	-
Phenanthrene	0.03±0.07	0.02±0.05	0.25	0.47	0.28	0.33	0.55	0.12		
Anthracene	0.02±0.01	0.01±0.01	-	-	-	-	-	-		
Fth	0.5±0.75	0.49±0.75	-	-	-	-	-	-		
Pyrene	0.29±0.33	0.26±0.27	0.18	0.44	0.38	0.5	0.34	0.16		
Benzene(a) anthracene	0.12±0.18	0.11±0.14	-	--	-	-	-	-	0.108	0.029
Chrysene	0.17±0.21	0.15±0.17	0.52	0.48	0	0.4	0.47	0.13	0.22	0.047
Benzo(b) fluoranthene	0.13±0.12	0.12±0.11	0.52	0.48	0	0.48	0.37	0.15	0.211	0.044
Benzo(k) fluoranthene	0.05±0.04	0.05±0.04	0.55	0.45	0	0.44	0.48	0.07	0.149	0.035
Benzo(a) pyrene	0.13±0.15	0.11±0.13	0.58	0.42	0	0.23	0.54	0.22	0.172	0.043
Dibenzo(ah) anthracene	0.08±0.1	0.08±0.1	0.54	0.46	0	0.55	0.47	0	0.013	0.004
Benzo(ghi) perylene	0.02±0.03	0.02±0.03	0.44	0.56	0	0.37	0.63	0	0.454	0.084
Indeno[1,2, 3-cd]pyrene	-	-	0.33	0.67	0	0.38	0.62	0	0.046	0.011

Table 22. Elemental emission (g/Kg) of particle matter from a rice straw firing boiler

Element	Rice Straw	
	PM _{2.5}	PM ₁₀
Fe	0.038±0.108	0.105±0.306
Ni	0.036±0.068	0.047±0.070
Pb	0.045±0.094	0.115±0.197
Sr	0.013±0.029	0.016±0.028
Ti	0.015±0.046	0.016±0.043
V	0.091±0.130	0.140±0.191
Zn	0.036±0.099	0.066±0.155
Si	0.14±0.34	0.185±0.364
Al	0.18±0.33	2.53±2.47
Ca	0.85±1.33	2.65±3.40
Cd	0.009±0.023	0.009±0.022
Cr	0.080±0.169	0.163±0.292
Cu	0.171±0.409	1.24±0.24
Mg	0.906±1.710	1.739±1.783
Mn	0.005±0.015	0.010±0.028
S	1.174±0.404	1.24±0.24
As	0.003±0.003	0.003±0.004
Se	0.0001±0.0002	0.0005±0.0004
Br	0.047±0.011	0.044±0.013
Rb	0.036±0.013	0.035±0.013
Zr	4E-05±7E-05	0.0002±0.0003
Ag	0.004±0.005	0.005±0.005
Sn	-	0.002±0.003
Sb	-	0.001±0.001
Ba	0.016±0.022	0.015±0.016
Bi	-	0.001±0.001

7 RELATIONSHIP BETWEEN FUEL TYPE AND PM EMISSION

7.1 FUEL TYPES ON PARTICLE EMISSION

The main agricultural fuels used in combustion systems are wood derived fuels, palm mill residues, rice husk etc. The growing demand of these fuels may lead to an unbearable pressure on the forest, since an increasing demand can drive to unsustainable levels of harvesting, with negative consequences for biodiversity, soil, and water conservation. Low-quality fuel can cause undesired effects in the equipment such as slagging, fouling or corrosion, and may originate substantial amounts of gaseous and PM emissions. On the other hand, the type of pellet has a significant impact on the emissions of CO, hydrocarbons (HC) and NO in the gaseous emissions side and generates high amounts of fine PM in the PM emissions side. Many studies showed that inorganic PM emissions were correlated with both the fuel ash content and the composition [72], [73]. According to their studies, PM emissions are significantly affected with the types of biomass fuel. Fig 7 showed a significant dependency of the fuel type on the emissions of dust for different agricultural waste fuels. The order of dust emission rate has changed slightly with increasing the temperature.

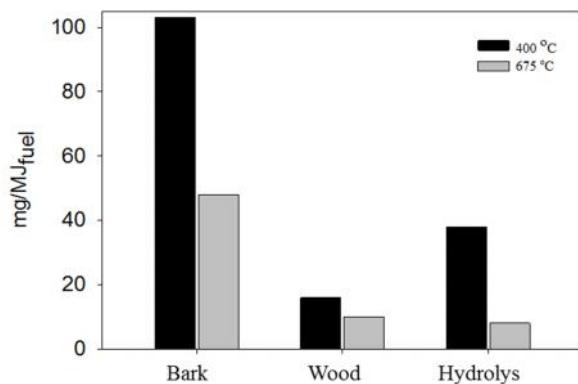


Fig. 7. Influence of fuel types on particle emission

7.2 INFLUENCE OF FUEL TYPES ON BOILER PERFORMANCE

Fig. 8 shows the CO, HC and NO emissions of the different agricultural fuel combustion boiler at thermal input 15-17 kW. The data repeatability for the gaseous and PM emissions was, on average, within 10-13% of the mean value. As shown in the Fig 8, wood pellet and bagasse present lower emissions of CO and NO_x and Pine and olive wood has lower emission of HC compared to the other fuels [55], [62], [74]. The HC and CO emissions follow the same trend, since the emissions of both species are related with incomplete combustion. The higher emissions of CO and HC yield by the olive pruning and cork indicate poor combustion conditions since these emissions are also related with incomplete combustion. However, the HC emissions are always rather small for all samples tested. Fig 8 also reveals that the NO_x emission are comparatively lower which is due to the nitrogen content of fuels. NO_x emissions mostly result from the fuel content of N, while their formation from the combustion air plays only a little role. Once more, there is no solid indication for the influence of the operating conditions on NO_x.

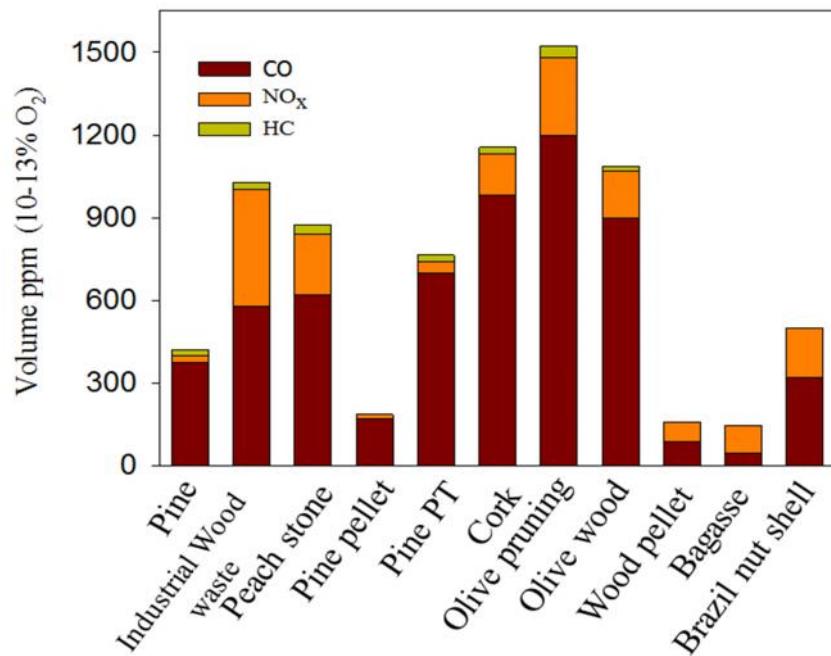


Fig. 8. CO, NO_x, and HC emissions for different agricultural fuels at thermal input 15-17 (kW)

7.3 ASH CHARACTERISTICS OF AGRICULTURAL FUELS

Solid fuels always contain inorganic components that form ash during combustion process. Some of these components have volatile properties which form fine fly-ash fraction while the nonvolatile species typically form large ash particles that remain in the bottom of the furnace. The main ash forming species in agricultural waste fuels are K, Ca, S, Mg, Cl, P, Mn, Si, Fe, Al etc. Table 23 shows composition of the ash forming species in agricultural wastes fuels found in literature [34], [54], [72]. The clean fuel usually contains higher amount of elements forming positive ions like K, Na than anions like S, Cl etc. Generally the amount of ash present in organic molecules in woody fuels is higher than in other agricultural wastes. Drying of agricultural fuels leads to precipitation of ions in aqueous solution, affecting ash behavior during combustion.

Figure 9 illustrates SEM micrographs of the particle morphology collected on quartz filters for combustion of different agricultural fuels. A large majority in the number of fine particles were seen as round uniform shape in Fig 9(a), approximately in sizes 20–50 nm, of which the surface evaporated easily under the beam of the SEM. Perhaps these particles were composed of solid seeds with a layer of liquid sulphuric acid. In Fig 9(b), the samples contained smaller amount of fine particles bigger than 100 nm, of which some were irregular shaped spheres and some compact shaped agglomerates [54]. Fig 9(c-f) shows typical submicron PM collected from Portuguese pine, Spanish pine cork, olive wool and olive pruning. A large number of soot aggregates was observed in all Figures [74]. Size of the particle was observed from the SEM images shown in Fig 9(g-i) [55], [73].

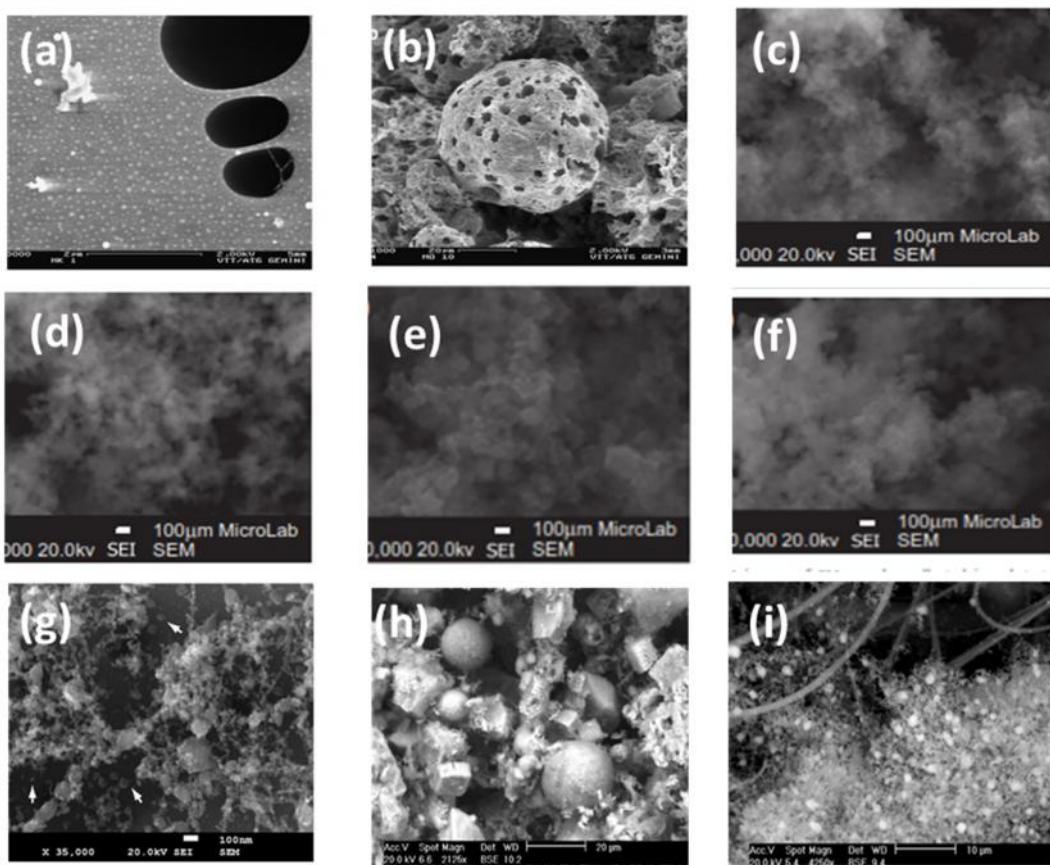


Fig. 9. SEM morphology of PM sample. (a) coarse particle: (b) collected from flue gases of wood combustion: (c) Portuguese pine : (d) Spanish pine : (e) cork: (f) olive wood: (g) pine pellet: (h) woody biomass: (i) bark pellet

Table 23. Properties and ash forming elements in the agricultural waste fuel (concentrations of elements given as mg/kg dry fuel)

Fuel	Al	Ca	Fe	K	Mg	Mn	Na	P	S	Si	Zn	Cl
Oat	24	640	80	5290	1330	40	43	4020	1640	-	28	578
Wood-pellet	10	940	10	670	200	70	10	40	70	-	7	42
Rape seed	-	5410	60	7910	3380	20	25	8880	4350	-	34	117
Rape seed residue	9	5980	90	10170	5410	50	36	12640	4910	-	58	92
Oat-peat	176	836	422	4270	1190	40	50	3278	1544	-	25	518
Pellet (Commercial)	-	752	-	409	164	-	-	49	53	-	9	41
Pellet (Birch bark)	-	3900	-	1250	426	-	20	459	342	-	127	300
Pellet (Alder bark)	-	7590	-	2695	582	-	-	577	567	-	103	98
Pellet (Pine seam)	-	792	-	661	267	-	-	232	135	-	10	51
Pellet (willow)	-	11700	-	3875	727	-	77	1200	891	-	211	82
Saw dust & bark	89	2900	67	1070	400	170	24	2451	90	78	42	80
Forest residue	170	1740	454	1470	357	141	26	169	128	158	23	1520
Pellet mix	1325	4146	4100	1200	527	120	610	500	900	5000	17	290
Wood dust	9	1280	25	475	228	73	214	90	73	-	29	99
Wood pellet	-	5	-	40	-	-	5	-	-	-	3	5
Wood	0.12	-	0.13	0.027	0.0025	0.13	-	-	-	0.0072	-	-

8 PARTICLE EMISSIONS CONTROL

The combustion of any fuel will emit pollutants, and emissions from agricultural wastes will differ from that of other fuel sources. It is important to understand the types of emissions and to consider what measures can be taken to reduce impacts to ambient and on-the-ground air quality. This is especially important in the case of PM, which is a concern for public health. There are steps that can be taken to reduce these impacts on air quality and public health.

8.1 EMISSIONS-REDUCTION MEASURES

To reduce PM emissions, special attention should be given to sourcing quality wood fuel, installing high-efficiency boilers, implementing best management practices, installing emissions-reduction equipment, ensuring proper sizing and stack height, and proper plant siting.

8.1.1 FUEL SELECTION

The quality of the fuel is an important factor in controlling the amount of PM emissions released. For agricultural wastes fuel based systems, the moisture and mineral content of the chips can affect the emissions coming out of the stack. Using clean and dried agricultural wastes will typically yield less PM emissions. Fuels that contain more ash-forming minerals produce more particulates in the form of fly ash which is present in the exhaust gases at combustion. The Pellet Fuels Institute (PFI) has developed voluntary standards that gauge pellet fuel quality and these grades, from highest to lowest quality, include: Super Premium, Premium, Standard and Utility (Table 24) [75].

Table 24. Maximum allowable ash content for PFI-Grade pellet fuels

Maximum Allowable Ash Content for PFI-Grade Pellet Fuels	
Super Premium	0.5%
Premium	1.0%
Standard	2.0%
Utility	5.0%

8.1.2 BOILER SELECTION

A high-efficiency boiler with an automated feeding system should select to get maximum yield with fewer emissions. The size of the system should be based on the facility's heat energy requirements. A fuel-heated boiler must provide air to oxidize its fuel. The system should additionally be equipped with an induced fan for better combustion control.

8.2 PM EMISSIONS-CONTROL EQUIPMENT

8.2.1 CYCLONES AND MULTI-CYCLONES

Cyclone is an air pollution control unit which removes particulates from an air, gas or liquid stream through vortex separation. Rotational effects and gravity are used to separate mixtures of solids and fluids. The method can also be used to separate fine droplets of liquid from a gaseous stream. The performance of a cyclone usually evaluated via its collection efficiency and pressure drop. The collection efficiency referred to the ability of the cyclone to separate the dust from the gas stream according to the dust size fraction. Many Studies have been carried out to improve the cyclone performance. Madhumita, et al. installed a unit called 'Post Cyclone' to improve cyclone efficiency [76]. Wang et al. introduced a new type of cyclone known as circumfluent cyclone and was able to improve the collection efficiency 8% than the conventional one.[77]

Multi-cyclones is a type of cyclone which the miniature axial entry cyclones is preferred compare to the other type of cyclone due to its ability to achieve higher collection efficiency. A multi-cyclone uses numerous smaller diameter cyclones to improve efficiency. However, its ability in capturing particulate matter (PM) especially the fine particulate size fraction is limited. Norelyza, et al. developed a multi-cyclones unit known as MR-deDuster as particulate emission control device in palm oil mill plant to enhance the performance of multi-cyclone [78]. The newly developed MR-deDuster is capable to capture dust sized $2.4\mu\text{m}$ at 50% collection efficiency with a reasonable low pressure drop. The unit is also capable of achieving more than 95% total dust collection efficiency for all dust tested [79].

8.2.2 FABRIC FILTER

In the case of mechanical separators such as cyclones and multi-cyclones have a broad range and relatively lower collection efficiency, while the collection efficiency can be higher for that of fabric filters or baghouses. Fabric filter has ability to separate particles from a gas stream of any conditions with relatively high efficiency. But their applications in these facilities are short lived due to wear and tear of the fabric media. To overcome this problem, "Pre-Coat" material is used to coat a layer of inert material onto the surface of the fabric as a barrier of protection as well as to allow a uniform air flow passing through the filter media [80]. A newly formulated filter aids material known as 'PrekotAC', an efficient dust separation agent in a fabric filter system was developed by Hajar and their groups [81], [82]. A considerable decrease in pressure drop was observed due to the effect of deviation in different particle size distributions of non-uniform particle size fractions for the PrekotAC mixture. Substantial savings could be achieved in the terms of maintenance costs with the application of PrekotAC in the industry.

9 CONCLUSION

In this paper, various factors leading to Sources of agricultural wastes, formation of particulate matter emissions from combustion of agricultural wastes fuel used in district heating applications as well as their impacts on human health were

explained based on the literature survey. Especially particle emission level, conversion technology, emission factors, size segregated particulate emission factors have been characterized briefly and the following conclusions can be made.

- Large amount of crop residues (4×10^9 Mg/yr) are produced in the world every year. The combustion of these residues in boiler seems to be a promising technique to contribute both the reduction of greenhouse gases and the solution of the waste disposal problems.
- Performances of agricultural wastes as a boiler depend on some properties of residues like, Moisture content, bulk density, ash content, volatile matter, pollutant emission etc.
- Particles size less than few hundreds of nanometers are better to characterized in terms of number concentration rather than mass (or volume) concentration, which is more significant for large particles.
- The mass concentration increases under unsatisfactory combustion conditions due to particles originating from incomplete combustion.
- There is a slight tendency to a decreased number concentration of emitted particles for increasing moisture content in the fuel.
- The data regarding size segregated particulate emission from different sources are very few and quite scattered. More work is therefore needed to characterize the PM according to their size.

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A Review on Stimuli-responsive grafted membranes Based on Facile Synthesis Process and Extensive Applications

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ABSTRACT: In the past few years, an increasing number of stimuli responsive thin polymer films and intelligent hydrogels have been reported in the literature for various biomedical applications, including drug delivery, tissue engineering and wound healing. The thermo-sensitive approach can be advantageous for some specific applications as it does not require organic solvents, co-polymerization agents, or an externally applied trigger for gelation. The conformation as well as change in physical properties of polymer brushes and polymer hydrogel can be influenced by the environmental stimuli, such as solvent composition, temperature, pH and electric fields. This review focuses on the recent advances of these stimuli responsive molecular thin film and stimuli responsive polymeric gels with unique properties and utilities. We also discuss some conflicting behaviors shown by polymer grafted membrane and polymer gel surfaces, synthesized by using same monomers. Major properties of stimuli responsive thin polymer films, and on their potential application in the field of nano-optics, ultrasensitive spectroscopies and other biomedical applications including drug delivery are also outlined.

KEYWORDS: drug delivery system; molecularly imprinted polymer; nanoparticles; stimuli-responsive.

1 INTRODUCTION

For more than two decades, stimuli-sensitive polymers have been drawn consequential attention for the fabrication of so-called "smart", "intelligent", or "environmentally sensitive" polymers, which can undergo a reversible and yet discontinuous volume phase change in response to various external physicochemical factors [1], [2], [3], [4], [5]. Molecular interactions between polymer chains, or between polymer chain and solutes present in a system will alter by pH, metabolites and ionic factors. On the other hand, for altering molecular interactions of polymer chain, physical stimuli, such as temperature or electrical potential, can also provide various energy sources. Among them, temperature and pH-responsive grafted membrane have been expensively studied due to their physiological significance [6]. Recently a trend has been observed in engineering biomimetic nanostructured thin films that combine a wide range of functional properties found in cell membranes [7]. These materials carry some practically important properties of synthetic materials, such as, mechanical and chemical stability, electrical, optical, magnetic properties, wetting, and adhesion [8], [9], [10], [11].

Fabrication of different types of grafted polymer film have been reported by several deposition techniques. Homopolymer brushes, which can be synthesized in various ways are exist in a large variety of structural geometries with vastly different bonding characteristics between the metal and oxygen. The characteristics of metal oxides are strongly dependent on their exact composition, fabrication temperature, crystal morphology, surface area, and crystallite size [12], [13]. The layer-by-layer deposition technique has been devoted to the development of molecular assemblies of thin film. This

technique mainly based on successive deposition of alternate layers of anionic and cationic polyelectrolytes including synthetic polymers, proteins and nucleic acids. The electrostatic force of attraction play as an origin of the strong adhesion between the anionic and cationic layers [14]. The layer-by-layer structure is possible to construct by means of polymers and biomaterials which have biological interactions such as protein–ligand, antibody–antigen and lectin–saccharide bindings. Bimetallic particles have also been of considerable attraction, because the physical and chemical properties of the metal particles can be developed by adding the other component to the monometallic particles [15]. Cross linked film is very important because of its importance in the industrial production of many semiconductors, hard disk drive storage devices, and micro-electromechanical systems. Surface-initiated polymerization method has the advantage of tethering polymers onto the surface with high grafting densities, which is ideal for coating surfaces. This method was also used for surface modification with surface-initiated grafted polymers prepared via physisorption onto the surface or chemisorption by covalent bonding [16]. Binary mixed homopolymer brushes, which represent a new, intriguing class of environmentally responsive materials are composed of two chemically distinct homopolymers randomly or alternately immobilized by one end via a covalent bond on the surface of a solid substrate. The two grafted polymers can undergo spontaneous chain reorganization in response to environmental variations and show different nanostructures and surface properties [17], [19]. These brushes exhibit different nanostructures and surface properties under different conditions. Block copolymer brushes exhibits complicated phase-separation behavior in a thin film, compared with in bulk due to the interfacial interactions of the blocks with the underlying substrate, the surface energies of the blocks and commensurability with the film thickness. According to the Flory–Huggins interaction parameter χ , block copolymer can self assemble into a variety of nanoscale structures (spherical, cylindrical, gyroidal, lamellar) with dimensions from a few nanometres to above 100nm depending on molecular weight, segment size, and the strength of interaction between the blocks. Molecular brushes have drawn progressive attention since its first preparation report by ATRP reported in 1998 [20]. The field of stimuli-responsive molecular brushes has been reported with a large number of papers. In the first part of this article, we review the general aspects of these stimuli responsive polymer thin film, their properties, ability to selectively recognize external signals and polymeric responsive systems. In the second part we discuss the recent developments and future trends dealing with stimuli responsive hydrogels. Rational approaches to induce stimuli-responsiveness of both cases are also highlighted.

2 STIMULI RESPONSIVE GRAFTED POLYMER

2.1 CONVENTIONAL POLYMERIZATION TECHNIQUES

Many methods have been developed for the polymerization of grafted polymer at different temperature by using different types of organic solvent like, 2,2'-azobisis(isobutyronitrile) (AIBN) or peroxide initiators, or in water using ammonium persulfate or potassium persulfate initiator in the presence of activators [21]. Polymerization in the presence of various chain transfer agents has been examined in order to control molecular weight and structure, especially for the functionalization of end groups. But in many cases inappropriate methods were selected for making the high-density polymer brushes. It has only recently been seriously considered that an appropriate surface conditions have to choose for attaching monomer to one end and the preparatory method to form grafted polymer for making a real high density polymer film.

Atom transfer radical polymerization (ATRP) [22], reversible addition fragmentation chain transfer (RAFT) [23], nitroxide-mediated polymerization (NMP) [24], are attractive living radical polymerization technique. A variety of monomers can be used and a variety of block copolymers were synthesized. Polymerization could be done at relatively low temperature and polymers having a narrow molecular weight distribution were successively investigated. Ring-opening metathesis polymerization (ROMP) using fast-initiating ruthenium catalysts (Figure 1) have allowed the preparation of new materials with unprecedented functional and structural diversity and blurred the line between small-molecule and polymer synthesis. This development in catalysis is particularly suited for the synthesis of diverse side-chain functional polymers with controllable molecular weights (M_n) and low polydispersities (PDI) [25], [26].

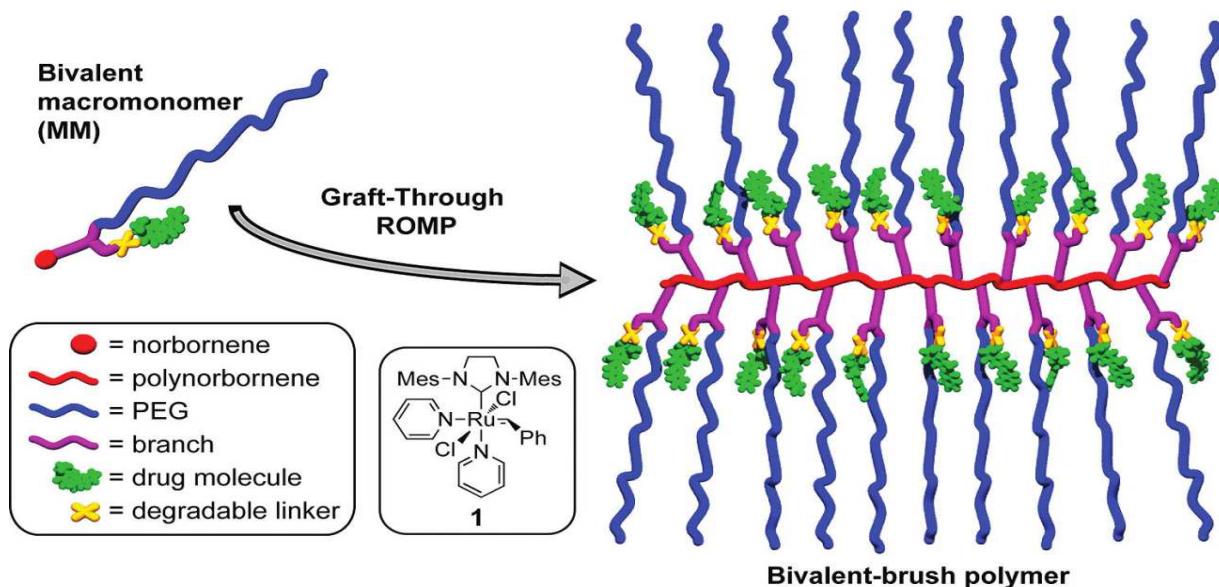


Figure 1. Schematic depiction of bivalent macromonomer (MM) and bivalent-brush polymer.

Numerous reports describing the successful synthesis of stimuli responsive polymer grafted film have appeared. For example, Guoqing et al. described a unique approach to obtain molecularly imprinted polymers (MIPs) with both pure water compatible (i.e., applicable in the pure aqueous environments) and stimuli-responsive binding properties. MIPs brushes were synthesized by poly(NIPAAm) (PNIPAAm) via surface-initiated reversible addition–fragmentation chain transfer (RAFT) polymerization [27]. Edwards et al. have recently demonstrated that capping gold nanoparticles (NPs) with thermoresponsive copolymers of di(ethylene glycol) methyl ether methacrylate (MEO₂MA) and poly (ethylene glycol) (OEGMA) methyl ether methacrylate, which results in a composite material and is capable of crossing the water-oil interface in response to the salt concentration of the aqueous phase [28]. Further investigation of this work was gold NPs capped with copolymers of MEO₂MA and OEGMA were prepared to investigate how surface chemistry, particle size, and salt chemistry affect the transfer of these particles across the water-oil interface [29]. Stimuli-responsive polymer brushes are excellent materials for active plasmonic devices because the conformation of polymeric chains can be controlled by pH, ionic strength, and temperature. In case of the polymer, which is bound to noble-metal nanostructures, the stimuli-sensitive conformational changes of the polymer can modify drastically the refractive index of the NPs' surrounding medium and consequently, their optical properties [30], [31]. There is a drawback of gold colloidal NPs or island films attached to polymer brushes. The optical response of these substrates prevent any improvement in analytical applications such as chemical sensing or surface-enhanced spectroscopies due to broad localized surface plasmon resonance (LSPR) bands. To improve plasmonic system performances, fabrication of perfectly calibrated systems and control of the polymer grafting steps for optimization of the stimuli-induced response of the polymer with high grafted density of polymer brushes have to be considered. Helene et al. demonstrate thermally induced modifications of the plasmonic response of lithographic gold nanoparticles functionalized by thermosensitive polymer brushes of (poly(*N*-isopropylacrylamide)) (Fig:2) to emphasize the idea that such structures may act as efficient real-time nanosensors [32]. A new bivalent-brush polymer structure was introduced by Jeremiah et al. for use in chemotherapy delivery. A water-soluble PEG side chain and a drug molecule were attached to a polynorbornene backbone via a branch point. In response to an appropriate stimulus, the drug is released in a controlled way after it attached via a degradable linker. The power of this approach for the preparation of water-soluble polynorbornene-PEG brush polymers and copolymers that have anticancer drug, doxorubicin (DOX) and camptothecin (CT) covalently bound near the core through a photocleavable linker was also demonstrated [33]. This process ensures that the weight percentage of drug loaded onto the brush polymers is the same as the weight percentage of drug on the macromonomers.

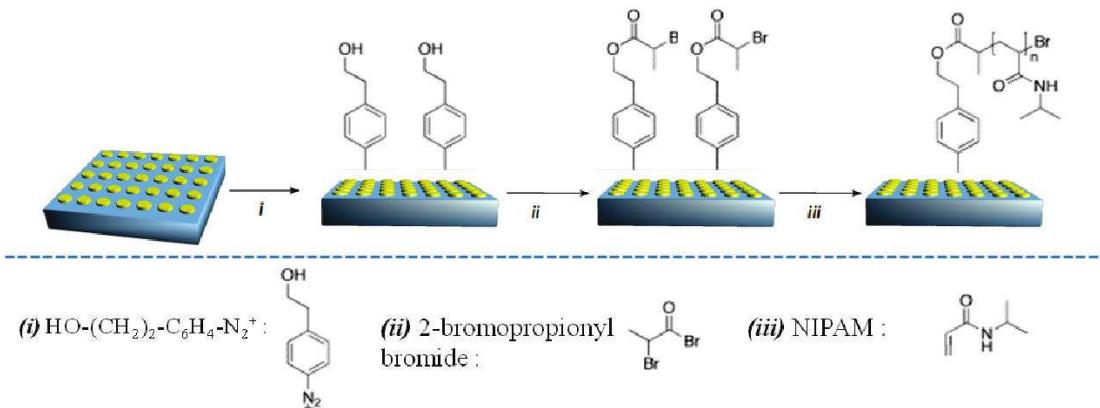


Figure 2 Fabrication of PNIPAM-grafted brushes on lithographic gold nanodot arrays. (i) Electroreduction of $\text{HO}-(\text{CH}_2)_2-\text{C}_6\text{H}_4-\text{N}_2^+$ salts on the substrate, (ii) esterification by 2-bromopropionyl bromide, and (iii) ATRP of NIPAM on the initiator-modified gold substrates.

Solution-based processing techniques of high performance organic semiconductor (OSC) materials have emerged as the most promising in terms of fulfilling the requirements of low cost, high functionality electronics, such as, thin film transistor circuits for flexible active matrix backplanes [34].

High mobility is one of the important production requirements for OSC materials. There was an approach to improve self-assembly of the functional molecules, which have a better control diffusion in the drying film by reducing the evaporation rate [35]. A higher boiling point solvent, such as toluene, xylene, etc. is used in this system. In this way mobilities close to but not much higher than $1 \text{ cm}^2 \text{ V}^{-1} \text{ s}^{-1}$ could be achieved. Later, Maria et al. reported another approach for further increasing mobilities of OSC transistors based on a dual solvent system [36]. In the case of the single solvent film, large elevations on the surface consisting of needle-shaped crystals are clearly visible, whereas a platelet-shaped crystallites was observed for double-solvent film. Platelet-shaped growth allows for better bridging of the electrodes and provides charge carrier pathways along two more directions, which maximize the charge transport across the channel. In this way, a very high device mobilities was achieved.

2.2 MAGNETICALLY MODALIZED THIN FILM

Magnetite nanoparticles are biocompatible and slowly degradable under biological conditions, which have different protein forms viz; ferritin and hemosiderin as major degradation products [37]. Magnetic nanoparticles have potential uses in magnetic field guided drug delivery, magnetic hyperthermia treatment of cancer and as contrast enhancement agents in magnetic resonance imaging [38]. If magnetic nanoparticles are encapsulated with poly(NIPAAm) based copolymers, it have been found to be a good drug carrier with controlled release behavior and magnetic field guided targetability. To release drug above LCST, Poly(NIPAAm) based magnetic nanohydrogels containing particle sizes in the nano range with optimized LCST of above 42°C will be a suitable choice for combined hyperthermia and drug delivery system. Temperature optimized biocompatible nanohydrogel and magnetic nanohydrogel was synthesized by the Manish et al. for possible application in hyperthermia for cancer treatment [39]. The average size of magnetic nanoparticles was found to be in the range of 10–12nm. and the presence of Fe_3O_4 encapsulated within polymer hydrogel matrix was supported by electron diffraction analysis. A shift in LCST of poly(NIPAAm) based hydrogels either by grafting chitosan and/or encapsulating magnetic nanoparticles was observed. During reaction, a considerable change in poly(NIPAAm)-chitosan nanohydrogel size was observed when chitosan concentration was exceeded due to crosslinking of chitosan to poly(NIPAAm) and/or partially to the adhesion of free chitosan particles onto growing poly(NIPAAm)-chitosan hydrogel particles. An increase in LCST due to presence of iron oxide magnetic nanoparticles was suggested that dipole–dipole interactions may be responsible which prevent collapsing of crosslinked polymer segments. The magnetic nanohydrogels exhibits a moderate specific absorption rate and excellent cytocompatibility studies and can be considered as a potential appellant for hyperthermia treatment of cancer.

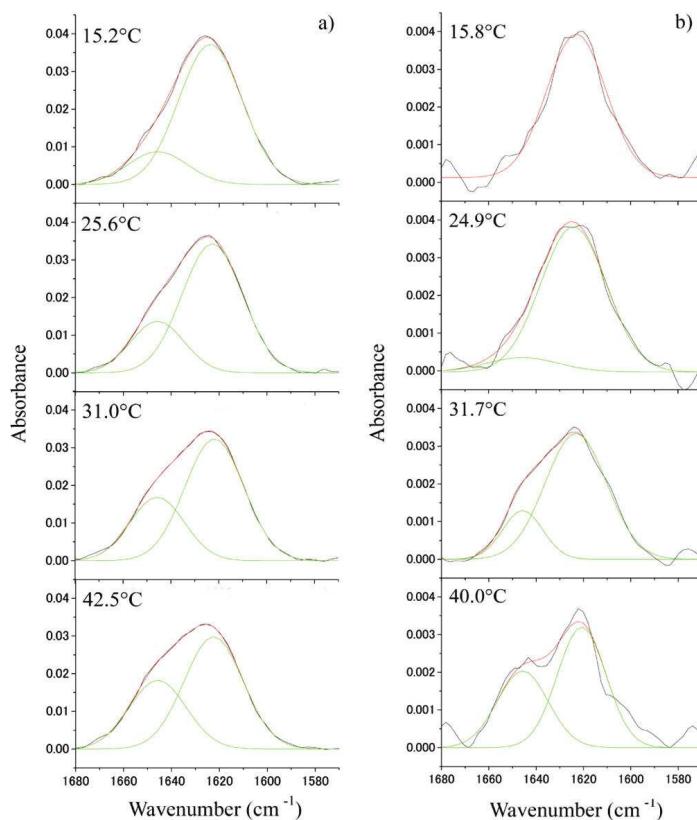


Figure 3. IR absorption spectra in amide I region for PNIPA grafted membranes with different graft densities at several temperatures. Black line: baseline subtracted amide I band, red line: curve fitted peak, green line: best fitted single Gaussian component. (a) high density brush; (b) low density brush.

2.3 INTERACTION INFORMATION OF PNIPA GRAFTED FILM

FT-IR is a powerful means to explain the interaction information of grafted membrane at the molecular level. Molecular behavior of PNIPA has been studied by several research group and brought out some interesting report. The vibration of amide group in PNIPA are highly sensitive during the change in temperature across the LCST. During changing the temperature across LCST, there exist two absorption peak at 1637 cm^{-1} for the PNIPA linear polymer in a solution state. But the intensity of these peaks are different. Maeda et al. interpret that intensity peak observed at 1625 cm^{-1} is assigned for C=O group that is bound to water molecules, and the intensity peak appeared at 1650 cm^{-1} is the peak of C=O group that is interact with neighboring N-H group [40]. However Katsumoto et al. reported dissimilar views regarding these peaks. According to them, the peak at 1625 cm^{-1} is refers the peak of C=O group forming a strong hydrogen bonding with the neighboring N-H group, and the peak at 1650 cm^{-1} is because of free C=O group [41]. H-NMR and UV spectra indicate that formation of hydrogen bonding with water depends on temperature [42], [43]. Change of the absorption peaks around the vibrations of amide groups in high and low density PNIPA brushes from $15.2\text{ }^{\circ}\text{C}$ to $42.5\text{ }^{\circ}\text{C}$ was observed [44]. In case of high density PNIPA brush, the amide I band was fitted at 1625 cm^{-1} and 1650 cm^{-1} at all temperature. The intensity peak at 1625 cm^{-1} decreased with the temperature increase, while the one at 1650 cm^{-1} increased (Fig: 3a). On the other hand, the amide I band of low density PNIPA brush consist only a single Gaussian component at $15.2\text{ }^{\circ}\text{C}$ centered at 1625 cm^{-1} (Fig: 3b). The component centered at 1650 cm^{-1} appeared at only higher temperature. PNIPA chains in the high-density brush are in a physically constrained state and the thickness of the membrane changed continuously over a much broader range with changes in temperature.

2.4 BIMETALLIC NANOPARTICLES DISPERSION IN POLYMER THIN FILMS

Metal and semiconductor nanoparticles dispersed in polymeric matrices exhibit unusual physical and chemical properties based on size-quantization effects of the nanoparticles. Bimetallic particles have also significant interest in surface chemistry, because the physical and chemical properties of the metal particles can be improved by adding the other component to the

monometallic particles [45], [46]. Polymer thin films containing metal nanoparticles can be synthesized by successive vacuum vapor deposition of a polymer and a metal followed by thermal annealing [47], [48]. If the films are annealed at a temperature above the glass transition temperature (T_g) of the polymer, the dispersion of the deposited metals can be achieved. But it has been shown that upon annealing in an inert atmosphere, Au particles can penetrate into nylon 11 films but Cu particles cannot [49]. To find out the reason behind this property, a further investigation was carried out which studied the effect of the composition and atmosphere on the dispersion of Au/Cu bimetallic nanoparticles, as well as their monometallic particles, induced by annealing in an N₂ atmosphere [50]. Deposition of Au and Cu on nylon 11 sample was confirmed by TEM image (Fig: 4). Although the formation of small particles on the nylon 11 surface at room temperature indicates a significant surface mobility of Au (and Cu) atoms, the changes in particle size with composition can be caused by the different surface diffusion coefficients of the Au and Cu atoms, depending on the interaction between the deposited metal atoms and the nylon 11 molecules. Remarkable composition dependence was observed in the particle distribution. The photoelectron intensity of the Au and Cu samples as a function of film depth shows that no indication of oxidation state for Cu was observed in the Cu Auger electron spectrum. According to the surface stress coefficient and critical composition results, it can be said that there is a strong correlation between the structure and dispersibility of particles in a polymer matrix, providing insight into the formation, structure and stability of metal/polymer composite systems.

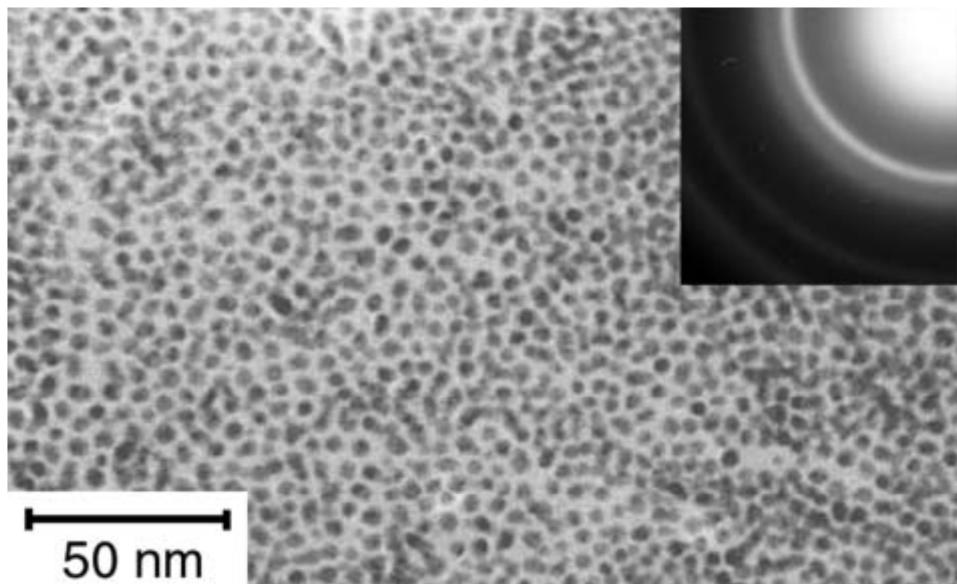
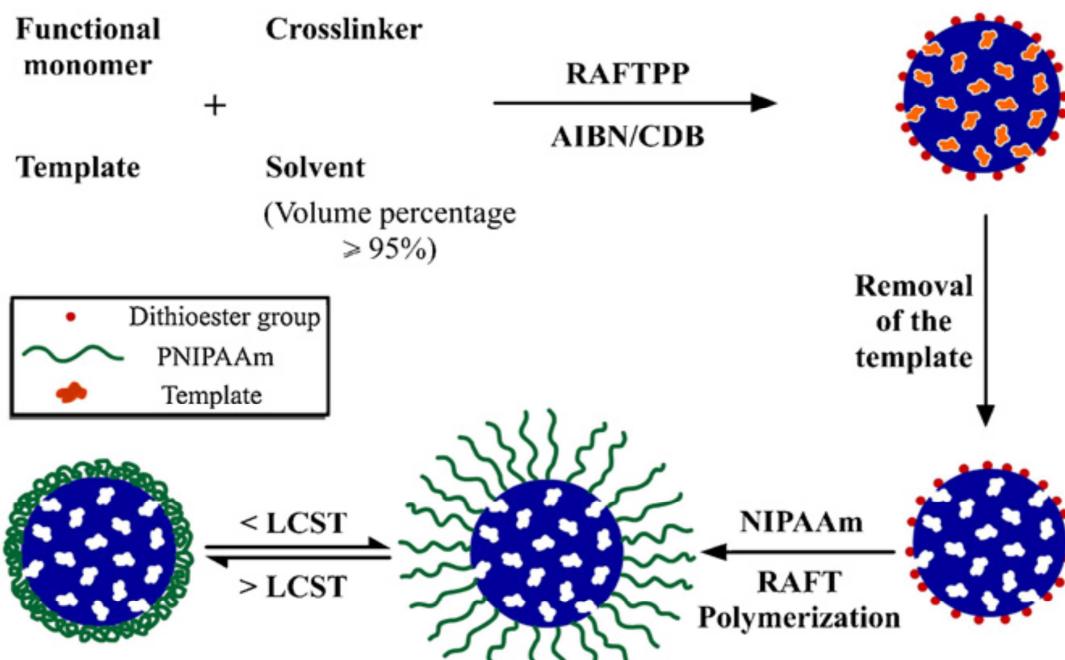


Figure 4. TEM image and SAED pattern of as-deposited Au_{0.70}Cu_{0.30} nanoparticles deposited on the nylon 11 surface.

2.5 MOLECULARLY IMPRINTED POLYMER BRUSH

In nature, biological processes like immuno-responses between the antibody and antigen, the ligand–receptor interaction, and enzyme catalysis are governed by molecular recognition mechanisms. Molecularly imprinted polymer (MIP) has proven to develop synthetic receptors with an affinity and specificity approaching that achieved in nature. MIP has also a lot of stimuli responsive properties, such as outstanding molecular recognition ability in the aqueous environments. Designing of advanced MIP is a matter of big challenge for the biological reporters [51]. MIP developed by Komiya et al. are only organic solvent-compatible and fails to show specific binding significantly. This MIP has a limitation to their practical applications in the field of biotechnology [52]. Meng et al. also successfully prepared pure water-compatible MIPs by adding certain amounts of hydrophilic monomers (e.g., 2-hydroxyethyl methacrylate and acrylamide) [53], [54]. Later an efficient approach has been reported by Guoqing et al. to obtain MIP brushes of poly(NIPAAm) via surface-initiated (RAFT) polymerization (Scheme: I). Aim of this experiment was to obtaining both pure water-compatible and stimuli-responsive onto the preformed MIP particles [55]. Their result shows that the MIPs exhibit significantly lower binding capacities towards phenoxyacetic acid and high molecular recognition selectivity of the ungrafted and grafted MIPs. Equilibrium binding experiments established that polymer brushes-grafting approach is highly efficient for the preparation of water-compatible MIPs. In comparison with the organic solvent-compatible MIPs and pure water-compatible MIPs, Guoqing's et al approach

should be more efficient in improving the surface hydrophilicity of the MIPs because it allows all the hydrophilic monomers to be grafted on the surfaces of the MIP particles.



Scheme I. Protocol for the preparation of water-compatible and stimuli-responsive MIP microspheres with surface-grafted functional polymer brushes.

2.6 ATTACHMENT AND DETACHMENT OF BACTERIA ON POLYMER THIN FILM

Biofilms are ubiquitous and its basic biological outline has been established and elaborated [56], [57]. The interfacial interactions between the cells and the supporting base are less well understood. Removal of unwanted biofilms, or biofouling, requires a better understanding of the substratum properties that are important in the maintenance of a biofilm. Hydrophobicity play an imoportant role in maintaining cellular attachment. If some cells attach initially to hydrophobic surface, these cells can easily be removed upon application of low shear forces [58]. The ability of the temperature responsive polymer (PNIPAAm) has been shown to release not only newly attached bacteria but also fully developed biofilms. The composition of the underlying SAM influences grafting efficiency may provide a means of controlling the polymerization process and the subsequent properties of the grafted surface. According to Cunliffe et al., the expected phase transitions of the polymers in solution were partly reflected by changing surface hydrophobicity. But there is a topographic differences in the polymer surfaces over the same temperature ranges [59]. Bacterial adsorption of surfaces also depend on the temperature, it increased with increasing the temperatures where the polymers were above the LCST but didn't change significantly to control surfaces or to a polymer surface. To release some bacteria like *Cobetia marina* and *Staphylococcus epidermidis*, the surface transition must be from one favored for attachment to one disfavored. For example, *C. marina* attaches well to PNIPA above 32 °C, released from the surface when rinsed with solutions below 32 °C. But in the case of *S. epidermidis*, it attaches larger numbers to surfaces with low water contact angle [60]. PNIPAAm from SAMs of ω -substituted alkanethiolates on gold surfaces were used to investigate the effect of water contact angles and the change in contact angle over the transition on the attachment and release of *C. marina* and *S. epidermidis* [61]. In the case of *C. marina*, tunable PNIPAAm provides a means by which cells can be removed at different points in biofilm development in order to assay physiological changes in attached (or attaching) cells. This system will only work for those strains of bacteria that can be attached with hydrophobic surfaces. For the attachment of *S. epidermidis* to SAMs, there is no strong dependence of *C. marina* as a function of water contact angle to the tunable PNIPAm surface. In addition, the model of this two bacteria are not alike. Liu et al. proposed that the attachment of bacteria to surfaces can be accurately patterned by also considering the contributions of Lewis-acid/base interactions to the surface energy of the attachment substratum [62]. The thermodynamic analysis underestimated bacterial retention when specific interactions between bacteria and serum proteins were considered for *S. epidermidis*. A combination of PNIPAAm and serum proteins and bacteria for biomaterial surfaces, as well

as bacteria/bacteria and protein/protein interactions might well be the best means for similar studies with hydrophilic organisms.

2.7 POLYMER COATED PLASMONIC NANOSTRUCTURE

Noble-metal nanoparticles (NPs) have a wide range of applications in nano-optics and ultrasensitive spectroscopies include guiding light on the submicrometer scale, light sources, filters, surface-enhanced Raman scattering or fluorescence. Many groups have considered the importance of achieving stimuli responsive plasmonic systems using active materials as a surrounding medium, applying a continuous and reversible modulation of the plasmonic response. Wurtz et al. observed a strong coupling between a plasmon supported by an assembly of oriented gold nanorods (ANR) and a molecular exciton. Their observation showed that both spatial and spectral overlap between the plasmonic structure and molecular aggregates are controlled [63]. Zheng et al. fabricated Au nanodisk arrays on glass substrates using nanosphere lithography combined reactive ion etching. Their analysis suggested that the nanoscale movements within surface-bound “molecular machines” can be used as the active components in plasmonic devices [64]. Leroux et al. fabricated a square array of oblate gold particles, the minor axis of which is oriented normally to the indium-tin oxide surface, and built an array of gold particles, which exhibits different localized surface plasmons (LSP) under X- and Y-polarizations due to some anisotropy. A short conclusion of their result reveals that conducting polymer electrochemical switching is a suitable way for adjusting the highest wavelength of nanoparticle surface plasmon resonance in a reversible way as well as combining conducting polymers and gold nanoparticle arrays allows one to develop switches and modulators [65]. Leroux et al. again used indium-tin oxide substrate as plasmonic devices to show that the quenching of the LSPR of gold NPs, induced by polyaniline switch, is stronger at higher wavelengths. According to their assessment, conducting polymer can be tailored at will supposed to change their switching potential or the transformation of their dielectric function upon switching which will yield to electrochemically driven plasmonic devices with adjusted optical characteristics [66]. A good control of the LSPR wavelength through the modification of the external stimulus can make gold nanoparticles polymer brushes. This system could be a very good candidate for real-time nanosensors. Thermosensitive properties of a hybrid plasmonic device based on stimuli responsive brushes grafted to lithographically designed gold nanostructures was analyzed to have a narrow LSPR band display [60]. The LSPR maximum position is mostly affected by the refractive index of water, because the NPs are deposited and not embedded in the indium-tin oxide substrate. This type of polymer structure has a fine tuning of their optical response through the change of temperature. This strategy can be applied to attach other stimuli-responsive polymer brushes on the lithographic system giving an efficient nanosensor lab-on-chip.

2.8 SELF-CLEANING POLYMER BRUSH

Segmented polyurethane type of polymer, which have both fluorocarbon and poly ethylene glycol segments and exhibits an enormous change of hydrophilicity have been reported several times [67], [70]. This type of polymer could be useful in the ability of the polymer to resist and release soils, combating fouling, and selective adsorption–desorption of proteins. Ability of stimuli-responsive polymer brushes to elicit a change in wettability upon solvent exposure is a continual development of polymer thin film. For a given surface, wettability depends on the surface tension of the fluids. If a homogeneous polymer grafted substrates has a lower surface energy than water, then the grafted membrane will always have a lower contact angle than water. To overcome the limitation of thermodynamics surface energetics, solvent-sensitive stimuli-responsive surfaces could be a good alternate. John et al. synthesized such type of polymer brush surfaces using oligomeric amphiphiles of polyethylene glycol and created a short perfluorinated end caps (f-PEG) [71]. According to their report, receding contact angle of a low surface energy fluid (hexadecane) is greater than the advancing contact angle of water. Because f-PEG surfaces displayed an increase in hexadecane contact angle and a decrease in the water contact angle. Polymer brush surfaces can be both truly oleophobic and hydrophilic and preferentially de-wet oil in favor of water producing self-cleaning surfaces where oil is removed by immersion of the surfaces. It was also exhibited that two droplets of different fluids (water and oil) on the same surface at the same time showed different constituents of the surface dominating interfacial energy. This type of surface behavior has potential application as self-cleaning coatings and oil-resistant anti-fog coatings.

2.9 RE-ASSEMBLY OF POLYMER THIN FILM

Patterned nanomaterials such as wires, rods, tubes, particles, flowers made from polymeric, metals, ceramics, composites, etc. have unique properties and wide applications. Patterned nanorings with different size, shape and interfacial spacing have been used to develop the performances of photocatalytic, optoelectronic, sensing, and data storage devices. Sun et al. synthesize hierarchical nanoporous TiO₂ mesoscopic ring arrays on solid substrates by using the annealed template-induced sol-soaking strategy. The ring size was controlled by changing the sol concentration and varying the annealing time

of the polystyrene sphere colloidal monolayer. TiO₂ metal loaded ring arrays might be used in optoelectronic devices, photocatalytic systems, and gas sensors [72]. Elin et al. demonstrated a linear relationship between sensitivity and spectral position for LSPR's situated in the near-infrared by exploring the LSPR resonance sensitivity of nanorings to bulk refractive index change. The sensing characteristics were expected to be influenced by the bulk sensitivity and the profile and homogeneity of the decay of the optical field away from the particle surface [73]. Guo et al. prepared a triblock copolymer by sequential anionic polymerization, end capping with ethylene oxide and subsequent aluminum catalyzed polymerization. A polyisoprene-b-polystyrene-b-polylactide triblock copolymer thin film was used as a template. They formed a core polyisoprene - shell polystyrene cylinders in a polyactide matrix with the cylinder axis oriented normal to the modified SiO₂ substrate. These nanoporous thin films should be able to perform as a good templates for the generation of metal anti-ring arrays upon deposition and template lift-off [32]. However, those methods can only be used to obtain special polymeric or pseudopolymeric rings, but it cannot be used flexibly and simply to fabricate different kinds of polymeric and organic-inorganic composite nanoring arrays. Xihong et al. demonstrated a technique of selective and sequential re-assembly of two blocks of a block copolymer thin film, patterned polymer arrays, including nanoislands, nanorings, etc., can be fabricated [74]. This is a facile approach to fabricate different types of functional polymeric nanoislands, polymeric nanoring and organic-inorganic composite nanoring arrays. This report demonstrated a technique to ordered Au-polymer composite nanoring arrays by pre-loading randomly distributed Au nanoparticles inside or on a diblock polymer thin film. During re-assembly process, Au or other nanoparticles are mixed in side or placed on the surface of the block copolymer thin film that can also be moved along with the polymer blocks. So disordered Au nanoparticles inside or on the surface of the thin film will be assembled again to form similar nanopatterns as the pure polymer.

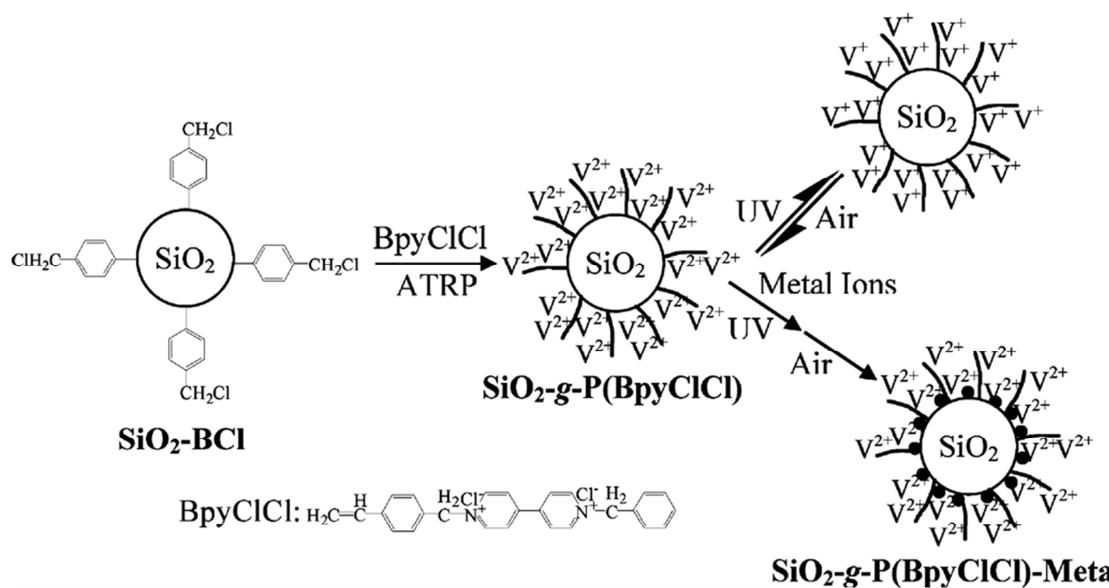
2.10 MIXED METAL COMPLEXES THIN FILM

Inorganic oxides exist in a large variety of structural geometries have found a wide range of applications in electronics, photocatalysis, solar hydrogen generation, and sensors [75], [76]. The characteristics of metal oxides are strongly dependent on their exact composition, fabrication temperature, crystal morphology, surface area, and crystallite size. Preparation of mixed metal oxides in various forms have approached by many soft chemistry methods, such as sol-gel, hydrothermal syntheses, and single-source precursor routes as well as chemical procedure such as chemical vapour deposition and aerosol assisted chemical vapour deposition method (AACVD). Liu et al. reported a synthesis procedure of free-standing 10-30 nm Lead zirconate titanate (PZT) nanoparticles with a modified sol-gel method [77]. This is the first report to synthesis free-standing PZT nanoparticles. The studies on PZT nanoparticles in a free-standing form elucidate the mechanism of ferroelectric properties in reduced dimensions as well as facilitate the applications of ferroelectric nanoparticles in advanced technologies. Muthar et al. described a high-pressure monoclinic and rhombohedral perovskite phases of PbTiO₃, in which more widespread use of this promising materials could greatly advance the field [78]. The results were consistent with Wu's principles theoretical predictions [79], but has a higher phase diagram than anticipated; moreover, the predicted electromechanical coupling at the transition is larger. This result also showed that at ambient pressure, the high electromechanical coupling in solid solutions with lead titanate is due to tuning of the high-pressure morphotropic phase boundary in pure lead titanate. It was also reveals that complex microstructures or compositions are not necessary to obtain strong piezoelectricity. Using this process, High-performance and pure electromechanical materials is possible to discovery, which could greatly decrease costs and expand the utility of piezoelectric materials. Qing et al. used sol-gel method by using a seed-mediated monodisperse spinel cobalt ferrite, CoFe₂O₄, nanocrystals can grow into a nearly spherical shape or an almost perfect cube in a highly controllable manner [80]. By adjusting the crystal growth rate, the shape of the nanocrystals was remarkably controlled. The shape of the nanocrystals can also be reversibly interchanged between spherical and cubic shape. Size of nanocrystal is depends on the blocking temperature, saturation, and remanent magnetization regardless of the spherical or cubic shape. But AACVD is easy to conduct, relatively simple and very versatile method among the alternative thin film deposition techniques. Using AACVD method, a single solution source can be used to fabricate multi component. This process also ensure both reproducibility and the presence of all the components in the deposited layer. Sultan et al. used Cu/ZnO mixed-metal oxide system to design and synthesis of discrete single source precursors for mixed-metal oxide composites and their subsequent use for the deposition of thin films by AACVD [81]. The microstructure, size and shape of the crystallites of films has changed by changing with substrate temperature. The crystallinity and the particle sizes are also depend on deposition temperatures. This system thus opens a new approaches towards the synthesis of nanostructured thin films of mixed metal oxide composite such as Cu/ZnO on a range of substrates and control of their microstructures.

2.11 NOVEL POLYELECTROLYTE FILM

Electronically charged polymer are very important for their relevance and importance to nanotechnology, surface engineering, and biotechnology. Polyelectrolyte brushes, which have ionic strength, pH, and solvent responsive behavior are

often been used to design smart surfaces and to achieve control over surface properties, such as wettability. Well-defined metal nanoparticles (NPs) can be prepared by the confinement of metal ions (such as AuCl_4^- and PtCl_6^{2-}) within certain polyelectrolyte films. Boyes et al. synthesized polyelectrolyte grafted membrane of either styrene or methyl acrylate and poly-(acrylic acid) modified by treatment with an aqueous solution of metal cations [82]. Zerovalent metal within the polymer brush was formed since the metal cations were reduced during treatment with H_2 . Furthermore, if the brush surface is treated with H_2 , it changes from smooth and featureless to having definite surface features. This was attributed to the formation of metal nanoparticles within the polymer brush. Mei et al. present a systematic study of the catalytic activity of platinum nanoparticles immobilized on spherical polyelectrolyte brushes that act as carriers [83]. As a model reaction, they use the reduction of p-nitrophenol by sodium borohydride that can be easily monitored by UV/vis spectroscopy. The average size of divalent PtCl_6^{2-} ions were 2 nm, which was bound as counterions within the brush layer and reduced to yield nearly monodisperse nanoparticles of metallic platinum. The reaction was pseudo-first-order with regard to p-nitrophenol and high catalytic activity was found when photometrically monitoring the reduction of p-nitrophenol by NaBH_4 in the presence of the nanoparticles. But it is well known that NPs show different characteristics as compared with their bulk counterparts and are of importance to application in emerging areas of nanoscience and nanotechnology. Xu et al. prepared a novel stimuli-responsive polyelectrolyte brushes of poly(N-benzyl-NO-(4-vinylbenzyl)-4,40-bipyridium dichloride) or



Scheme II. Schematic Diagram Illustrating the Preparation of P(BpyClCl) Brushes via Surface-Initiated ATRP of BpyClCl from the SiO_2 -BCI NPs and of Metal Nanodots on the SiO_2 -g-P(BpyClCl) Surface.

P(BpyClCl) via surface-initiated ATRP of N-benzyl-NO-(4-vinylbenzyl)-4,40-bipyridiumdichloride P(BpyClCl) from the benzyl chloride - immobilized SiO_2 (SiO_2 -BCI) NPs [84]. The exchange rate between BV^{2+} and BV^+ states of the P(BpyClCl) brushes on the SiO_2 nanoaparticles can be utilized directly, instead of metal reducing agents, to decorate the NPs with metal nanodots (<5 nm) (Scheme II). The P(BpyClCl) brushes on the SiO_2 nanospheres were used as the reduction process of the metal ions was actuated by activating the P(BpyClCl) brushes with BV^{2+} via UV irradiation in degassed metal salt solutions. The reduction process was terminated through the introduction of air to produce the metal nanodots (SiO_2 -g-P(BpyClCl)-metal NPs) after a predetermined period. These smart P(BpyClCl) brushes offer a facile route and added flexibility in the construction and preparation of high-surface-area substrates with well-dispersed metal or bimetal species.

2.12 ULTRATHIN FILM

Electropolymerization have been investigated to fabricate polymeric ultrathin films with respect to their synthesis properties, and characterization. The study of electropolymerizable monomers such as thiophene, aniline, pyrrole, and carbazole can yield unique polymerization mechanisms and electro-optical applications. Electropolymerization of 2,2':5',2''-

terthiophene (3T) at the interface between two immiscible electrolyte solutions (ITIES) where the interfacial potential is controlled by partitioning ions was reported by Evans-Kennedy et al. [85]. It was demonstrated that with low concentrations of 3T in the organic phase the hexamer of thiophene, sexithiophene (6T), can be synthesized at the liquid/liquid interface. Electropolymerization of terthiophene leads to the formation of highly electrochromic and conducting polythiophenes. Different thiophene oligomers species were identified spectroelectrochemically depending on the interfacial potential and the concentration of 3T present in the organic phase. Sexithiophene and its bipolaron were found as main products at low concentrations. But at higher concentrations, an insoluble black polymer was precipitated at the interface and sexithiophene radical cations and radical cation dimers were found to be present in solution. Modification of controlled living radical polymerization techniques such as surface-initiated RAFT or SI-RAFT permits the synthesis of tethered polymers with different functionalities. It provides a powerful tool for tailoring functionality and thickness of nanostructured coatings. It also exhibiting good control over molecular weight (MW), polydispersity index (PDI), composition, and macromolecular architectures. Carlos et al. focused for the first time a new route to forming surface-grafted polymers through the electropolymerization of electro-active chain transfer agent moieties followed by the homo- and diblock RAFT polymerization of different monomers from the surface [86]. In order to control molecular weight growth from the surface and maintain active “living” end groups, addition of free CTA and AIBN was performed in each case. The MW and PDI for these reaction was controlled by using the free polymer chains obtained from the solution. It should be possible to analyze various combinations of electroactive polymers and polymer compositions together with site directed electropatterning. This newly presented method opens a new favorable circumstance for further investigation and establishment of the “polymer brush” behavior under different conditions.

3 GRAFT COPOLYMERIZED HYDROGEL

3.1 RADIATION-INDUCED GRAFT POLYMERIZATION

If hydrogels are crosslinked structures and contact with water, it exhibit very low mechanical strength. To have a free movement of the hydrogels in polymer chains, it is therefore, appropriate to attach these hydrogels to another water insoluble surface by graft polymerization so that a comb like structure is produced. The grafting can be initiated by high energy radiation or a chemical means and materials with sutures, wound dressings, implants and tissue engineering may be produced [87]. The lower critical solution temperature (LCST) of the grafted polymer stays at 32 °C, but it should be above 37 °C to achieve the required task of drug delivery. S. Ikram et al. developed a smart polypropylene(PP) non-woven fabric where the drug release takes place above 37 °C in contact with the human body [88]. According to their result, the grafting parameters play a key role in the graft management within the fabric matrix. Due to the higher peroxidation at higher doses,

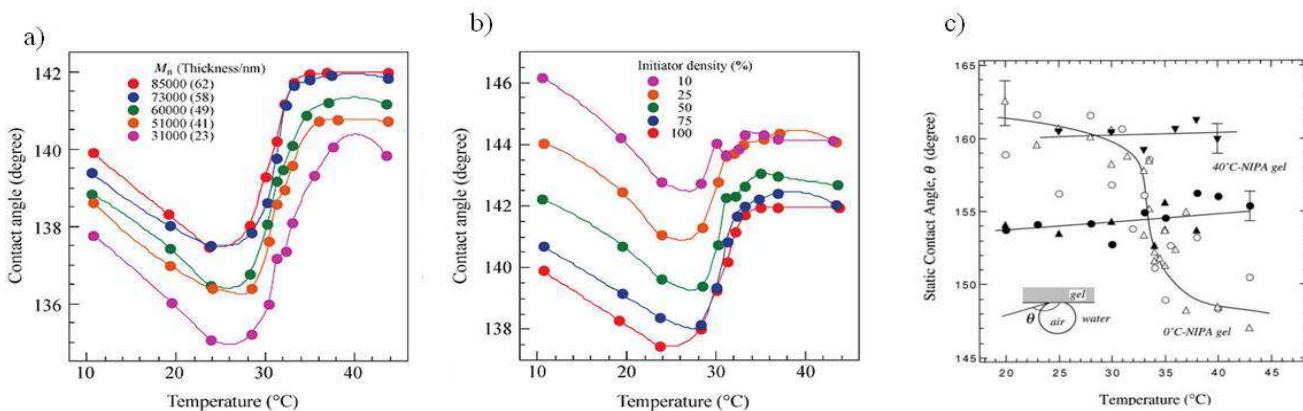


Figure 5. Contact angle of air bubble underneath PNIPA grafted membranes in water, (a) for the same high density PNIPA brushes with different molecular weight (b) for the almost same molecular weight PNIPA grafted membranes with different grafted densities, and (c) PNIPA gel surface in water as a function of temperature.

3.2 CONFLICTING BEHAVIOR BETWEEN GRAFTED MEMBRANE AND HYDROGEL

Recent progress in controlled or living radical polymerizations, which has extensive properties of the component polymer in the diluted solution can be applied in various smart soft materials with ordered architectures [89], [90], [91], [92]. As a result highly ordered soft materials can be fabricated, and their physicochemical properties are strongly influenced by

molecular interactions. Synthesis and characterization of semi dilute, medium density and high density polymer brushes has been reported in many studies [93], [94], [95]. Inappropriate methods were selected for making the high-density brushes of PNIPA. Appropriate surface conditions is most important factor for attaching PNIPA to one end and the preparatory method to form grafted PNIPA for making a real high density brush of PNIPA. A high-density PNIPA brush is necessary to obtained more precise properties due to the presence of intermolecular interactions. Suzuki et al. reported the precise preparation of a high density brush of poly(N-isopropylacrylamide) (PNIPA) brush on silicon substrate by ATRP and performed a systematic study of the physicochemical properties of the brushes [44]. Sessile drop method was used to measure contact angle and examine the hydrophilicity of water-soluble polymer grafted membranes. According to their result, The contact angle decreased with an increase in temperature up to 24 °C but the value of contact angle increasing when temperature passes LCST (Fig: 5a). A similar change was observed for the PNIPA brushes, composed of different molecular weights but with nearly identical graft density (Fig: 5b). This temperature dependent contact angle result is conflicting with previously reported PNIPA hydrogel surface [96]. Atsushi et al. conducted similar experiment on PNIPA gel and found that the absolute value of contact angle at different locations decrease with increasing the temperature, where the decrement of contact angle at temperature around 32 °C become large in accordance with increment with temperature (Fig: 5c). The static contact angle versus temperature was found to be quite different between two reports. But contact angle of both PNIPA grafted membrane and PNIPA gel decrease up to around 25 °C in water, indicating that the hydrophilicity of the surface decreases gradually.

3.3 FUNCTIONALIZED POLYMER GEL

Environmental stimuli-responsive gating membranes exhibit permeability changes in response to external stimuli such as temperature, pH, ionic strength, electric field, and substance species. It can be prepared by grafting of functional polymers or graft copolymerization of functional monomers directly onto the existing porous membranes [97], [98], [99]. A functional membrane consisting of a thermo-sensitive polymer gel, PNIPAAm, on the surface and inside the pores of track-etched polycarbonate (PC) membranes, which have straight cylindrical pores with a sharp pore-size distribution was developed by Wencai et al. [100]. Their report demonstrated a fast and reversible valve switching mechanism in a small temperature range. The surface morphology data of PC membrane reveal that the pristine PC membranes has cylindrical and straight pores, having uniform pore geometry with a pore size of 0.7-0.9 μm, which was consistent with the reported 0.8 μm nominal pore size. Water contact angle result of pristine PC membrane and the PC-g-PNIPAAm membranes at 25 and 40 °C showed a reverse properties of hydrophobicity and hydrophilicity. When the temperature increased above LCST, the hydrophilic/hydrophobic transition of the grafted PNIPAAm layer on the PC-g-PNIPAAm membrane surface made the PC-g-PNIPAAm hydrophobic. A hydrophilic membrane surface is better to increase the water flux of membrane rather than a hydrophobic membrane surface. Similarly a hydrophilic pore surface should be helpful to increase the water flux of membrane than a hydrophobic pore surface.

Natural amphoteric polyelectrolyte derived from chitosan, has a wide range of biomedical applications especially in its biocompatibility such as wound dressings, artificial bone and skin, bacteriostatic agents and blood anticoagulants etc. The graft copolymerization of N-isopropylacrylamide (NIPAAm) with carboxymethylchitosan (CMCS) was carried out by Hou-feng et al. and compared with PNIPAAm gel [101]. The poly(NIPAAm-g-CMCS) hydrogel has numerous open and porous structure in swelling state to reduce the flow resistance of water molecules in or out of the hydrogel to improve temperature sensitivities. This thermosensitive and biodegradable hydrogel have been used to separate and purify some biological materials such as proteins, enzymes and amylase as well as in the drug delivery system.

4 CONCLUSIONS

The recent decade was fruitful in the development of number of stimuli-responsive polymer grafted membranes and nanoparticle-polymer composites that open a wide research area in the field of polymer. Development of polymer grafted film was approached in the understanding of intrinsic properties and envisaged therapeutic use. Some extensively unique properties of polymer grafted films, like flexibility and biomedical application associated with the in situ method of fabricating, grafted membrane have considerably enhanced their visibility in recent years. It triggered a quantum jump in research efforts leading to the optimization of new synthesis protocols, establishment of novel systems and investigation of special features and applications. The grafted film prepared by graft copolymerization of PNIMAm onto various types substrate have shown a LCST in the range of 25-33 oC. The stimuli responsive polymer films have shown an improved drug loading capacity, and a sustained release behavior. It was developed that a smart polypropylene(PP) non-woven fabric where the drug release takes place above 37 oC in contact with the human body. The grafting parameters play a key role in the graft management within the fabric matrix. Still some limitation is of grafted film in seen especially for biomedical

applications. A range of materials capable of recognizing important signaling molecules with a high level of selectivity must be developed. We do believe that his review could help to develop new stimuli responsive polymer grafted film which could be utilized in various field.

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**تأثير الفكر والمعتقد على العملية البناءية:
المدينة اليمنية القديمة في الالف الاول قبل الميلاد نموذجاً تطبيقياً**

Influence of Thought and Belief on the Process of Building: Ancient Yemen City in the First Millennium BC as an Applied Model

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ABSTRACT: Settlement pattern of cities Depends on several factors including topography, climate, available materials and the cultural expression of community. The reaserch concerns for the cultural expression of community. This research deals with the city in ancient Yemen during period of the ancient kingdoms since the beginning of first millennium BC even the kingdom of Himyarite in the Central Highlands of Yemen. The research aims to identify the relationship between the religious beliefs of a society and its impact on Architecture. The reaserch methodology depends on putting theoretical framework shows the relationship between beliefs and the process of designeing and building. Then, it is applied on the architecture through selecting of certain models of ancient cities of each kingdom. The research concluded general conclusions about Urbanism in that era, in addition to know the strength of the relationship between religious beliefs and structural output.

KEYWORDS: kingdoms of Yemen, Yemen's ancient architecture, ancient religion of Yemen, Yemen's history, symbolism.

ملخص: يعتمد نمط الاستيطان للمدن على عدة عوامل منها التضاريس والمناخ والمواد المتوفرة والتغيير الحضاري والثقافي للمجتمع، وما يهمنا في هذا الصدد هو عامل التغيير الحضاري والثقافي. يتناول هذا البحث المدينة في اليمن القديم خلال فترة حكم الممالك وذلك منذ بداية الألف الأول ق.م. وحتى قيام مملكة حمير في المناطق الجبلية الوسطى. وبهدف البحث إلى التعرف على العلاقة بين المعتقدات الدينية للمجتمع وتأثيرها على العمارة والعمارة المدنية، وعلىه فقد تم طرح إطار نظري يوضح العلاقة بين المعتقدات والعملية البنائية، ثم تطبيقه على العمارة المدنية، من خلال انتخاب نماذج معينة للمدن اليمنية القديمة لكل مملكة. وقد خلص البحث إلى نتائج عامة حول العمارة المدنية في تلك الحقبة، إضافة إلى معرفة فرة العلاقة بين المعتقدات الدينية والنتائج البنائية.

كلمات دلالية: المالك اليمنية القديمة، العمارة اليمنية القديمة، الديانة اليمنية القديمة، تاريخ اليمن، الرمزية

المقدمة 1

يتناول البحث الحالي العمارة المدنية (المدن) لمملوك اليمن القديم في الفترة التاريخية لليمن التي تبدأ في بداية الألف الأول ق.م (المرقطن، 2013)، وهي الفترة التي ظهرت فيها الكتابة. ونستطيع القول إن الحضارة اليمنية القديمة ونشأة المالك قد تركزت في الهضبة الشرقية والمرتفعات الشرقية والمناطق الوسطى من اليمن. وهذه المنطقة من شبه الجزيرة العربية حُكمت من قبل ممالك هي: معين، وسبأ، وقبان، وأوسان، وحضرموت. وقد اعتمدت تلك الممالك على تجارة التوابيل كاللبان والبخور، التي استخدمت كجزء من الطقوس في ثقافات عده، حيث انتشرت طرق التجارة والتي تصل بين مركز الانتاج في مدينة سمهر وقنا إلى غزة، وأماكن أخرى من المناطق القريبة من البحر الأبيض المتوسط (Gerlach, 2008). ونظرًا لحركه التجارة والتنقل عملت الناقاط والمطحاطات التي تخدم المسافرين، ومن هنا توسيع تلك الأماكن مكونه المدن (المرقطن، 2013). كما أقيمت المدن الرئيسية لمملوك اليمن على الوديان، حيث أقيمت مأرب عاصمة سبأ على وادي أذنه، وتتنوع عاصمة قبان على وادي بيحان، وشبوة عاصمة حضرموت على وادي المعشار، وقرناء عاصمة معين على وادي الجوف، وهجر يهر عاصمة أوسان على وادي مرخة (حنثور، 2005).

مشكلة البحث: لقد ظل تاريخ العمارة اليمنية القديمة غائباً، إلا ما تناقلته المصادر التاريخية والتي يدورها تحيز بنوع من المبالغة السردية، والتشويش الناتج من تضارب أراء الكتاب وأختلاف الروايات المتواترة. ومن جانب آخر، يشير البروفيسور يوسف محمد عبدالله حول موضوع دراسة المدن اليمنية القديمة إلى "أن الأبحاث الأثرية والتاريخية والاجتماعية في هذا المجال لا تزال في أول أمرها، بل تسير ببطء، وأبرز الجهود التي بذلت في هذا السبيل هي أبحاث البعثة الأمريكية لدراسة الإنسان، ودراسات فون فيسبن، وجرو همن، والبعثة الفرنسية في شوة، ورسالة الشيبية في أسماء الأماكن اليمنية القديمة، ومعظم هذه الأبحاث لا تُعنى مباشرة بتاريخ المدينة اليمنية القديمة ومواقعتها وخطتها وفن عمارتها، وإنما تلمس هذه الأمور لمساً خفيفاً لدى الحديث عن الآثار والنقوش القديمة في اليمن"(عبد الله، 1990). والحقيقة، إن غالبية من قام بدراسة التراث اليمني هم الأثريون والتاريخيون في ظل غياب ملحوظ لدور المعماريين في هذا المجال، مما كان له انعكاساته في عدم إبراز التراث العمراني لليمن. وبناءً على ما سبق، فإن العمارة اليمنية القديمة، والتي كان من المفترض أن تكون بؤرة اهتمام الدراسات المعمارية، بقيت تتناول في مجالات اهتمام الدراسات التاريجية والاثرية، ولم تتم دراستها معماريًا ضمن مناهج معمارية هدفها محاولة فهم تلك العمارة.

الأهداف: يتضمن البحث العمارية اليمنية القديمة وبالخصوص المدينة القديمة، وذلك لهدفين: الأول إظهار وإبراز خصائص واسس التشكيل العماني للمدن اليمنية القديمة خلال فترة الالف الاول ق.م، والثاني التتحقق من مدى تأثير المعتقدات الدينية على العمارة والعمان ل تلك الفترة.

منهجية البحث: في الحقيقة، لقد اعتمد البحث على الافكار والطروحات التي وضعها بعض علماء الانثربولوجيا وعلماء الاديان المقارنة ومنهم (ميرسيا الياد وروجيه كايو ويوسف شلخد وروبترسن سميث) حول المكان المقصى و حول نظرية الانسان المتبين للعالم والوجود. هذا وقد اعتمدت منهجية البحث على المنهج التقليدي والذي يعتمد على النقاوة وخصوصاً المعتقدات الدينية التي سادت حينها، من خلال طرح اطار نظري للعلاقة بين الرؤى العقائدية للمجتمع وتأثيرها على المنتج البنائي، ثم تطبيق ذلك على نماذج منتخبة من المدن لكل مملكة يمنية قديمة. كما تم اعتماد المنهج التاريخي والوصفي في جزئيات تفاصي ذاك.

2 الرؤى العقائدية والعملية البنائية

سيتم طرح نموذج للعلاقة بين الرؤية العقائدية والعملية البنائية عبر عدد من الخطوات، وهي: إيجاد الموقع (المكان المقدس)، ثم تحديد المركز (المقدس)، ثم تحديد الحدود (البيازات)، وأخيراً تبني النموذج الأمثل.

2.1 إيجاد الموضع (المكان المقدس)

عادةً ما تسعى الذاكرة الجمعية للمجتمع التقليدي إلى تحويل أي فراغ إلى مكان ترغبه الإقامة فيه باباطته بهالة قدسية تمنحه أبعاداً ميتافيزيقية. والاعتقاد بقدسية مكان ما يمكن في الاعتقاد بأن بقعة من الأرض أصبحت أرضًا مقدسة لالله يظهر نفسه فيها (Smith, 1894)، ويعرف المكان المقدس إنه "مجال أرضي، معزول عن العالم المدنى، يحظر على الإنسان دخوله عموماً، لأن روحًا خفية تجلت فيه واتخذته مسكنًا لها" (شلحد، 1996)، وهذا المكان منظم بطريقة سامية تحركه قوى عليا تتصف بالفقيس، وعلى التقىض منه يوجد مكان آخر (غير المقدس) منظم بصورة عشوائية لا تعالى فيه ولا طهارة. وفي هذا الصدد، يشير كاروا إلى أن من المفترض أن يرسو أي مجتمع على نظام يصونه من المحظورات التي تومن سلامته، فكل ما يضمن صحتهم وثباتهم يعتبر مقتضا (كالياوة، 2010). ويختلف المكان في معتقد الإنسان المتدين، فالمكان لديه غير متاجس تحكمه انكسارات ميزة ما هو مقدس عن غير المقدس، فالمكان المقدس يكون ذو بنية وشكل محدد، بينما يكون المكان غير المقدس عديم الشكل؛ والانقطاع الذي يحدث يفضح عن "النقطة الثابتة" التي تمثل المركز والممحور لكل توجهات المستقبل (إلياد، 1988).

ومن الضروري التحري عن اختيار المكان الملائم وتجنب ما يعتقد انه فضاء يخص جالبات الشر والتقوى الخفية، ومحاولة العيش في المكان الذي يتواجد داخل حدود المقدس، فالميل لدى المجتمعات التقليدية هو العيش اكبر ما يمكن داخل حدود المقدس الذي يتصرف بالحقيقة والقوة ويكون مشبع بالكينونة (الإيد، 1988). وفي اليمن القديم كان يتم تحديد المكان المقدس (الحرم)، من خلال تخصيص ساحات واسعة تحجر للإلهة، حيث تسمى في النقوش "بطحة" أو "بطحنن"، ثم تقام المعابد في وسطها (العربيق، 2002). ويتصف المكان المناسب في اليمن القديم: أولاً، على المكان فيكون في سفح جبل يطل على أكبر مساحة مفتوحة أو في تل مرتفع على وادي ليتحقق عدد من العوامل منها الأمان من مخاطر السيول والفيضانات ومن مخاطر الحيوانات والغذاء، ثانياً وجود المناخ المناسب والمياه، ويكون قربى من مناطق الحقول الخصبة الضرورية للزراعة، يقول المؤرخين حين أتّجه سام بن نوح باحثاً عن المكان المناسب وجد اليمن أطيبها ثم بحث فوجد صناعه أفضلها (الهمداني، د.ت.).

2-2 عناصر المكان المقدس

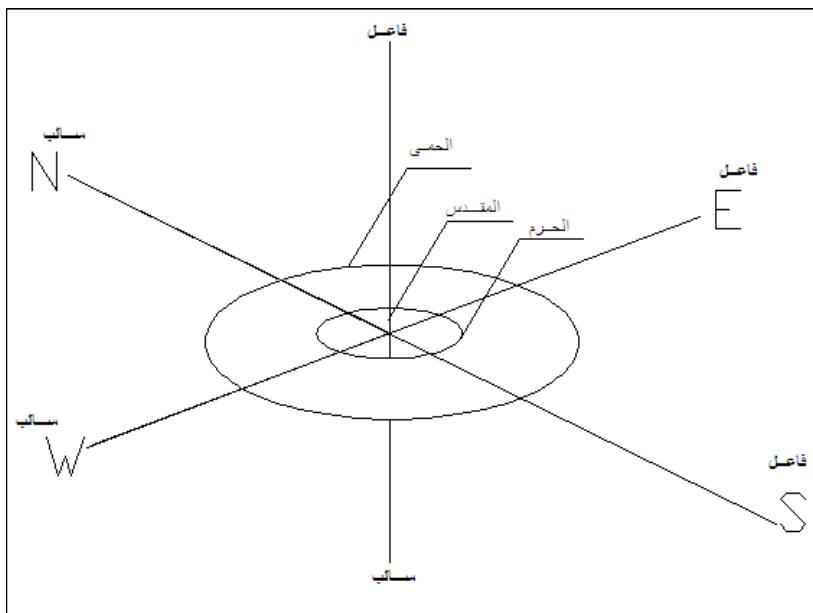
تعرف الأماكن المقدسة في اليمن القديم باسم (حرم، حرم، محرم)، وتتميز بأنها محظية يكون كل حيوان ونبات داخلها آمناً لا يجوز قتله أو قطعه (Hoyland, 2001)، ويُعرف بعض الباحثين المكان المقدس فيقول أن "المكان المقدس هو موضع تجلّي قوّة خفية، يسْتَلزم تعرِيفاً من حيث حدوده وسماته. فهو يتَّألف عموماً من ثلاثة دوائر مركبة، ذات أبعاد وقداسة غير متكافئة. فالمركز، موضع تجلّي الخارق بالذات، يعد منزلة مقام الإله، قدس الأقداس حيث لا يستطيع أحد الدخول سوى جهاز الطقس وبالتالي، يبني فيه حرم، كعبة أو بيت، أي منزل يكون في آن مقاماً للإله وحاجزاً يحمي المؤمن من غواية الاقتراب مما يتَّبعه المسروح والممكן" (شلّد، 1996). والمكان المقدس في اليمن القديم يتدرج من المركز الذي يكون المقدس بأ Mantzar، والذي فيه يتجلّي الإله ويسكته، ثم يأتي الحرم أو المحرم، ثم الحمى الذي يطوق المكان المقدس ويحدد معالمه (العربي، 2002) (الشكل 1). وعلىه، فالمكان المقدس يتكون من:

1-2-2 المركز: هو مكان تجلی المقدس، ويمثل النقطة الثابتة التي تظهر بعد الانقطاع، والتي تسمح بتكون العالم (الإيداد، 1988)، وبهذا يتحدد المكان المقدس عبر اختيار المركز والارتباط به كونه يمثل النقطة المرجعية لجميع التوجهات المستقبلية؛ ويرتبط المركز بمركز العالم في مفهومه وارتباطه بال المقدس، ويمثل هذا المركز المكان الذي يسكنه المقدس (الإله) ويكون أما قدس الأقداس في المعبد أو المعبد نفسه في المدينة.

2-2 الحرث: هي الحدود المقامة بين المقدس والمقدس (شلحد، 1996)، وهو مكان مقدس يتم التعامل فيه بشكل من الخصوصية تختلف عن الأماكن العامة (Smith, 1894)، والحرث أو المحرث عبارة عن مساحة كبيرة من الأرض يمتلكها الإله أو يتقى المجتمع على قدسيتها وتحصص للإله، وهذه المساحة لها حدود معينة تفصل بينها وبين الأرضي العادلة. وإن لفظ محرث يمثل مجلل الموقع أي "محيط مقدس" واسع الامتداد، محيط محدد الأطراف "وفقاً لنصل النصب الذي يمثل حجر حد للموقع والذي عثر عليه في أطراف موقع درب الصبي "قف/ زن/ محرثهن" أي حد هذا الحرث" (الأغبري، 2003).

3-2 الحمى: هو مجال وهبي من الأرض يحمي ويطوق الحرث، ويعرف الحمى في نقوش المسند بلفظ (محبت) (محمي) ومعناها الأرض المحمية، والحمى هو المحجر (علي ج 7، 1993)، وفسرت لفظة "حجر" في النقوش بمعنى "حامية بطلسم أو تعويذة"، والحجر في اللغة يعني المنع والحماية (سالم، 2011). وطابع الحمى القدس يتميز بحضور ممارسة العمل الجنسي، وقتل الطرائد وقطع الأشجار، وقتل الجنادل على حدوده عمل العادة (كابيا، 2010). وقد شمل مفهوم الحمى كل الممتلكات والأراضي الخاصة بالإله، والأراضي الخاصة بالإفراد، وكان له قوانين صارمة يفرضها الإله نفسه، فثمة نقش عبارة عن قانون صادر من الإله تأبى حول حماية مراعي خاصة بمدينة برن ومنع الرعي فيها لأفراد من خارج المنطقة (التعيم، 2000).

هذا ويختلف الفضاء وقدسية المكان لدى العرب تبعاً للطبيعة الثانية لجسم الإنسان من حيث الأمام والخلف واليمين واليسار، والأعلى والأسفل، فيكون الأمام مقدس والخلف مقدس، ويكون الأعلى مقدس والأسفل مقدس، واليمين مقدس واليسار مقدس (Sowanee, 2009)، ويكون ذلك حسب الاتجاه أفقياً بالإضافة على محور حرفة الشمس فاليمين ميموناً وخيراً واليسار (الشمال) منحوساً (علي ج 6، 1993). وعليه، جاء معقد العرب حول "الطيرية" فإن تيامن الطير دل على الفأر وإن اتجه يساراً دل على التشاوؤم (دغيم، 1995)، وإن جهة اليمين تقابلي الجنوب المفعم بالبركة والخير، فريح الجنوب تحمل الخصوبة والازدهار. وعلى المستوى العمودي فإنها تنقسم إلى ثنائية علو مقدس وسفلي مقدس، وعلى هذا فالعالم العلوي مرتبط بالنور، بالنظام، بالنظام، بالنظام، بالنور، بمكان سكن الخبر (الآلهة)، أما العالم السفلي فهو مرتبط بالفوضى واللعنة، وهو عالم جهنمي تسكنه الحيات والشياطين وقوى الشر، لذا فإن الفضاء ينقسم إلى مناطق لكل منها قيمة رمزية، وكل اتجاه مثل يمين شمال أمام خلف أعلى أسفل ومركزه قيمة يستمدتها من صلته بال المقدس أو غير المقدس (عجينة ج 2، 1994).



الشكل 1: الطبيعة الثانية وتدرج قدسية المكان في المعهد اليمني (الباحث)

3-2 تحديد المركز والمحور (المقدس)

من أهم اشتراطات الكشف عن المكان المقدس والتوجه "التأسيس العالم" حيث العيش واقعياً، هو الحصول على المركز "النقطة الثابتة"، والتي يتم الكشف عنها من خلال علامات خارقة لا تنتهي لهذا العالم أو بمساعدة أحد الكائنات التي لا تنتهي إلى عالم البشر (إلياد، 1988)، ولكن هذه النقطة الثابتة تمثل المركز الذي يمتد منه المحور الكوني للعالم، فقد كان يحدد موقع المركز والمحور في اليمن القديم في الجبال أو مكان مرتفع عن مستوى الأرض. كون الجبل يحمل رمزية مزدوجة فهو يرمز إلى المركز والمحور، فكان اليمنيون القدماء يختارون الجبال كمكان لإقامة معابدهم نظراً لقدسيتها واعتبارها أماكن مقدسة (De Maigret, 2002) والمركز هو النقطة الثابتة التي تمثل حجر الأساس، وتحديد موقعها يتطلب دلائل احتداء ببداية خلق الكون حتى يصبح البناء البشري مشابه للعالم في بداية خلقه (إلياد، 1987)، فحين بدأ سام في البحث عن أطيب أرض ووجد صناعه أطيبها، بدأ بتأسيس المدينة وتحديد مركزها الذي يمثل قصر غمدان ووضعه للأنسان، جاء طير وأخذ الخيط "العقربنة" وتحرك ليحدد له مكان ركن البناء "الظبر" (الارياني، 1995). إن وجود الطير يشير إلى أمر اختطاط صناعه ولأجل اختطاطها كمكان مقدس، يتوجب تحديد مركزها المقدس فجاء الطير ليحدد المركز (المقدس)، والمحور هو الظبر الذي جاء في النقوش بعدة مدلولات منها الجبل أو الربوة الصخرية أو الحجر أو حجر الركن، فمنها مثلاً "وقف/ ظبر هو/ سون/ مشرق": وممر صخره تجاه المشرق" وعن تأسيس وبناء قصر غمدان يذكر إن سام بن نوح بعد أن وضع الخيط بموضع الأساس في فج عضدان غربي حقل صناعه بناء الظبر (الأغبري، 2003).

ويتمثل المعبد صورة مصغره للكون والعالم، لذا فهو يحتل مركز العالم، وجراه الأربعه تمثل جران السماء الأربع (Lethaby, 1892). وعلى مستوى الكون الصغير (المعبد) يمثل قدس الأقداس المركز، وبوجود المركز تكتفى القداسة في المعبد، ومن قداسة المعبد تأتي قداسة المدينة كل، فمقام الإله داخل المدينة يجعل منها مكاناً مقدساً، حيث ينتشر وينتشر الحدود الافتراضية لوجوده في رقعة معينة، ف تكون المدينة مقدسة بفضل مكان محدد فيها يضفي عليها صفة القداسة وينتشر إلى حرم (الربيعي، 2000). وأن لوجود المعبد داخل المدن اليمنية القيمة قد اكتسبها القداسة، وبذلك تتصف تلك المدن بقداسة حلّت عليها وعلى سكانها بتواجد الإله وبيته داخل حدود سورها. وعليه، فإن تحديد مركز المكان المقدس يتطلب بناء معبد يحتله المقدس نفسه، فيكون المعبد هو المركز الروحي ونقطة الوصول بين المحاور الأفقية والمحور العمودية الذي يصل إلى السماء، ووجود المعبد يسبيغ على المكان القداسة والحرمة، وحول هذا القطب يمتد العالم الصالح للسكن.

2-4 تحديد الحدود – الحيازات

إن لتبني الفضاء وانشطاره إلى مكان مقدس وأخر غير مقدس دور في تعريف المكان المقدس وعزله عن المكان غير المقدس عن طريق تحديده وتعيين معالمه، فكان يتم ذلك في اليمن القديم بأنصاف أو أوثان أو عن طريق تطبيقه دائرياً (Hoyland, 2001)، ثم يوكل حمايته إلى إله خاص بحماية الحدود، حيث كان لكل مملكة يمنية قيمة إله خاص بالحدود، فمثلاً كان الإله "ورفو" إله الحدود في مملكة قتبان (الحسني، 2012)، وكان الإله "قوس أو قيس" إله حماية الحدود عند قبايل ذو ريدان (الحمد، 1995). هذا وتمثل الحدود نهاية تأثير المقدس، وهي الإطار المقدس لكل مكان، فالمعنى المنسد تحت لفظ "حول" وتعني قوة سحرية للمعبود لحماية المكان (سالم، 2011). ومن الحديث جاء مفهوم "الحوطة" المنشقة من الفعل الماضي "حوط"، وكلمة الحوطه تعنى الموضع والمكان الذي يخترقه الوالى ويحدد من كل الجوانب أفعال شائنة فيها، وهي عادة على شكل دائري تحيط بالمكان، ويأتي معنى الحديث في نقوش المسند تحت لفظ "حول" وتعني قوة سحرية للمعبود لحماية المكان (سالم، 2011). ويعلن أنه أصبح حرمًا أميناً ومكانتنا مقدسًا (عقيل، 1987)، فلا يصبح للકائنات الشيربرة مفعول، فلا تؤدي الأفاعي الساكنات داخله أو على قرب منه، وقد قال اللبخى إذا داغت الأفاعي إنسان ما قرب ناعط وصاح ناعط ناعط لم تضره بشيء وذلك أن مدينة ناطع محوية، أي مقدسة ومحفوظة (الهمداني، 2004). ومن الخصائص العامة للحوطة، أن تكون في ملتقى الطرق التجارية، وأنها محاطة بهالة قدسية، وإن تعرّف بحرمتها حكومات المنطقة والقبائل المحيطة (عقيل، 1987).

ولقد كانت هناك حدود تفصل بين الأماكن بحيث يكون ما يدخلها من أرض مقدسة لا يمكن انتهاكها، وعلى مستوى العمران فإن هذه الحدود هي عبارة عن أراضي مقدسة تفصل بين المدن والقرى (بروتون، 2002). وللمدن حدود ما كان خارجها عُد منقطع الصلة عنها، وتسمى هذه الحدود في التفاصيل المسندية بلفظ (اود) بمعنى (الحد) وهي حدود المدينة (علي ج 5، 1993). وإن وجود وتجلّي المقدس في المركز يتنّج عنه تكتّف الفراسة، بحيث تقل وتتدرج كلما ابتعد النساء عن (المركز) الذي يمثل بالمذبح أو قدس الأقداس في المعابد، ثم يأتي بعد الحرم الذي يمثل بالمعبد، وأخيراً يأتي الحمى الذي يحدد بالتطييف والإحاطة للأرض المحمية من كل الجهات بعد أن تحدد حدوده بوسائل معينة كما عمل كلبي بن وايل باستخدام بعد عواء الكلب من كل الجهات (علي ج 7، 1993). وعادة كان يتم رسم حدود الأرض المقدسة ووضع علامات (ركائز أو أعمدة) على جميع الأطراف، وفي المدن كان يحدد المكان المقدس بواسطة الجدران (Hoyland, 2001)، أو الأسوار المحيطة بالمدن، وكانت للأسوار آلية خاصة بحمايتها ففي نقش قتباني يوضح أن الإله عم كان حامياً للمدينة وأسوارها، حيث جاء فيه ان "أهل أسسلم قاموا ببناء أسوار المدينة ذي سلم (أو سليم) من معبد عم وقوة شعبهم (قبيلتهم) أسسلم وضعوا في حماية (الإله) عم المدينة ذي سلم" (الحسني، 2012).

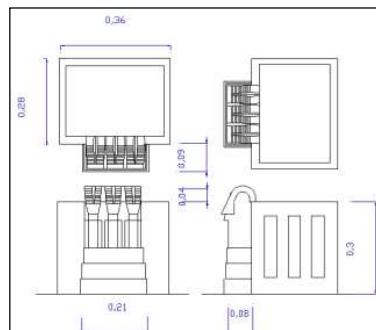
2-5 تبني النماذج - البديهي والمثالي

ارتبطت فكرة النمط type بالمفاهيم والقيم الروحية وذلك من خلال الأنماط العليا التي تشمل النماذج الأولية لأي عملية خلق جديدة، حيث يمثل خلق العالم النمط البديهي (archetype) لكل حركة خلق يشير إلى مثال يحتذى به في كل خلق جديد (الباد، 1988)، وهذا النوع يمثل أنماط تحمل تعبيرات أسطورية يشتراك في تصورها أفراد المجتمع كونها تعبير عن الاعتقاد بأن الإله أو الأبطال الأسطوريين هم من صنعوه. هذا ويمثل النموذج الأمثل (prototype) (القابل المرجعي لتبني أي نتاج عماري جديد بهدف المحاكاة والرمزية لصنع أسطوري أو إلهي مخلد، وهذا النموذج التجسيدي المقدس للمفاهيم والقيم الروحية العليا ضمن ثقافة المجتمع، وبينني فكرة النموذج الأمثل تتعدد المفاهيم العليا لدى المجتمع عن طريق الاستحضار لها فيكتب له الاستمرار والديمومة وتترسخ في ذهن الأفراد في أشكال مادية. والحقيقة، لقد كانت المعابد في مخيلة النساء تتمثل النموذج الأمثل prototype للسماء، فهو ينبع من تنصيم المعبد وشكله وبين العالم (Lethaby, 1892)، كما يمثل المسكن كون صغير في الرؤية التقديسية (الصالوي، 1994). وفي هذا الصدد يعتقد رابوبورت أن تصور الإنسان للكون والعالم ينعكس بمقاييس أصغر للكون فيما يمثل المدينة بكاملة أو القرية أو المسكن، وحتى الفراغ والأثاث (Rapoport, 1969).

وان الإنسان الديني بطبيعة يخلق رموزاً فيزيائية لمفاهيم عقائدية مثل تبني النموذج للجبال المقدسة، في أعمال وأشكال معمارية تملك وظائف روحية تشبه جبال الإله، وكون الجبل قد أرتبط فيزيائياً وروحياً بالسماء والإله، لذا استخدم كنموذج لفضاء والمكان المقدس، وكونه يمثل المحور الكوني ويملك قوته المقدسة لذا تحولت هذه القوة إلى أشكال مثل المعابد والقصور وغيرها (Sowannee, 2009). وإن هذه النماذج تجسد التصورات والأفكار الأساسية للحياة الأولى في السماء (زمن البدء)، فمثلاً كانت فكرة البيت الإلهي (السماوي) لدى العرب القدماء له شكل "مكب" وليس شكلاً آخرًا فكان الشكل المكعب مقدساً (الربيعي، 2000)، فبنيت على غراره كل المعابد والمساكن. وفكرة الشكل المكعب جاءت من الجبل الذي يمثل النموذج الأمثل والذي يتميز ببنائه المشابه لثبات العالم، لذا تم تبني الشكل المستقر- المربع والمستطيل - محاكياً للجبال المقدسة.

وعند البحث عن جذور الشكل المعماري للمعبد اليمني باعتباره النموذج الأمثل، يتضح التشابه الكبير عند مقارنة شكل المعبد مع أشكال موائد القرابين (الاشكال 2-5). فشكل المعبد عبارة عن مكعب تبرز البواحة في مقدمته وبذلك فالشكل العام جاء ليليبي الرؤى والمفاهيم العقائدية فيجسد بصورة رمزية المادنة المقدسة التي جاءت بدورها تعبير عن مفاهيم فكرية. وحيث أن الشكل هو وسيلة الاتصال الأولى عند الإنسان على مر التاريخ، فالتعديل في الشكل يمثل حقيقة الإيصال، وإن المعنى للشكل إن كان مجرد يمكن في فعل الاتصال والتشابه. وفي هذا الصدد، يقول العربي "كان تصميم المعبد اليمني وخاصة الشكل الخارجي هو الملهم لفنانين اليمنيين القدماء حيث استلهماه ووظفوه في جميع أنواع الزخارف التي استخدموها على الفنون الصغرى. فقد استلهماه منه عدد كبير من أشكال المبادر، ومعظم أنواع تيجان الأعمدة المخروطية الشكل، ونوع من أنواع موائد القرابين، وهي موائد القدادات التي جاءت مطابقة لتصميم المعبد من الخارج" (العربي، 2002). ويؤكد ذلك كريستيان دارل حيث يشير إلى أن موائد القرابين تعتبر مجسم مصغر لشكل المعابد القديمة، وإن التزيين والزخارف التي توجد عليها تشابه الزخارف التي زخرفت بها المعابد (دارل، 1999).

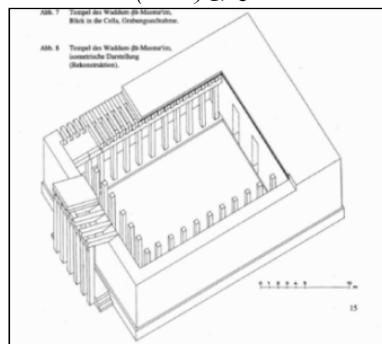
ومن جانب آخر، فإن مسقط المسكن اليمني القديم ما هو إلا تكرار لسقوط المعبد، وذلك نتيجة التشابه الكبير، وهذا التكرار قد تكرر على موائد القرابين المقدسة. ولقد قارن البرفيسور دي مغريه بين مساقط المعابد والمساكن والمقابر فوجدها تتشابه من ناحية الشكل والتفاصيل مع بعض الحالات التي استبدلت فيها الأعمدة في صالة المعبد بقوابط في المسكن والقبر، مما يوحي بوجود نموذجاً معمارياً واحداً تم تحويله على حسب الوظائف (De Maigret, 2005)، هذا وقد اعتبر دي مغريه مسقط المعبد مستوى من مسقط المسكن، ولكننا نختلف معه ونرى العكس من ذلك، وهو أن مسقط المسكن مستوحى من المعبد، كون المعبد بيت الإله، فوجود نموذجاً موحداً قد طبق في المقابر والمعابد والمساكن دلالة على وجود رؤى ومفاهيم يمنية مرتبطة بتصور معين يحملها هذا النموذج تتعلق بقصر الإله في السماء. وعليه، فتطبيقه أولًا جاء على المعبد كونه يمثل نسخة طبق الأصل لنماذج بدئية، ويدعم هذا الرأي تأكيد أحد الباحثين عند حديثه عن أصله تخطيط المعبد اليمني وامتداده ليشمل العمارة المدينية، حيث قارن وشبّه تخطيط قصر شبوة ومساكن ربيون ومشغة بتخطيط المعبد (العربي، 2002).



الشكل 3: مسقّط وواجهة أمامية وجانبيّة لمائدة القرابين (الباحث)



الشكل 2: مائدة قرابين يصف من الواقع - المتحف الحربي بصنعاء (تصوير الباحث)

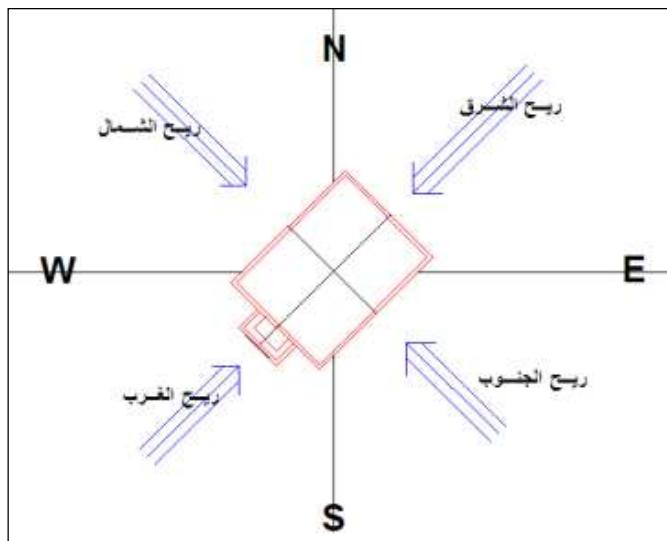


الشكل 5: ايزومترٍ لمعبد ودم ذي مسعم
(De Maigret, 2002)



الشكل 4: مجسمات لمعبد نكرح ومعبد عثر داخل براش (De Maigret, 2008)

وعن التوجيه الامثل، يتضح عند المقارنة بين المعابد اليمنية القديمة أن توجيه المعابد استقر على اتجاه معين، فكان الاتجاه الرئيسي الذي يربط البوابة مع قدس الأقداس في المعابد القديمة، يقع على محور جنوب غرب- شمال شرق. وعليه، فإن تصميم المعبد في اليمن القديم كان بتوجيه أركانه إلى الجهات الأصلية؛ لتشير إلى الجهات الأصلية الأربع، فيما تتجه أضلاع الشكل باتجاه حركة الرياح الأربع (الصبا، والدبور، والشمال، والجنوب)، أو يكون توجيه المعبد محورياً مع محور الشمس، فتكون البوابة غرباً وقدس الأقدس شرقاً مع ميل بسيط يجعل البوابة تتجه قليلاً باتجاه الجنوب وقدس الأقداس شماليّاً، فيكون الدخول إلى المعبد على يمين محور الشمس عند الاعتدال، فيعكس هذا التوجيه المعتقد أن اليمين ميموناً والشمال شومماً (علي ج، 6، 1993) (الشكل 6).



الشكل 6: النموذج الأمثل للتوجيه (الباحث)

3 المدينة اليمنية القديمة

أطلق على المدينة اليمنية القديمة في نقش المسند "هجر أو هجرن"، حيث تردد هذا الاسم في كثير من النصوص النقشية التي من خلالها ميز الباحثون الآثريون بين نوعين من المدن: هجر المدينة (العاصمة) كعاصمة سبأ مأرب (كمهر / مرتب)، وهجر المدينة عاصمة (الإقليم) الذي يقيم فيها القبل مثل (هجر / وعلان) مدينة وعلان (الجرو، 2003)، والمدينة الهجر هي مدينة دينية محمية وأنمه فلا يجوز فيها الخصومات والنزاعات (العرقي، 2002). وقد تعددت المدن اليمنية التي أطلق عليها اسم هجر، حيث تم حصر 106 مدن تحمل اسم هجر من نقش المسند، وكانت الهجر المدينة مكاناً آمناً يأمن فيه الناس على أنفسهم وأموالهم، ويمنع فيه الاقتتال، لذلك أصبحت الهجر مكاناً آمناً يؤدي فيه الناس شعائرهم الدينية بحرية (بركات، 1995)، والهجر من المهرة والذي يمثل العامل الرئيسي في تعريف المكان

بـ"الحوطة"؛ أي المكان المقدس، واستمر حتى بعد دخول الإسلام اليمن، وكانت زيارة بعض الحوطات لدى الحضارة فرض عين، واعتبر بعضهم الحج إليها أفضل من الحج إلى بيت الله الحرام "مكة" (عفيف، 1987).

3-1 مدن مملكة سبا

بلغت مملكة سبا شهرة كبيرة خلال الألف الأول ق.م، حتى أنها ذكرت في التوراة والقرآن، كما ذكرت في المصادر الكلاسيكية، وجاءت هذه الشهرة لتعكس المكانة التي شغلتها مملكة سبا، حيث مثلت العمود الفقري للتاريخ اليمني القديم. وقد بدأت بوادر الاستيطان للملكة السبئية، عبرة عن تجمعات بشرية قامت بإنشاء مدنهما في بداية الأمر في المناطق الشرقية لخولان العالية، حيث وجدت البعثات الأثرية العاملة في اليمن مجتمع إثنائي في مناطق شعب العقل والجفنة وبلا الريب (De Maigret, 2002)، واحتوت تلك المجاميع على منشآت كبيرة ذات جدران سميكة ومداخل حميمية، خُصصت للأنشطة العسكرية والت التجارية (دي مغريت، 1988). هذا وقد تطورت المدن السبئية في فترات لاحقة، وأصبحت تمتلك مخططاً بمعابر وقيم تستجيب لمتطلبات الشعب والدولة، فقد صنمت مدينة مأرب عاصمة المملكة على أرقى معايير التصميم والتخطيط السائد حينها، حيث يقترح جلاس أن تخطيط مدينة مأرب من عدة مناطق: المنطقة الأولى للتل الشرقي الذي بنيت عليه المدينة الإسلامية، كما يوجد تل في الركن الجنوبي الشرقي من المدينة وتحوي على معبد عثرة، وتوجد مساحة مفتوحة تقع في الجنوب الغربي (الميدان) إلى الغرب والشمال الغربي، ويوجد القصر في جنوب الميدان ربما كان هو قصر سلحين، حيث دل على ذلك القواعد الحجرية الضخمة. ولقد مثلت مدينة مأرب مركزاً دينياً مهماً وسوقاً تجارياً كبيراً، فمثلت ما يعرف بالحوطة (Doe, 1983)، لذلك فهي مكاناً مقدسًا يحتل موقع المركز.

سيتم تطبيق النموذج على بعض المدن السبئية، واعتبارها نماذج للعمارة المدينة في المملكة، وهي مدينة "يلا" كونها تمثل الأقدم، ومدينة "صررواح" كون معالمها واضحة.

3-1-1 مدينة يلا الدربيب

تقع المدينة في وادي "يلا"، على بعد 30 كم إلى الجنوب الغربي من مدينة مأرب، ومن خلال التواریخ الرادیو کربونیة التي أجريت على مسكن يقع في المدينة، فإن المدينة قد مررت بأربع مراحل استيطانية، الأولى في نهاية الألف الثاني ق.م، والأخيرة في القرن السابع ق.م (إیدینز وبلکنسون، 2001). وتمثل مدينة يلا الدربيب نموذجاً للمدن السبئية المبكرة، حيث وجدت على تل طبعي يرتفع عن مستوى الوادي، وبظهور من تخطيطها صغر حجمها، ومن الواضح أن المدينة قد صنمت بشكل منحنٍ، وذلك تماشياً مع طبوغرافية الموقع المرتفع عن سطح الوادي، وأخذت مساحة 2.3 هكتار، حيث تركزت مبانيها على المنطقة الداخلية المرتفعة في الجنوب الشرقي للمدينة، حيث تلقي المباني السكنية حول ساحة وسطية كبيرة (الشكل 7-8).

أثبتت التنقيبات الأثرية أن للمدينة سوراً قديماً قبل سورها الحالي تشكل من التقاويف وتلائق البيوت الخارجية للمدينة بشكل طوقاً دائرياً (دي مغريت، 1988)، كما أن أول ظهور للأسوار ذات البروزات (البارزة والغائرة) يشكل أبراج كان في مدينة يلا الدربيب (الشكل 9)، والحقيقة أن للأبراج غرض إثنائي، فهي تقوم مقام الدعامة والأكتاف التي تربط الأجزاء وتحميها من السقوط، وكانت تسمى هذه الدعامات بلغة المسند "محفر"، وهذا الأسلوب من التسوير يفيد في كسر خط السور الطولي، ويعطي السور لمسة فنية من خلال الاختلاف في الظل والنور على واجهة السور، وهذا الأسلوب كان متبعاً في بعض دول الشرق القديم، فقد ظهر في مجموعة زوسرا بصفاروة وفي معابد العراق القديم (بركات، 1995). وللمدينة مدخل يقع في الركن الشمالي الغربي بين بروز لكتين من السور ويتم الصعود إلى مستوى المدخل عبر سلم متدرج (الأغبري، 1994).

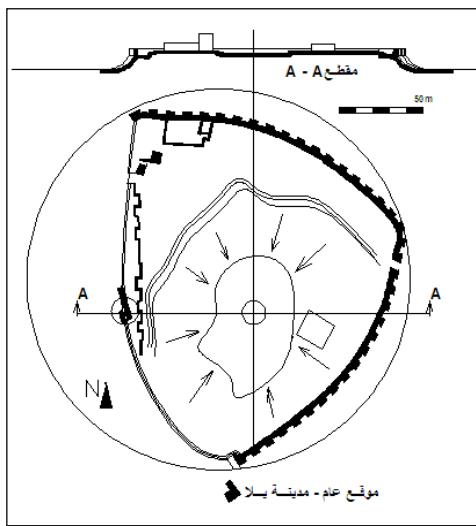


الشكل 8: صورة جوية لمدينة يلا الدربيب
(شبكة الانترنت)



الشكل 7: موقع عام لمدينة يلا الدربيب
(De Maigret, 2002)

وبناءً عليه، فقد اثر المعقد اليمني على اختيار موقع المدينة في مرتفع عن المحيط، ليرمز إلى الجبال المقدسة (المركز والمحور) مكان تجلی الإله. وشكل سور المدينة ظاهرة فريدة وجديدة، فعلاوة إلى أن السور يجسد حدود المكان، والحد الفاصل بين المكان المقدس (داخل المدينة) والمكان غير المقدس (خارج المدينة)، فقد مثل أول ظهور للأسوار الوظيفية والرمادية، والتي تتميز جدرانها بأسلوب الناتئ والغاز، وقد جاءت الرمزية من خلال المحاكاة الشكلية لفرون الوعول المنحنية والحلاقية، بحيث وظفتها البناءون في الشكل الخارجي للسور، فعلى جانب الوظيفة البروزات كدعامة إثنائية للسور وتنقية قوامه ونقطاط دفاعية للساكنين في مواجهة الأعداء، كذلك حماية معنوية ورمادية من خلال التوظيف الرمزي لرموز الهيبة تشمل رموزاً تجريدية لصفوف الوعول الذي يرمز للإله عثرة. كما ان الوصول إلى مستوى أرضية المدينة يتم عبر درج يسبق المدخل ليشير بذلك إلى الارتفاع والسمو إلى الجبل المقدس ومنها إلى السماء. ويتم الدخول إلى المدينة من مدخل على جانبية كلتين تشير بدورها إلى القطبية والثنائية للعالم والوجود. وأخذت الساحة الوسطية التي تلقي حولها مساكن المدينة العليا دور المركز والمحور العمودي الذي يربط المدينة مع السماء، فيتضمن لساكنيها الاتصال بال المقدس. وعليه، فقد شكلت الساحة الوسطية المركز في قديسية المكان فيما شكل السور حدود الحرم (الشكل 10)، وباعتبار المدينة قد اقيمت في منطقة مقدسة كانت تقام فيها طقوس الصيد المقدس، والتي تمتد من معبد معراب المساجد في الجنوب إلى الجفينة وشعب العقل في الشمال والشمال الغربي والتي تمثل حدود الحمى في قديسية المكان.



الشكل 10: مسقٍت وقطع لمدينة يلا (الباحث)



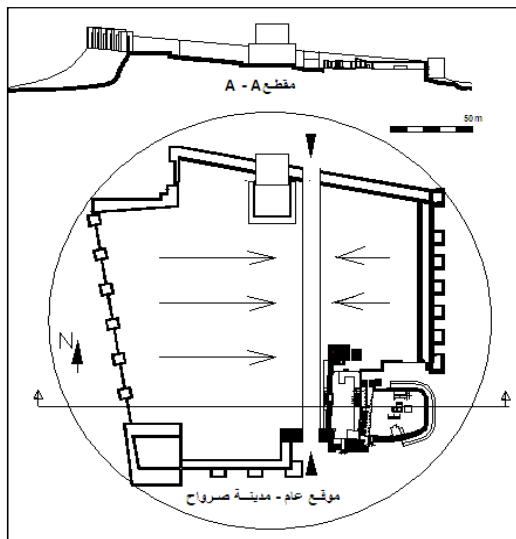
الشكل 9. سور يلا من الجنوب - تظهر البروزات (الباحث)

3-1-2 مدينة صرواح

تقع مدينة صرواح على سفح جبل يبعد 40 كم غرب مدينة مأرب، وقد صممت المدينة على مساحة تتجاوز 6 هكتارات، وجاءت متماشية مع طبوغرافية الموقع، وتم تخطيطها داخلياً بشكل شبه عبارة عن شوارع تربط أجزاء المدينة شرق- غرب، وشمال- جنوب، وللمدينة شارع رئيسي يقسمها إلى قسمين شرقاً وغرباً، حيث تقع في الجهة الشرقية المبنية الدينية، بينما تقع المباني المدنية غرب هذا الشارع، ويقع المعبد المقدسة (وعول المقدسة) في الركن الجنوبي الشرقي من المدينة، وفي منتصف الجهة الشمالية يوجد القصر أو مبني إداري (الشكل 11). وقد صممت المدينة بحيث تتجه أركانها إلى الجهات الأصلية، وبتجه محورها الرئيسي (الشارع الرئيسي) جنوب- شمال، والذي يربط المعبد في الجنوب مع القصر في الشمال.

يحمل توجيه المدينة وتخطيطها مدلولات رمزية، فالتجهيز جنوب - شمال يرمز إلى طريق التجارة، والمحور يجسد رمزاً للمحور الأفقي الذي يربط البوابة وهماياً بالمعبد، ووجود المعبد في المدينة، يجعلها جزءاً من عالم الآلهة، ويسبغ عليها القدسية والحرمة، والمعبود في مضمونه الرمزية يمثل المركز والقطب الكوني الذي يربط السماء بالأرض، وحول هذا القطب يمتد العالم الصالح والمبارك للسكن؛ وباعتبار الجنوب مموماً والشمال مشوّماً، فقد احتل المعبد جنوب المدينة حيث يمثل مركزها الروحي كما احتل الجهة اليمنى للداخل من بوابة المدينة الجنوبية وذلك باعتبار الجهة اليمنى فاعله واليسرى سالبه، وأحيطت المدينة بسور يبلغ ارتفاعه 8م، ويت Shank من بروزات مكونة من أجزاء ثلاثة وغائرة، وبني السور بالطوب (اللبن) من الداخل، ومن الأحجار من الخارج.

وهذا التصميم جاء انعكاساً لمفاهيم دينية مرتبطة بالمسننات التي جردت من صوف الوعل، والتي تحمل رموزاً ذات دلالات حول دور الآلهة في حماية الشعب والمدنة، كما ان السور يجسد الحدود الفاصلة بين قطبية المكان، ويحدد حدود الحرم والحمى، ويحدد حدود المقدسة، وللمدينة مدخلان، واحد يقع في منتصف الضلع الجنوبي، وآخر يتحمل وقوفه في الضلع الشمالي، وتم تمييز البوابة وتحصينها لكونها تمثل مدخل المدينة، ونقطة الفصل بين العالم الخارجي (المدن) والعالم الداخلي (المقدس)، وهي تحدد المعالم الأخيرة لحدود المكان المحرم (المقدس). وبناءً عليه، فقد تحقق المعتقد اليمني حول المكان المقدس وعناصره المختلفة، فاختيار موقع المدينة في مرتفع جبلي ليرمز إلى الجبل المقدس، ومثل المعبد المركز، وجسد السور حدود المكان المقدس، ومثلت البوابة نقطة الحد، وجسد الشارع الرئيسي المحور الأفقي والخط الفاصل في قطبية العالم والوجود. كما تتحقق معتقد اليمن حول الاتجاه، فمثل الشارع الرئيسي الشرخ الذي حد المكان المقدس واعطى المكان توازناً محوريّاً، حيث احتوت الجهة الشرقية منه على المباني الدينية وكان فاعلاً فيما احتوت الجهة الغربية منه على المباني المدنية. كما اخذت المدينة الشكل المستطيل او القريب من المربع الذي يتوسطه محور يبدأ باليابنة وهو النموذج المثالي. وتوجهت شوارع المدينة إلى المعبد (الشارع الرئيسي) لتجسد الاروقة في المعبد وقواعد الغرف في المسكن (الشكل 12).



الشكل 12: موقع عام ومقطع لمدينة صرواح (الباحث)



الشكل 11: موقع لمدينة صرواح (Gerlach, 2008)

3-2 مدن مملكة معين

قامت مملكة معين ومدنه الرئيسية مثل قرناو، وكمنة، ونشان، وشق، وبراقش في وادي الجوف الذي تحيط به سلاسل جبلية، هي اللوز ويام. سيتم انتخاب نموذجين من المدن المعينة هما: العاصمة قرناو (معين)، والعاصمة الدينية براوش.

3-2-1 مدينة قرناو (معين)

مثلت مدينة قرناو العاصمة السياسية للمملكة المعينة، وهي تقع في وادي الخارج من الجوف، فوق تل يرتفع 15م على مستوى سطح الوادي. والحقيقة، أن اختيار الموقع على مرتفع جاء لتحقق فكرة تقسيس مكان تواجد الآلهة، ويكون دالاً لمدلولات الجبال المقدسة، وأختيار مكان مرتفع جاء تعويضاً عن الجبل المقدس، حيث إن الموقع المحاذية والقريبة تخلو من الجبال. كما تم تحطيط مدينة قرناو بشكل مستطيل وذلك ببعد 350*240م تقريباً (Doe, 1983) (الشكل 13)، وبذلك فقد حاولوا تحقيق الجوانب العقائدية في محاكاة شكل المائدة المقدسة، وتم إخراج البوابة الغربية إلى الخارج لتبدو كمقامة بارزة تشبه المقدمة التي تقدم المأوى المقدسة.

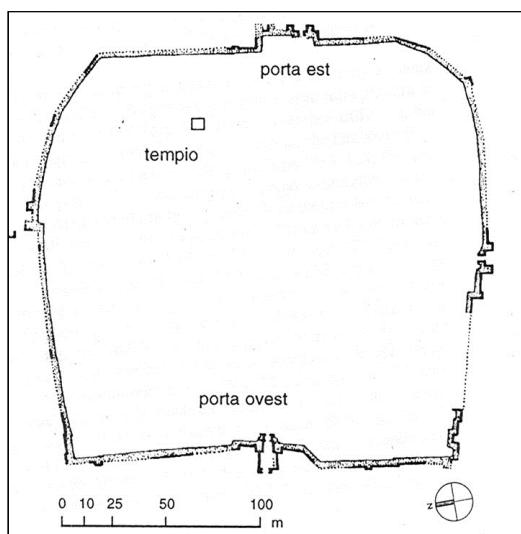
ومن جانب آخر، فقد تم توجيه المدينة لتجه أصلاعها إلى الجهات الأصلية بمحور رئيسي شرق - غرب، وبزاوية ميل 107 درجة من الشمال إلى الشرق، فيعطي هذا التوجيه دلالات تشير إلى ارتباط أركان المدينة بحركة الشمس في فصل الشتاء، وتم تعزيز ذلك ببناء برج في أركانها الأربع. ولقد أحياطت مدينة قرناو بسور حجري يرتفع 8م، عليه نوافذ عبارة عن فتحات صغيرة صُممَت في صفين، وتم تأثير نهاية السور بصف حجري يبرز من جانبي السور (الشكل 14). وعليه، فالسور يمثل نهاية حدود المدينة ويجسد حدود المكان المقدس ليصبح خارج السور عديم البنية والشكل، وداخل السور مكان مقدس له شكل وبنية يصلح للسكن. هذا وقد بنيت عدد من المعابد داخل المدينة معروفة منها الآن معبد عثرة الذي يقع في الجهة الشمالية الشرقية للمدينة، وبهذا المعبد يتحدد المركز الذي يجسد المقدس فيسمح للاتصال مع السماء.

يتم الدخول إلى مدينة قرناو عبر أربع بوابات تقع كل بوابة في ضلع من أضلاع المدينة الأربعة، وهي بذلك ترمز وتشير إلى الجهات الأصلية للعالم؛ ومن كل بوابة يمر شارع تقاطع جميع هذه الشوارع في مركز المدينة. هذا وتم تصميم المدخل الغربي بشكل بارز عن سور المدينة، حيث يتكون من مدخل خارجي ضيق، ثم فناء يوجد على جانبه الأيمن رواق مسقوف، ثم مدخل آخر ضيق، بحيث يكون المدخل الخارجي والفناء خارج السور، بينما يدخل المدخل ضمن حدود سور المدينة، فيعطيها دلائل كمرحلة تهيئة بين الخارج والداخل، وبينو الجزء الخارجي من البوابة محاكيًّا شكل المائدة المقدسة، حيث المستطيل يمثل شكل المائدة، تبرز منه مقمة مثلت بالمدخل الضيق البارز للخارج. ويوجد سلم في البوابة الجنوبية وسلم في البوابة الغربية يؤديان إلى مستوى أرضية المدخل ومن ثم إلى داخل المدينة (الأغوري، 1994).

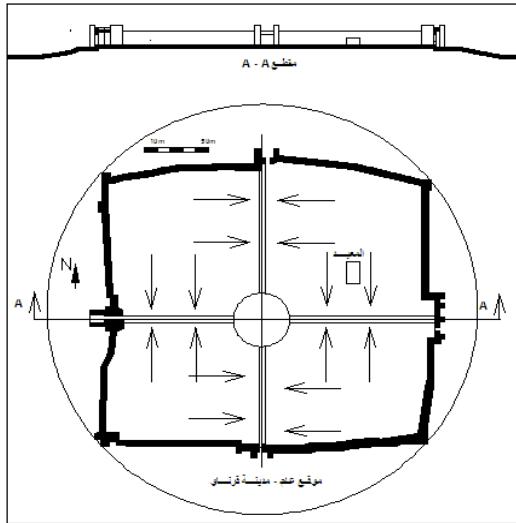
إن السلم يشير إلى الصعود الداخل يرفع نظره إلى السماء، كما ان رفع مستوى أرضية المدخل بهدف تمييزها باعتبارها تفصل الفضاء الخارجي (العلم) عن الفضاء الداخلي (الخاص). وعليه، فقد جسد المركز عند تقاطع الشوارع المؤدية إلى بوابات المدينة اضافة إلى كون المعبد يمثل المركز ايضاً، وجسد السور حدود الحرم، وحدد حدود الحرم، اقيم خارج المدينة في الجهة الشرقية وذلك على بعد 800م منها. كما جسدت المدينة النموذج المثالي وهو الشكل المستطيل، وجدست بوابتها الرئيسية (البوابة الغربية) والمدخل (الشارع الرئيسي- من الشرقي إلى الغربي) والمعبد الذي اقيم في الجهة الشرقية من المدينة التوجية الامثل، حيث حلت بوابة المدينة محل بوابة المعبد وحل الشارع الرئيسي محل المدخل فيما حل المعبد محل المقدس (المذبح)، وتوجهت شوارع المدينة إلى المدخل (الشارع الرئيسي) لتجسد الاروقة في المعبد وقواطع الغرف في المسكن (الشكل 16).



الشكل 14: جزء من سور مدينة معين (الباحث)



الشكل 13: موقع عام لمدينة معين (حتشور، 2007)



الشكل 16: موقع عام ومقطع لمدينة معين – قرناو (الباحث)



الشكل 15: منظر للبوابة الغربية من الجنوب (الباحث)

3-2-2 مدينة براقيش (بئل)

تعتبر مدينة براقيش (بئل) العاصمة الدينية للمملكة المعينية (عبد الله، 1990)، وتقع مدينة براقيش على مسافة 15 كم إلى الجنوب من مدينة الحزم، وتقع على مرتفع على سطح الوادي، ويتجه محور المدينة الكبير باتجاه الجنوب الشرقي إلى الشمال الغربي (الشكل 17). ولقد جاء تخطيط المدينة على شكل نصف دائري قریب من الشكل البيضاوي، وبمساحة أكثر من 4 هكتارات، ويحيط بالمدينة سور ارتفاعه 14 م مدعوماً بأبراج، وقد بني السور من الحجر وتمت زخرفته في نهاية البناء بأفارييز مستندة (دي مغربية، 2004).

لقد مثلت مدينة براقيش مكان مقدس حيث تحتل المدينة موقعاً مقدساً، فقد كانت من الأماكن المقدسة التي كانت محجاً يحج إليها، وكانت تقام فيها شعائر طقوسية وتقديم أضاحٍ وولائم وطواوف وصلوات (الجو، 1998)، وبها عدد من المعابد، وتم اختيار موقع مرتفع أقيمت عليه يرمز إلى الجبال المقدسة. وأخذت المدينة شكل الانحناء لقرون الوعل، وتم تعزيز ذلك ببروزات وتراجعات في بدن السور محاكيًّا لعقد قرون الوعل، فالانحناء غير المنتظم لسور المدينة يجعلها تبدو وكأنها الانحناء الذي تأخذه قرون الوعل. ولالمدينة بوابتان أحدهما تقع في الجهة الشرقية والأخرى في الجهة الغربية (Doe, 1983). وبني السور بأسلوب البناء المتدرج الذي يتراجع للخلف فيه صنف الأحجار العليا عن الصنف الذي أسفله، ويعيل البناء للداخل، وذلك لتحقيق فكرة التدرج للجبال المقدسة والميل الذي يحقق انحناء قرون الوعل. وتم إنتهاء بناء السور بحزام بطيقة وهو عبارة عن صفوف من المستنمات، وتم صقل حواف أحجار البناء الخارجية لتجعلها تبدو مطروفة ومحاطة. ولها بوابة رئيسية تقع في الجهة الغربية، وهي عبارة عن مدخل غائر نتيجة ارتداد في السور، بحيث تبدو واضحة وذلك بهدف تمييزها بوصفها نقطة مهمة وظيفياً، فضلاً عن كونها نقطة حد تفصل الخارج (العلم) عن الداخل (الخاص).

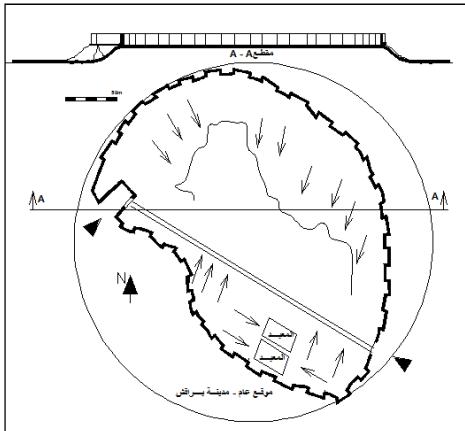
وعليه، فقد جسدت مدينة براقيش المكان المقدس، حيث جسدت المعابد التي أقيمت فيها المركز، وحدد الشارع الرئيسي الذي يربط البوابة الغربية بالبوابة الشرقية المحور، وجسد السور حدود الحرم، فيما تحدد حدود الحمى بواسطة المجمعات الشعائرية التي أقيمت في شقق المناص. كما تتحقق التموج الامثل للتوجيه حيث جاءت البوابة في الغرب وجاء المحور الاقفي الذي تتجه إليه الكل البنائي محل المحور الوهمي الذي يربط البوابة بال المقدس في المعبد (الشكل 20).



الشكل 18: صورة من الغرب لمدينة براقيش



الشكل 17: موقع عام لمدينة براقيش- قرقل ايرث

الشكل 20: موقع عام ومقطع لمدينة براقيش
(الباحث)الشكل 19: تراجعات البناء في سور مدينة براقيش
(الباحث)

3-3 مدن مملكة حضرموت

امتدت مملكة حضرموت على مساحة كبيرة من الأرض، حيث كانت تمتد من حدود مملكة قتبان غرباً وحتى حدود عمان شرقاً، وقد قامت فيها عدد من المدن المهمة منها: شبوة، ونقب الهجر، وريبون. سوف يتم التطبيق على بعض المدن الحضرمية، واعتبارها نماذج للعمارة المدنية في مملكة حضرموت، وهي مدينة "شبوة" كونها تمثل العاصمة، ومدينة "نقب الهجر".

3-3-1 مدينة شبوة

تقع مدينة شبوة على وادي المعشار ووادي العطف في مرتفع صخري يرتفع إلى 50 م عن سطح الوادي. وقد تم استيطان مدينة شبوة منذ فترات قديمة جداً تعود إلى الصور الحجرية القديمة والحديثة، فالآثار الموجودة على التلال المحيطة بالمدينة تدل على أن المدينة قد سكنت خلال العصر الباليوليتي، كما وجدت لقى أثرية تعود إلى العصر الحجري الحديث (بيرين، 1996)، فيما تم التأكيد من الاستيطان فيها إلى بداية الألف الثاني ق.م، واستمرت كمدينة فاعلة من القرن السابع ق.م إلى القرن الرابع الميلادي (Breton, 2003).

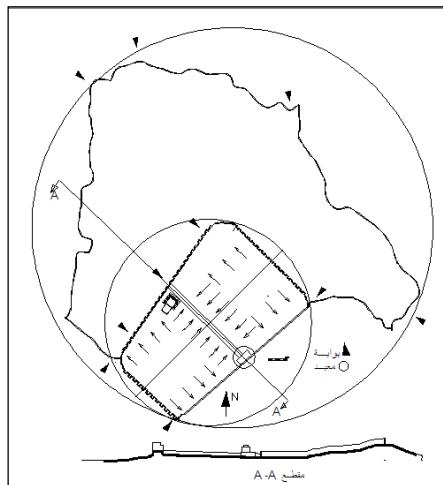
تأخذ المدينة الشكل المستطيل المنحرف بزيادة اتساع ضلعها الشمالي الشرقي (الشكل 21)، وهذا الشكل يمثل شكل المائدة المقدسة. ويقطع المدينة شارع رئيسي يبدأ من الشمال الغربي الذي يوجد فيه المدخل وعلى جهة اليمين القصر، وينتهي المحور بالمعبد الرئيسي للمملكة في الضلع الجنوب الشرقي، والملاحظ أن أركان المدينة تتجه إلى الجهات الأصلية. ويمتاز خطيط المدينة ونسيجها الحضري بالانتظام الهندسي على شكل متوازد للوحدات التي تتخللها شوارع ضيقة متعددة مع المحور الرئيسي للمدينة، والذي يقسم المدينة ويربط بين القصر والبوابة والمعبد، والكل البنائية تتجه بشكل متوازد مع المحور المركزي ومع السور المحيط بالمدينة، ويتباين نسيج المدينة من منطقة إلى أخرى، حيث تتوارد مبانٍ منعزلة في بعض المناطق، وتتشابك وتزدحم المباني في مناطق أخرى (دارل، 1996).

ويوجود الشارع الرئيسي الذي يخترق المدينة والذي ربما كان شارعاً مخصصاً لإقامة المواكب الدينية كونه ينتهي عند مدخل المعبد الرئيسي للمملكة (الأغبري، 1994)، فقد نتفق المعنى للمحور الأفقي الذي يربط البوابة بالمعبد الرئيسي، والذي يناظر محور المعبد الذي يربط البوابة والمقدس، وتم اختيار موقع مرتفع للمقدس (المعبد)، حتى تتحقق الرمزية للجل المقدسة، مكان تواجد الإله، فيكون هذا المعبد مرتفعاً عن بقية أجزاء المدينة، حيث يليق بمكانة الإله، ويتحقق المعنى الرمزي لحماية الإله للمدينة والساكنين من خلال إشرافه وإطلالته على جميع أجزاء المدينة. وبوجود المعبد الرئيسي (المركز) يتحقق للمدينة قدسية المكان، فيسبغ المعبد على المدينة قدسية يجعلها مكان مقدس وصالح للسكن.

يحيط بالمدينة سوران، أحدهما خارجي يمر على التلال الخارجية، والأخر داخلي يحيط بالمدينة، والسور الخارجي يُبني بأسلوب البناء الكلاسيكي من بروزات تتناوب على طول الجدار. فيما يُبني السور الداخلي من الأحجار واللبن بأسلوب يتغير بتناوب طولاً، ففي أماكن يُبني بأسلوب البروزات وأخرى يكون مستقيماً. وقد من بناء السور عبر عدد من المراحل التاريخية، ففرق إشارات كتابية، فإن جزءاً من بناء السور قام به (عم أنس)، وهذا النعش يحدد فقط زمن بناء برج وفناة أضيف إلى السور نحو عام 200 ق.م، ثم أعيد ترميم وتنقية السور وإضافة بعض الأبراج بعد ذلك، وخلال الربع الثالث من القرن الثاني الميلادي قام الملك يدج إل بين ابن يدع أبو بتريم ثلثة أبراج وأربعة أفنية (بيرين، 1996).

إن فكرة بناء السور بشكل بروزات ودخلات يحاكي شكل المسننات التي تم تجريدتها من صفوف الوعول رمزاً للإله عثرة الحامي للمنشآت والمدن. ويجسد السور حدود المكان المقدس فيكون السور الداخلي مجسداً للحرم في تدرج المكان المقدس، فيما يجسد السور الخارجي للمدينة حدود الحمى. وللمدينة عدد من البوابات أهمها البوابة الشمالية الغربية، وهذه البوابة هي البوابة الرئيسية للمدينة، حيث بنيت بالأحجار ولها برجان، وينتجه منها الشارع الرئيسي للمدينة، الذي يمثل المحور

المركي للمدينة، فيربط القصر الذي يوجد على يمينه، وفي نهايته يوجد المعبد الرئيسي للمملكة "معبد سين ذو اليم". والبوابة في معنقد اليم القديم تجسد نقطة الحد حيث تفصل المكان المقدس (الخارج) عن المكان المقدس (الداخل). وعليه، فقد جسدت مدينة شبيهة المكان المقدس، حيث جسد المعبد نهاية الشارع الرئيسي المركز، وحدد الشارع الرئيسي الذي يربط البوابة الرئيسية بالمعبد المحور، وجسد السور الداخلي حدود الحرم، فيما تحدد حدود الحرم بواسطة السور الخارجي. كما تحقق النموذج الامثل للشكل والتوجية حيث جاءت البوابة في الغرب وجاء المحور الأفقي (الشارع) الذي تتجه إليه الكتل البنائية محل المحور الوهمي الذي يربط البوابة بال المقدس في المعبد (الشكل 22).



الشكل 22: موقع عام وقطع لمدينة شبيه (الباحث)

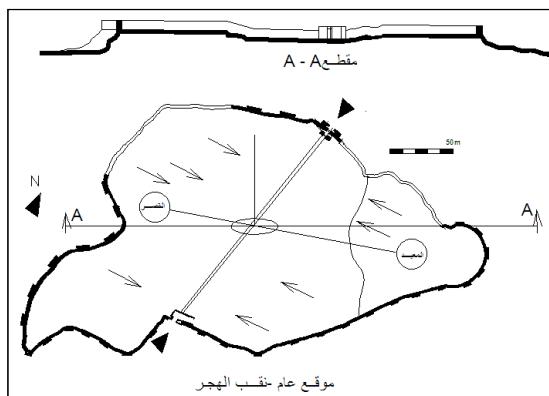


الشكل 21: موقع عام لشبيه يظهر سور الداخلي والخارجي (Breton, 2009)

3-3-2 مدينة ميفعة (نقب الهجر)

تقع مدينة نقب الهجر على تل يرتفع 14م عن مستوى الوادي، وت分成 المدينة جيولوجياً إلى قسمين شماليًا وجنوبياً، حيث المنطقة الشمالية هي الأقل ارتفاعاً. ومن الملحوظ أن جيولوجياً الموقع قد أثرت على تخطيط المدينة، فقد تماشت حدود المدينة مع تضاريس الموقع (الشكل 23)، هذا ويتوجه محور المدينة الكبير باتجاه شرق-غرب. ولقد صممت المدينة إلى أحياط تتناسب مع طبيعة الموقع الجيولوجي، فهي الجنوب وبالقرب من المدخل الجنوبي على الجزء المرتفع في الغرب يوجد القصر وحوله عدد من المساكن، وعلى المنحدر الشرقي بالقرب من المدخل الشمالي يقع المعبد (بركات، 1995). وللمدينة بوابتان في الشمال والجنوب، حيث البوابة الشمالية هي البوابة الرئيسية للمدينة، فيما تتميز البوابة الجنوبية بموقعها، حيث تحيط منطقة ذات قمة صخرية صلبة ومنحدرة، وللمدينة سور بني كثيفه من أسوار المدن اليمنية القديمة، حيث يتشكل من دخلات وبروزات، ويتبعد السور الطبيعية الجيولوجية للمنطقة، حيث يتقطع في بعض المناطق المحمية طبيعياً، فيقطع في شمال وشمال غرب المدينة.

يحمل تخطيط مدينة نقب الهجر مجموعة من المعاني الرمزية منها ان اختيار موقع المدينة في مرتفع صخري عن المحيط لتحقيق الجوانب الرمزية للجبال المقدسة، وجاء السور بشكل بروزات لتحقيق الجوانب الرمزية، وجاء المعبد (المركز) قريب من المدخل الشمالي ليسع على المدينة قدرة المكان، وجسد السور حدود المكان المقدس، فيما جسدت البوابة نقطة الحد والفصل بين المكان المقدس والمقدس. وعليه، فقد جسدت مدينة نقب الهجر المكان المقدس، حيث جسد المعبد الذي يقع في الجهة الشرقية المركز وحدد الشارع الرئيسي الذي يربط البوابات الشمالية والجنوبية بالمحور، وجسد السور حدود الحرم، كما تتحقق النموذج الامثل للشكل والتوجية، وجاء المحور الأفقي (الشارع الرئيسي) الذي تتجه إليه الكتل البنائية محل المحور الوهمي (الشكل 24).



الشكل 24: موقع عام وقطع لمدينة نقب الهجر - ميفعة (الباحث)



الشكل 23: موقع عام لمدينة ميفعة (بركات، 1995)

3-4 مدن مملكة قتبان

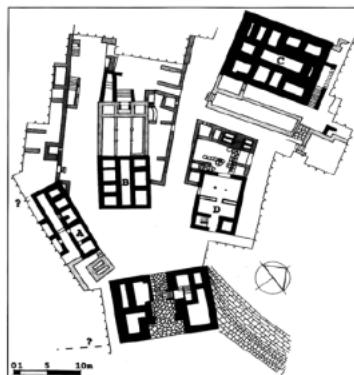
قامت مملكة قتبان في بداية الألف الأول ق.م. في وادي بيحان، وانتهت في القرن الثاني الميلادي. سوف يتم التطبيق على مدينة تمنع كونها العاصمة واعتبارها كنموذج للعمارة القتباينية.

3-4-1 تمنع (مجرد حملان)

كانت مدينة تمنع عاصمة لمملكة قتبان والتي تقع حالياً في منطقة بيحان على مخرج وادي بيحان في الجهة اليسرى، حيث ترتفع المدينة على تل يبلغ ارتفاعه 25م عن مستوى سطح الوادي، تغطي مساحة 37 هكتاراً بأبعد 670م طولاً و350م عرضاً (Doe, 1983). ولقد جاء تصميم المدينة بشكل بيضاوي، حيث تتجه بمحورها الطولي من الجنوب الغربي إلى الشمال الشرقي، ومن خلال ما كشفت عنه البعثات الأثرية لمبانٍ قريبية من البوابة الجنوبية وساحة السوق يتضح أن نسيجها الحضري جاء بنمط يمني قديم يمترّج فيه جميع مكونات المدينة من كلّ عمرانية وفضاءات مفتوحة وشوارع رئيسية وأزقة ضيقة (الشكل 26). ويتشكل النسيج الحضري للمدينة اعتماداً على المناطق التي تم التقسيم فيها في ساحة السوق وبالقرب من البوابة الجنوبية من ساحات مركبة توجّد في السوق وأمام القصر والمعابد والبوابات، وتربط بينها شوارع رئيسية ينخللها شوارع أقل حجماً وأزقة تفصل بين الكتل البنائية.

يتم الدخول إلى مدينة تمنع عبر عدد من البوابات، حيث توجد واحدة في الجنوب الغربي، وأخرى في الجنوب الشرقي، وواحدة في الشمال الغربي، وواحدة في الشرق (بركات، 1995). ولقد شيدت البوابة الجنوبية من أحجار صخمة من الحجرانيت في الأسفل ثم تم البناء بالخشب والطين والتغليف بأحجار مصفولة، وللبوابة برجان من كل جانب، وفي الجهة اليسرى سكن للحراسة (الأغوري، 1994). ولمدينة تمنع سور لم يكن عبارة عن سور منفصل عن جدران المباني، بل تشكّل السور من جدران المباني الخارجية (دي مغريه وروبن، 2006). وللمدينة سوق، وهو عبارة عن ساحة كبيرة تحيط بها المباني السكنية التي يتكون دورها الأرضي من دكاكين ومخازن تجارية، ويوجد في وسط السوق مسلة نقش عليها قانون التجاري، ويمثل سوق المدينة مركزاً، ويعزز ذلك وقوع مسلة الملك شهر هلال التي كتب على أوجهها الأربع قوانين السوق (دي مغريه وروبن، 2006) (الشكل 27).

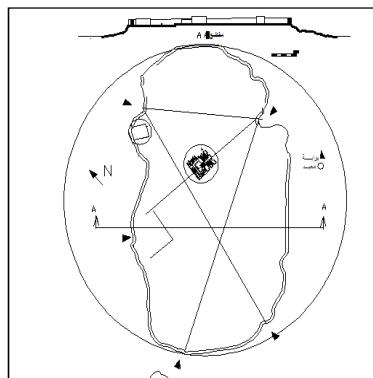
وعليه، فقد مثلت مدينة تمنع مكان مقدس توفر فيها شروط وعناصر المكان المقدس، حيث احتوت على عدد من المعابد (المراكز)، وجاء المعبد الكبير في مركز المدينة (Doe, 1983). وتم اختيار موقع مرتفع أقيمت عليه يرمي إلى الجبال المقدسة؛ وجسد السور حدود المكان المقدس فيما جسدت البوابات نقطة الحد بين المكان المقدس والمكان المدنى (الشكل 28).



الشكل 26: الجزء الجنوبي (الحسني، 2012)



الشكل 25: شارع ضيق بين مساكن في تمنع (الباحث)



الشكل 28: موقع عام ومقطع لمنع (الباحث)



الشكل 27: سوق تمنع ومسله السوق (الباحث)

4 العلاقة بين الرؤية العقائدية والعملية البنائية: المدن اليمنية القديمة

اتبع تخطيط المدينة اليمنية القديمة نظاماً معيناً، يعتمد على اختيار الموقع المدروس الذي يتوافق مع المتطلبات التخطيطية كالامن والمناخ والتضاريس، فكانت تتم دراسة الإطار العام للمدينة، الذي يشمل حدود السور وموقع البوابات وسهولة الوصول للمدينة، والسوق الذي يرتبط بطريق القوافل التجارية، وأماكن خزن وتجميع المياه المطلوبة للساكرين، وموقع الفصر والمعبد، وشبكة الشوارع الرئيسية والفرعية.

4-1 الموقع (المكان)

لقد أثرت جيولوجية الموقع بشكل كبير على شكل المدينة، كما أثرت الجوانب الأمنية المطلوبة للتحصين وحماية المدينة بشكل كبير على اختيار موقع المدينة، فكان يتم اختيار موقع المدينة على مرتفع يتوفّر فيه مجموعة عوامل مرتبطة بالجوانب الأمنية والعائنية والاقتصادية. وعلى الرغم من أولوية الموقع الجغرافي المناسب والمتطلبات الأمنية، فإن ذلك لا يمنع إدراجه رمياً داخل حدود المقسّم وعزلها عن الفضاء الآخر (الجن والأرواح الشريرة) في ثانية الفضاء القدس والمدن. - فضاء القرى الخيرة وفضاء القرى الشريرة-. وبذلك لم يعد الاستيطان شأن انساني فقط وإنما أصبح القرار يخص عالمين، يمنح بعدها الاستيطان والسكن بعداً انطولوجياً. عليه، فقد اتخذت المدن في المكان المرتفع على مستوى المنطقة المحيطة، بحيث تتحقق فكرة تقسيس الجبال، وظهوره وتجسد الإله، كما أقيمت بعض المدن على أرض كانت "حرم" (أرض مقدسة)، وبذلك تصبح المدينة مقدسة ومحفوظة بسبب انشائها على أرض مقدسة يملكونها الإله، كما كان يتم إنشاء معبد أو عذابة داخل المدينة لمقام الإله، فتصبح المدينة كلها مقدسة بفضل مكان المعبد وحول الإله فيه فيسخن على المدينة قيسية ويتحولها إلى مدينة مقدسة.

4-2 النموذج الأمثل (الشكل والتوجيه)

أخذ تخطيط المدن اليمنية القديمة نمطاً معيناً، فهي إما مستطيلة أو مستديرة أو في شكل قريب منه اعتماداً على جيولوجيا الموقع لتحقيق الجوانب الرمزية، فالمستطيل يشير إلى شكل المذهب، والمستدير يشير إلى شكل الشمس أو القمر باطواره، ومفهوم المدينة الذاهنة يرتبط بمفهوم الكون، وصورة الوحدة الكاملة، وشكلها يظهر طريق المرأة الذي يندمج بنفسه داخل الكون، وإن مركز المدينة الذي يشير إلى المحاور والاتجاهات الأصلية، ما هو إلا تعبير عن الحياة المقدمة والصورة الساكنة المترنة للكون. وقد كانت مدن مملكة معين أكثر من غيرها تحقيقاً للجوانب الرمزية، فالمنونجان المختاران هما معين كمدينة تمثل العاصمة السياسية وجاءت كالماندة المقدسة، والمدينة الأخرى هي براش والتي تتمثل العاصمة الدينية وجاءت كشكل قرون الوع. أما عن توجيه المدن اليمنية القديمة فقد ارتبط بالموقع الذي أقيمت عليه، من حيث ارتفاعه وتضاريسه وحواهف، وكانت أغلب المدن تتجه إلى الجهات الأصلية، أي كانت الأركان متوجهة نحو الجهات الأصلية، والأضلاع تتجه للجهات التالية.

4-3 الاختطاط والتخطيط للمدن اليمنية القديمة

لقد تدخلت الأساطير في بناء المدن اليمنية القديمة، فنجد أن كثيراً من الأحيان يُعزى بناء المدن إلى النبي سليمان وفي بعض الأحيان ينسبون بناء المدن إلى القدماء مثل قوم عاد وثمود (بركات، 1995)، بحيث تكون المدينة نموذجاً ارضياً للجنة السماوية وهي في معتقدهم تمثل فكرة (الفردوس الأرضي) وأنها تحتل مركزاً حيوياً في الأرض تشتهر في ذلك مركز الجنة السماوية (الرباعي، 2000). عليه، فإن التناهياً داخل منظومة المعتقدات العربية القديمة بين "الجنة" و"المدينة" كان مؤكداً ووافعاً لذا فإن "جنة عدن" كانت تعبيراً عن الدرجة الرفيعة من التمدن الذي شهدته اليمن القديم في عصر الملك القديمة (الرباعي، 2000). حيث أن المدينة بنظرهم كانت مقدسة، لذا كان يتطلب عند إنشائها وحين الانتهاء من البناء إقامت طقوس معينة، حتى يتم تكريس المكان وإضفاء نوع من التقديس عليه ووضعه تحت حماية الإله، فتذكر التفاصيل أن ملك حضرموت قام بذبح عدد من الحيوانات بعد إتمام بناء التحصينات لمدينة عرمة (العربي، 2002).

هذا وقد تباينت المدن اليمنية القديمة في حجمها، فمنها المدن الصغيرة ومنها المدن الكبيرة، ونظرًا لمحدودية المدن بسور أو موقعها الجيولوجي، فإن كل زيادة كانت تحدث في حجم السكان لا يصاحبها اتساع وبناء خارج الأسوار، ولكن انعكس في الاتجاه والبناء إلى الأعلى، ولهذا كان الغالب على نمط البناء السكني النساء البرجي، فيما جاءت شوارع المدن ضيقة ومبانيها متلاصقة ومتراسة، ويتسم النسيج الحضري للمدن اليمنية القديمة بأن تقسيم المدينة إلى أحياه شيدت بها التصور ومنازل الحرفيين والعمامة والمعابد، ويحتل القصر موقعاً متميزاً، وفي قلب المدينة أو مواجهة للقصر يقع الميدان الرئيسي الذي يستعمل كسوق تجاري (السروري، 2002)، وكان يحيط بالمدينة سور ذو أبراج لحمايتها من غزو الغزاة، ولها أبواب تعلق ليلاً وتحرس حراسة شديدة، كما تعلق وتسد أيام الحروب (علي 5، 1993). عليه، فقد تميزت المدن اليمنية القديمة بنسيجها الحضري المتضامن، وهي ذات نسيج متشارك من المباني والشوارع، حيث تبدو ذات تخطيط عشوائي، ولكن عند التمعن وتتبع البؤر المشكّلة للمدينة يتضح أنها تتوزع حسب بنية مورفولوجية واضحة، وذلك بتقارب وتلامح المباني الذي تتخللها ممرات وأزقة، وفضاءات مقفرحة داخل أحياه المدينة. أما من حيث التكوين العام للمدينة فغالباً ما يكون المعبد والقصر هما محوراً ثالث المدينة، وتتركز اتجاهات الحركة ومسالكها إليها، كما أن السوق يمثل المحور للمدينة والقطب المركزي الذي يربط الحركة بين المعبد والقصر.

4-4 السور (الإحاطة)

لقد كان لكل مدينة يمنية قيمة سور يطوقها ويحميها، وكانت هذه الأسوار تبني بشكل بروزات، وإضافة إلى أهمية هذه البروزات في أعلى السور كمساحة كافية لإعطاء السور الاستقرار والمتانة المطلوبة، كما أنها تعمل عمل الفواصل، فيعمل كل جزء بمفرده، مما يمنع سقوط السور بالكامل. ولقد انعكست الجوانب الدينية على فكرة تصميم أسوار المدن اليمنية القديمة، وذلك من خلال التشريح التفصيلي لرمز الإله الحامي للمدينة، وتشكل السور من بروزات جاءت تجريداً لعقد قرون الوع، وفضلاً على خدمة هذا الأسلوب من البناء وفوائد الدفعية، من أجل تقاديم حالات الفشل الإنسائي للجدار، فيما يشير العريقي إلى أن استدارة الأسوار كانت حماولة أراد من خلالها المعماري أن يعطي شكل آنية فخارية (العربي، 2002). وللسور وظائف مادية كحاج للمدينة وخط دفاع، ووظائف معنوية فكلاً ما ظهرت المدينة أمام العدو أكثر تحسيناً قبل هدفه بمحاولة اختراقها، ويرجح البالد (1988) أن الأسوار والدفّاعات للمدن المسكونة كانت في أصلها كنوع من الدفّاعات السحرية هدفها تقاديم ومنع غزو الشياطين وأرواح الموتى أكثر مما هو غزو البشر. وبين وضع المدن تحت رعاية الإله معين أو عدد من الآلهة يسكنون داخل المدينة يعني له معابد، فقد أصبحت المدن بمناي عن القوى الشريرة ضمن حدود توقف عند حرم المدينة، التي كانت الأسوار عبارة عن تجسيد مادي لها بصورة رمزية، ومن خارج هذه الأسوار تصبح الأرض غير مقدسة تسكنها عوالم مجهولة، والسور هو تجسيد لفكرة الإحاطة للأماكن المحمية، لذلك فهو يمثل الحدود والحيارات التي تفصل بين المقدس (داخل المدينة) والمقدس (خارج المدينة).

4-5 البوابة (نقطة الدخول)

مما لا شك فيه، إن البوابات تمثل أضعف نقاط في السور، لذلك فقد أدركوا أهمية تحصينها وتصميمها بأسلوب يضمن لها المنعة لتكون قادرة على الصمود أمام هجمات الأعداء، فعملت الأبراج المحيطة بحيث يكون للبوابة برجان من الجانبين للحراسة والمراقبة. والحقيقة، لم تكن للمدن اليمنية القديمة بوابة واحدة فقط بل عدد من البوابات كان الغالب عليها أربع. وللبوابة معانٍ أخرى مرتبطة ب نقطة الدخول التي تفصل بين المكان المقدس والمقدس.

4-6 السوق والشارع (المركز والمحور)

لقد أخذ السوق موقعاً متميزاً في المدينة، وكان عبارة عن فضاء كبير مفتوح يتشكل من التقاء المساكن حوله، ولكنه فضاء عاماً، لذا فقد تواجد في مراكز المدن (بركات، 1995) أو على جوانبها بعيداً عن المساكن، وكان يتوسط السوق الشارع الرئيسي الذي يبدأ من المدخل الرئيسي للمدينة وبخترقها عرضياً أو طولياً (جنشور، 2007)، وينتهي عند ساحة تتقسم القصر أو المعبد الرئيسي للمدينة، وبالإضافة إلى الشارع الرئيسي للمدينة توجد شبكة من الشوارع الفرعية التي تتخلل الحارات والمساكن للمدينة، وغالباً ما تكون متعمدة مع الشارع الرئيسي للمدينة. ويمثل السوق قلب المدينة سواء كان في مركزها هندسياً أو في مكان آخر، وقد كان

يعمل عمود يحدد المركز مثل سوق تمنع وتنقش عليه قوانين السوق ولوائح التجارة. ومن أهم سمات المدن اليمنية القديمة وجود محور- شارع رئيسي- يربط بين البوابة ويمتد إلى القصر أو المعبد، فيما تختلف الشوارع التي تتخلل الكتل البنائية، حيث تدرج في العرض وتضيق كلما زاد تفروع الشوارع المؤدية للحرابات.

4-7 المعبد (المركز الروحي)

اختلاف موقع المعبد داخل المدينة، فليس للمعبد موقعاً محدداً (بركات، 1995)، ومن الملاحظ أن المعابد قد وجدت بشكل كبير، حيث لم تبني مدينة إلا وبها عدد من المعابد سواء كانت داخل سور المدينة أو خارجها. ولقد كان لمعتقد اليمنيين القدماء حول الحماية، ووجود عالمين من سكان الأرض هم البشر والكائنات غير المرئية، دوراً في أن يكون لكل مكان إله يحميه، ولهذا المكان حدود لا تشمل رعياته وحمايته خارجها، انعكس ذلك على توقيع المعبد، ليكون بيت الإله حتى يحل أو يتجسد فيه، ومن ثم يقوم بحماية شعبه سواء داخل المدينة كي يعيش السكان تحت ظله ورعايته، أو معابد خارج السور لتحل فيها الآلهة، فتكون حامية ومراقبة للشعب والمدينة من خارج أسوارها. والمعبد بمفهومه الضمني يمثل قطب الدنيا وعمودها الرأسى الذي يضمن ارتباط الأرض بالسماء، ووجوده في المدينة يضمن لها ولساكنيها العيش في مكان مقدس تم ربطه بالسماء (إلياد، 1988).

4-8 القصر والمساكن

ساد النمط البرجي متعدد الطوابق للمساكن، وكانت المباني السكنية تنتشر بصورة منتظمة على أطراف قصبة المدينة وسوقها، ثم في فترات لاحقة توسع البناء مما أدى إلى تلاصق المساكن أو تقاربها بشكل يبقى فقط أرقية ضيقة تفصل بينها (حنشور، 2007). وجاءت المساكن بنمطها البرجي تعبر عن فكر المجتمع واعتقاده في المحور الذي يربط السماء بالأرض بربط بين العالم النفي المقدس في السماء والعالم غير النفي والمدن في الأرض. أما القصر فهو يمثل المركز الإداري والسياسي للدولة ومقر إقامة الملك، وقد احتل القصر مكانة مهمة في تحطيط العمران سواء من حيث موقعه أو من خلال تميز تصميمه، فكان لكل مدينة قصر.

5 النتائج

خلص البحث الحالي إلى نتيجة عامة مفادها ان المنهج التقليدي الذي يعتمد على دراسة ثقافة المجتمع ودورها في صياغة العمارة وال عمران يمثل منهجاً علمياً اثبت جدواه في تفهم العمارة التاريخية والترااثية، وعليه فقد اثبتت البحث الحالي امكانية استخدامه في مثل هكذا عمارة.

كما خلص البحث في دراسة الحالة (المدن اليمنية القديمة) إلى النتائج التالية:

- 1- تم اختيار أغلب المدن الكبيرة تبعاً لطرق التجارة الرئيسية، هذا وقد أقيمت المدن في الأماكن المرتفعة على مستوى المنطقة المحيطة، حتى تتحقق الجوانب الدينية والرمزية لمعتقد تقديراتي التي هي أماكن تجلی الإله، كما وقد أقيمت بعض المدن على أرض كانت "حرم" (أرض مقدسة).
- 2- تميزت المدن اليمنية القديمة بنسيجها الحضري المتضامن والمتناهيك من المباني والشوارع، حيث تظهر في الوهلة الأولى أنها ذات تحطيط عشوائي، ولكن عند تتبع البؤر المكونة للمدينة يتضح أنها تتوزع حسب بنية مورفولوجية واضحة، وذلك بمقارب وتلامح المباني الذي تتخللها ممرات وأزقة، وفضاءات مفتوحة (النوافذ) داخل أحياط المدينة.
- 3- أخذت أشكال المدن نمطاً معيناً، فهي إما مستطيلة أو مستديرة أو في شكل قرب منه اعتماداً على جيولوجيا الموقع لتحقيق الجوانب الرمزية، فالمستطيل يشير إلى شكل المنبع (الماء المقدسة)، والمستدير يشير إلى شكل الشمس أو القمر بأطواره.
- 4- انعكست الجوانب الدينية على فكرة تصميم أسوار المدن اليمنية القديمة، وذلك من خلال التshireح التفصيلي لرمز الإله الحامي، فقد تشكل السور من بروزات جاءت تجريداً لعقد قرون الوعل، وفضلأً على خدمة هذا الأسلوب من البناء وقواته الدافعية، من أجل تقاديم حالات الفشل الإنساني للجدار مثل الانبعاج والانهيار الكلي للجدار.
- 5- جسدت المدينة اليمنية القديمة وعناصرها العمرانية المكان المقدس والتصورات الفلسفية حول الكون والعالم، فقد جسد المعبد المركز والمقدس، وحيث أن معتقد اليمن القديم كان لكل مكان إله يحميه، ولهذا المكان حدود لا تشمل رعياته وحمايته خارجها، انعكس ذلك على توقيع المعبد، ليكون بيت الإله حتى يحل فيه، ومن ثم يقوم بحماية شعبه سواء داخل المدينة كي يعيش السكان تحت ظله ورعايته، أو معابد خارج السور لتحل فيها الآلهة، ف تكون حامية ومراقبة للشعب والمدينة من خارج أسوارها، والمعبد بمفهومه الضمني يمثل قطب الدنيا وعمودها الرأسى الذي يضمن ارتباط السماء بالأرض. كما جسد السور حدود الحرم والحمى، وجسد الشارع الرئيسي المحور الاقفي، وجسدت البوابة الحد والفاصل.
- 6- تميزت المدينة اليمنية القديمة بميزة جوهرية ووحدة عضوية للمدينة ومكوناتها الأساسية كالشارع الرئيسي والمعبد والقصر. وهي مؤلفة من مدينة داخلية ومدينة خارجية، حيث تحتوي المدينة الداخلية على شارع يحدد محاور المدينة ويربط البوابة الرئيسية بالقصر والمعبد.

6 التوصيات

يوصي البحث بعدة توصيات منها:

- 1- يوصي البحث بزيادة عمل التنقيبات والدراسات الأثرية، للكشف والإفصاح عما تخفيه الأرض اليمنية، مما يسهل ويشجع الباحثين المختصين بالعمارة القيام بدراسات تساعده على إظهار التراث المعماري لليمن.
- 2- ينبغي الحفاظ على العمارة اليمنية القديمة؛ كونها تمثل إرثاً حضارياً تركه الأجداد، فيشعرنا بالانتماء والتواصل مع التاريخ العريق لأمتنا، فيولد إحساساً بالألفة ويقوى الهوية الحضارية للجماعة.
- 3- يوصي البحث الدارسين والباحثين في مجال العمارة والأثار، والتاريخ، والأنثropolجيا، وعلم الاجتماع، بتكييف الدراسات الخاصة بالمجتمع اليمني القديم، وثقافته المادية وغير المادية.

شكر وتنوية

أود أن اعبر عن جزيل شكري لأبناء بيحان ومأرب والجوف، والمتحف الوطني بصنعاء، والمتحف العربي بصنعاء. كما اعبر عن جزيل امتناني وتقديربي للأخوة: الدكتور صلاح الحسيني، والدكتور احمد حنشور، والدكتور جمال الحسني، والدكتور خلون نعمان حيث قاموا بتزويدني بأكثر المراجع الهامة. كما ينبعي التوجيه إلى أن هذا البحث هو جزء مسئل من رسالة الدكتوراه للباحث أحمد عبدربه النهمي، كلية الهندسة، جامعة القاهرة.

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Study of Correlation, Magnitude of Genetic Diversity and Selection Indices in Popular Rice (*Oryza sativa* L.) Landraces of Bangladesh

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ABSTRACT: The study was attempted with an objective to evaluate the relationship among yield and yield contributing characters, genetic diversity and selection indices of 76 rice genotypes. Number of tillers plant⁻¹, number of effective tillers plant⁻¹ and number of filled grain panicle⁻¹ were positively and significantly correlated with yield plant⁻¹ suggesting that genotypes with high partitioning efficiency gave increase in yield plant⁻¹. Path analysis suggested that number of effective tiller plant⁻¹, number of filled grains panicle⁻¹ and 1000- seed weight were related to the yield plant⁻¹ mostly through their direct effects. The genotypes were grouped into seven clusters based on Euclidean distance following Ward's method and the highest intra-cluster distance was found in cluster VI and inter-cluster distance between the cluster I and VI. Study of selection indices through discriminant functions observed that Bhute shalot possessed the highest selection score index (301.41) and rank as the best followed by Hati bajore, Jamai naru, Bazra muri and Enghi which suggests that the highest scoring genotypes might be recommended for farmer's cultivation for better yield. Among this landraces the superior genotypes may be used in future plant breeding program.

KEYWORDS: Cultivars, Association, Additive genetic model, Environmental fluctuation, D²-value, Dendrogram, Genetic distance, Genetic gain

1 INTRODUCTION

Rice occupies the unique position in many nations because for its importance in traditional diets and the main source of income of many peoples in the whole world. For many Bangladeshis, it signifies both life and culture. It is deeply ingrained in Bangladesh culture and even the words 'food' and 'rice' are synonymous in Bengali. The wide environmental diversity in Bangladesh, attributed mainly to the considerable variation in topographic and seasonal components, is reflected in the range of rice groups cultivated, viz., transplanted (t.) aus, broadcast (b.) aus, transplanted (t.) aman, broadcast (b.) aman, and boro. Land under cultivation for T. aman, Boro and Aus season is 5.64 million hectares, 4.77 million hectares and 1.11 million hectares, respectively. In rice production ranking Bangladesh stands fourth although here average production of rice is only 4.32 tons per hectare [1]. A large number of the Bangladeshi farmers are adopted with local landraces and a few landraces have been incorporated into modern breeding programs; the vast majority of traditional Bangladeshi landraces remains uncharacterized and underutilized. Grain yield in rice is correlated with different yield contributing traits. These traits are also correlated between themselves. Therefore, the relationship between grain yield and different contributing traits establishes a complex chain. The complex chain of such relationship is further analyzed in more simple way through path coefficient. The path coefficient breaks the correlation coefficient of the yield with its contributing traits into direct and indirect effects. Such analysis reflects light on the real causes of relationship. As the yield is influenced by its components characters, therefore direct selection for yield is often misleading. The technique of discriminant function developed by Fisher [2] and adopted for selection by Smith [3] is useful in improvement of yield by combination characters. For improving

yield, selection index is superior on the basis of yield alone. Therefore, discriminate function based on important characters for selection has proved to be very useful in plant to discriminate undesirable genotypes on the basis of their performance. Genetic diversity represents the heritable variation within and between populations of organisms [4]. Genetic diversity plays an important role in plant breeding because hybrids between lines of diverse origin generally display a greater heterosis than those between closely related strains. When uniformity becomes the cause of genetic vulnerability, genetic diversity is the only insurance against it [5]. Therefore, the aim of the present study was to provide genetic variation and relatedness of some rice genotypes through phenotypically and conservation of their diverse gene pool.

2 MATERIALS AND METHODS

The experiment was conducted at the experimental farm of Bangladesh Institute of Nuclear Agriculture, Mymensingh, during July 2011 to January 2012. Geographically the experimental area is located at $24^{\circ}75'$ N latitude and $90^{\circ}5'$ E longitudes at the elevation of 18 m above the sea level. Fifty four rice landraces (i.e. Dudh kalam, Hati bajore, Malagoti, Kuchra, Enghi, Kajol shail, Hogla, Jamai naru, Hari, Dakh shail, Moina moti, Marish shail, Patnai, Bhute shallot, Kute patnai, Mohini shallot, Moghai balam, Sada gotal, Khak shail, Mohime, Holde gotal, Jota balam, Tilek kuchi, Rani Shalot, Kathi goccha, Bashful balam, Bazra muri, Durga bhog, Kumra ghor, Khainol, Ghunshi, Chinikani, Dhar shail, Khejur chori, Shaheb kachi, Raja shail, Hamai, Mura bajal, Lal gotal, Kalmilata, Volanath, Rupessor, Sylhet balam, Karengal, Kalo mota, Mota aman, Ghochi, Chap shail, Mondeshor, Nona kochi, Ghocca, Tal mugur, Ghigoj and Tor balam) were collected from the farmer's field of southern Bangladesh. Rest of the rice genotypes (21 landraces i.e. Fulkainja, Piarjat, Koicha binni, Lal biroi, Lalanamia, Golapi, Asam binni, Kakua binni, Nona bokhra, Jongli boro, Kashrail, Ledra binni, Nunnia, Rotisail, Genggeng binni, Chinisail, Jolkumri, Ponkhiraj, Mowbinni, Bogi, Kali boro and Binadhan-8) was collected from Plant Breeding Division, Bangladesh Institute of Nuclear Agriculture, Mymensingh. The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. The experimental field was divided into three blocks each representing one replication. Each block was then sub-divided in to seventy six plots. The seventy six rice genotypes were placed in each plot. The size of the unit plot was one square meter in size. Row to row and plant to plant distances were 20 cm and 20 cm, respectively in each plot. The genotypic and phenotypic correlations were estimation by the formula suggested by Miller *et al.* [6]. Direct and indirect path coefficient were calculated as described by Lynch and Walsh [7]. The genotypes were arranged in different clusters followed by the method suggested by Ward's Method based on Euclidean distance and hierarchical cluster analysis. Average intra and inter-cluster distances were calculated as suggested by Singh and Chaudhary [8]. Selection indices were constructed using the methods developed by Smith [3] based on discriminative function of Fisher [2].

3 RESULTS AND DISCUSSION

3.1 ESTIMATION OF CORRELATION CO-EFFICIENTS

Relationship between physiological and yield contributing characters was studied through analysis of correlation between them. Phenotypic and genotypic correlation co-efficient among different yield components of 76 rice genotypes are presented in Table 1. Correlation analysis among yield and its contributing character revealed that the genotypic correlation co-efficient of 19 associations were higher than their phenotypic correlation co-efficient indicating the association is largely due to genetic reason. The phenotypic correlation co-efficient of 20 associations were higher than genotypic correlation indicating suppressing effect of the environment which modified the expression of the characters at phenotypic level. In the present study out of 45 associations 18 associations were significant both at genotypic and phenotypic level. Among the 18 associations, 11 associations were positively significant and the rest 7 were negatively significant. The significant and positive association between the characters suggested additive genetic model thereby less affected by the environmental fluctuation. Besides, 8 relationship were positive and non significant. The positive and non-significant association referred information of inherent relation among the pairs of combination. On the other hand 19 relationship were found negative and non significant. The negative and non significant association referred a complex linked of relation among the pair of combinations. It appears from Table 16 that plant height was positively and significantly correlated with days to 50% flowering and days to maturity. It was negatively and significantly correlated with number of tillers plant⁻¹. Panicle length, effective tillers plant⁻¹, filled grain panicle⁻¹, unfilled grain panicle⁻¹ and yield plant⁻¹ was negatively correlated with plant height and statistically was non-significant. Finally, Plant height was positively and non-significantly correlated with 1000 seed weight (g). Panicle length was positively correlated with filled grain panicle indicating that long panicle produced more grains. It also showed positive correlation with number of tillers plant⁻¹, effective tillers plant⁻¹, unfilled grain panicle⁻¹ and yield plant⁻¹; among this only unfilled grain panicle⁻¹ was significantly correlated with panicle length. Days to 50% flowering

was positively and significantly correlated with days to maturity, number of filled grain panicle⁻¹, number of unfilled grain panicle⁻¹ and 1000 seed weight. It was also negatively and non-significantly correlated with number of tillers plant⁻¹, number of effective tillers plant⁻¹ and yield plant⁻¹. Days to maturity was negatively correlated with number of tillers plant⁻¹, number of effective tillers plant⁻¹, number of filled grains panicle⁻¹, number of unfilled grains panicle⁻¹ and yield plant⁻¹ but positively correlated with 1000-seed weight. Number of tillers plant⁻¹ showed significant positive correlation with number of effective tillers plant⁻¹ and yield plant⁻¹ but negative correlation with number of unfilled grains panicle⁻¹ and 1000-seed weight. Present experiment indicated that number of filled grains panicle⁻¹ and 1000- seed weight were most important characters which exhibited positive correlation with yield plant⁻¹. The result was supported by Osman *et al.* [9] and Selvaraj *et al.* [10]. Kiani and Nematzadeh [11] also observed that filled grains panicle⁻¹ correlated significantly with grain yield.

Table 1. Phenotypic (above) and genotypic (below) correlation co-efficient among different yield components of 76 rice genotypes

Items		Panicle length (cm)	Days to 50% flowering	Days to maturity	Number of tiller plant ⁻¹	Number of effective tiller plant ⁻¹	Number of filled grains panicle ⁻¹	Number of unfilled grains panicle ⁻¹	1000 seed weight (g)	Grain yield plant ⁻¹ (g)
Plant height (cm)	P	-0.138	0.256*	0.255*	-0.254*	-0.204	-0.128	-0.089	0.127	-0.145
	G	-0.145	0.252*	0.237*	-0.264*	-0.206	-0.133	-0.093	0.124	-0.151
Panicle length (cm)	P		-0.090	-0.114	0.165	0.169	0.197	0.313**	-0.078	0.190
	G		-0.104	-0.112	0.163	0.176	0.202	0.317**	-0.079	0.190
Days to 50% flowering	P			0.970**	-0.126	-0.100	-0.421**	-0.245*	0.339**	-0.204
	G			0.986**	-0.126	-0.104	-0.424**	-0.246*	0.342**	-0.207
Days to maturity	P				-0.167	-0.145	-0.483**	-0.247*	0.360**	-0.268*
	G				-0.184	-0.149	-0.492**	-0.252*	0.359**	-0.272*
Number of tiller plant⁻¹	P					0.977**	0.205	-0.048	-0.202	0.384**
	G					0.985**	0.205	-0.050	-0.203	0.382**
Number of effective Tiller plant⁻¹	P						0.237*	-0.079	-0.219	0.417**
	G						0.237*	-0.079	-0.220	0.419**
Number of filled grains panicle⁻¹	P							0.125	-0.431**	0.685**
	G							0.124	-0.436**	0.685**
Number of unfilled grains panicle⁻¹	P								-0.197	-0.042
	G								-0.198	-0.043
1000 seed weight (g)	P									0.127
	G									0.125

* and ** indicates significant at 0.05 and 0.01 probability, respectively

3.2 ESTIMATION OF PATH CO-EFFICIENT

The relations between grain yield and yield contributing characters were studied in detail by path co-efficient analysis. Yield plant⁻¹ being the complex outcome of different characters, was considered as the resultant variable and other characters as causal variable. Estimates of direct and indirect effects of ten yield contributing characters both at phenotypic and genotypic level are shown in Table 2 and Table 3, respectively. Path co-efficient at phenotypic level revealed that number of filled grains panicle⁻¹ (0.8218), 1000- seed weight (0.5703), number of effective tiller plant⁻¹ (0.5623), days to 50% flowering (0.1503), panicle length (0.00824) had direct positive effect on grain yield plant⁻¹, indicating these are the main contributors to yield. However, plant height, days to maturity, number of tillers plant⁻¹ and number of unfilled grains panicle⁻¹ had direct negative effect on grain yield plant⁻¹. Path co-efficient at genotypic level revealed that number of effective tiller plant⁻¹ (3.01), days to 50% flowering (2.490), 1000- seed weight (0.585), number of filled grains panicle⁻¹ (0.500) and number of unfilled grains panicle⁻¹ (0.0246) had direct positive effect on grain yield plant⁻¹, indicating these are the main contributors to yield. However, plant height, panicle length, days to maturity and number of tillers plant⁻¹ had direct negative effect on grain yield plant⁻¹. The residual effect at phenotypic level was 0.1989 indicating that the ten characters contributed 80.11% of variability in yield plant⁻¹ studied in path analysis. The residual effect at genotypic level was 0.1456 indicating that the ten characters contributed 85.44% of variability in yield plant⁻¹ studied in path analysis. The residual effects towards yield plant⁻¹ in this study may be due to several reasons such as causal factors (characters) not included in the analysis and sampling errors. Though days to 50% flowering showed direct effects on yield plant⁻¹ but its genotypic and phenotypic correlation is negative. It indicates that days to 50% flowering would not be reliable criteria for improving yield plant⁻¹. On the other hand number of effective tiller plant⁻¹, number of filled grains panicle⁻¹ and 1000- seed weight showed direct effects on yield plant⁻¹ and their genotypic and phenotypic correlation is also positive. The above information revealed that number of effective tiller plant⁻¹, number of filled grains panicle⁻¹ and 1000- seed weight were related to the yield plant⁻¹ mostly through their direct effects and this information and the present findings suggest that these characters should be used as selection index

for selecting higher yield plant⁻¹. The recent research also emphasized the importance of these characters. Similar results had also been reported by Osman *et al.* [9], Kiani and Nematzadeh [11] and Akhtar *et al.* [12].

Table 2. Partitioning of phenotypic correlations into direct and indirect effects of ten important characters of 76 rice genotypes by path analysis

Characters	Plant height (cm)	Panicle length (cm)	Days to 50% flowering	Days to maturity	Number of tiller plant ⁻¹	Number of effective tiller plant ⁻¹	Number of filled grains panicle ⁻¹	Number of unfilled grains panicle ⁻¹	1000 seed weight (g)	Grain yield plant ⁻¹ (g)
Plant height (cm)	-0.0546	-0.00113	0.0384	-0.0432	0.0619	-0.1147	-0.1051	0.00107	0.0724	-0.145
Panicle length (cm)	0.00754	0.00824	-0.0135	0.0193	-0.0402	0.0950	0.1619	-0.00379	-0.0444	0.190
Days to 50% flowering	-0.01399	-0.00074	0.1503	-0.1644	0.0307	-0.0562	-0.346	0.0029	0.1933	-0.204
Days to maturity	-0.01394	-0.00094	0.1458	-0.1695	0.0407	-0.0815	-0.3969	0.0030	0.2053	-0.268*
Number of tiller plant ⁻¹	0.0138	0.00136	-0.0189	0.0283	-0.2438	0.5494	0.1685	0.00058	-0.1152	0.384**
Number of effective tiller plant ⁻¹	0.0112	0.0014	0.0150	0.0246	-0.2382	0.5623	0.1948	0.00096	-0.1249	0.417**
Number of filled grains panicle ⁻¹	0.0069	0.0016	-0.0633	0.0818	-0.0499	0.1333	0.8218	-0.00152	-0.2458	0.685**
Number of unfilled grains panicle ⁻¹	0.00049	0.00258	-0.0368	0.0418	0.0117	-0.0444	0.1027	-0.0121	-0.1123	-0.042
1000 seed weight (g)	-0.00694	-0.00064	0.0509	-0.0610	0.0492	-0.1231	-0.3542	0.00239	0.5703	0.127

Bold figures indicate the direct effect

Residual effect = 0.1989

Table 3. Partitioning of genotypic correlations into direct and indirect effects of ten important characters of 76 rice genotypes by path analysis

Characters	Plant height (cm)	Panicle length (cm)	Days to 50% flowering	Days to maturity	Number of tiller plant ⁻¹	Number of effective tiller plant ⁻¹	Number of filled grains panicle ⁻¹	Number of unfilled grains panicle ⁻¹	1000 seed weight (g)	Grain yield plant ⁻¹ (g)
Plant height (cm)	-0.271	0.0037	0.629	-0.641	0.742	-0.619	-0.0665	-0.0023	0.0726	-0.151
Panicle Length (cm)	0.0393	-0.0254	-0.259	0.303	-0.458	0.529	0.101	0.0078	-0.0462	0.190
Days to 50% Flowering	-0.0682	0.0027	2.490	-2.66	0.354	-0.312	-0.212	-0.0061	0.2002	-0.207
Days to Maturity	-0.064	0.0028	2.46	-2.70	0.517	-0.448	-0.246	-0.0062	0.210	-0.272*
Number of Tiller plant ⁻¹	0.0714	-0.0042	-0.315	0.497	-2.81	2.96	0.103	-0.0012	-0.118	0.382**
Number of effective tiller plant ⁻¹	0.0557	-0.0045	-0.259	0.403	-2.77	3.01	0.118	-0.0019	-0.128	0.419**
Number of filled grains panicle ⁻¹	0.036	-0.0052	-1.05	1.33	-0.576	0.713	0.500	0.0031	-0.255	0.685**
Number of unfilled grains panicle ⁻¹	0.0252	-0.0081	-0.615	0.681	0.141	-0.238	0.062	0.0246	-0.116	-0.043
1000 seed weight (g)	-0.034	0.0020	0.854	-0.970	0.571	-0.662	-0.218	-0.0048	0.585	0.125

Bold figures indicate the direct effect

Residual effect = 0.145

3.3 NATURE AND MAGNITUDE OF GENETIC DIVERSITY

Using Euclidean distance following Ward's method, the genotypes were grouped into distinct clusters. Based on D2-value, the genotypes were grouped into seven clusters (Table 4). Cluster VI and VII had same no. of genotypes i.e. eight. The cluster II contained 24 genotypes which is the largest one and the cluster IV contained only six genotypes which is the smallest one. The average intra and inter cluster distances are presented in Table 5. It was observed that inter cluster distance were always higher than those of intra cluster distance. The intra cluster distance of cluster VI had 947.44 which was the highest value and cluster I had the second highest (678.13) intra cluster distance. The mutual relationships among the seven clusters are presented in the diagram (Fig. 1). The averages inter and intra cluster distance (Table 5) have been used to denote cluster distance. The maximum inter cluster distance was observed between genotypes of cluster I and VI (2046.48) followed by

clusters II and VI (1751.03). Thus, hybridization among genotypes drawn from these widely divergent clusters with high yield potential would likely to produce heterotic combinations and wide variability in segregating generations.

Table 4. Clustering pattern of 76 rice genotypes based on Euclidean distance following Ward's method and the member present in each respective cluster

Cluster number	Number of genotypes	Percent	Name of genotypes
I	11	14.47	Dudh kalam, Khak shail, Khainol, Hamai, Ghocca, Tal mugur, Tor balam, Fulkainja, Koicha binni, Kashrail, Binadhan-8
II	24	31.58	Hati bajore, Kajol shail, Hogla, Mohini shalot, Sada gotal, Mohime, Holde gotal, Bashful balam, Bazra muri, Kumra ghor, Ghunshi, Shaheb kachi, Raja shail, Mura bajal, Lal gotal, Kalmilata, Volanath, Rupessor, Karengal, Kalo mota, Mota aman, Chap Shail, Mondeshor, Nona kochi
III	9	11.84	Malagoti, Durga bhog, Chinikani, Dhar shail, Ghochi, Jongli boro, Chinisail, Ponkhiraj, Kali boro
IV	6	7.89	Kuchra, Jamai naru, Marish shail, Bhute shalot, Rani shalot, Khejur chori
V	10	13.16	Enghi, Hari, Dakh shail, Moghai balam, Tilek kuchi, Sylhet balam, Piarjat, Lalanamia, Rotisail, Genggeng binni
VI	8	10.53	Moina moti, Jota balam, Lal biroi, Golapi, Kakua binni, Ledra binni, Nunnia, Bogi
VII	8	10.53	Patnai, Kute patnai, Kathi goccha, Ghigoj, Asam binni, Nona bokhra, Jolkumri, Mowbinni

Table 5. Average intra and inter cluster D2 and D values of seven clusters

Cluster	I	II	III	IV	V	VI	VII
I	678.13 (26.04)	891.95 (29.87)	1044.22 (32.31)	1005.34 (31.71)	1287.58 (35.88)	2046.48 (45.24)	1264.41 (35.56)
II		455.26 (21.34)	799.49 (28.28)	374.74 (19.36)	1179.38 (34.34)	1751.03 (41.85)	866.85 (29.44)
III			527.15 (22.96)	772.60 (27.80)	806.73 (28.40)	1307.28 (36.16)	726.14 (26.95)
IV				189.89 (13.78)	929.17 (30.48)	1264.72 (35.56)	620.99 (24.92)
V					394.24 (19.86)	852.00 (29.19)	456.75 (21.37)
VI						947.44 (30.78)	828.93 (28.79)
VII							331.96 (18.22)

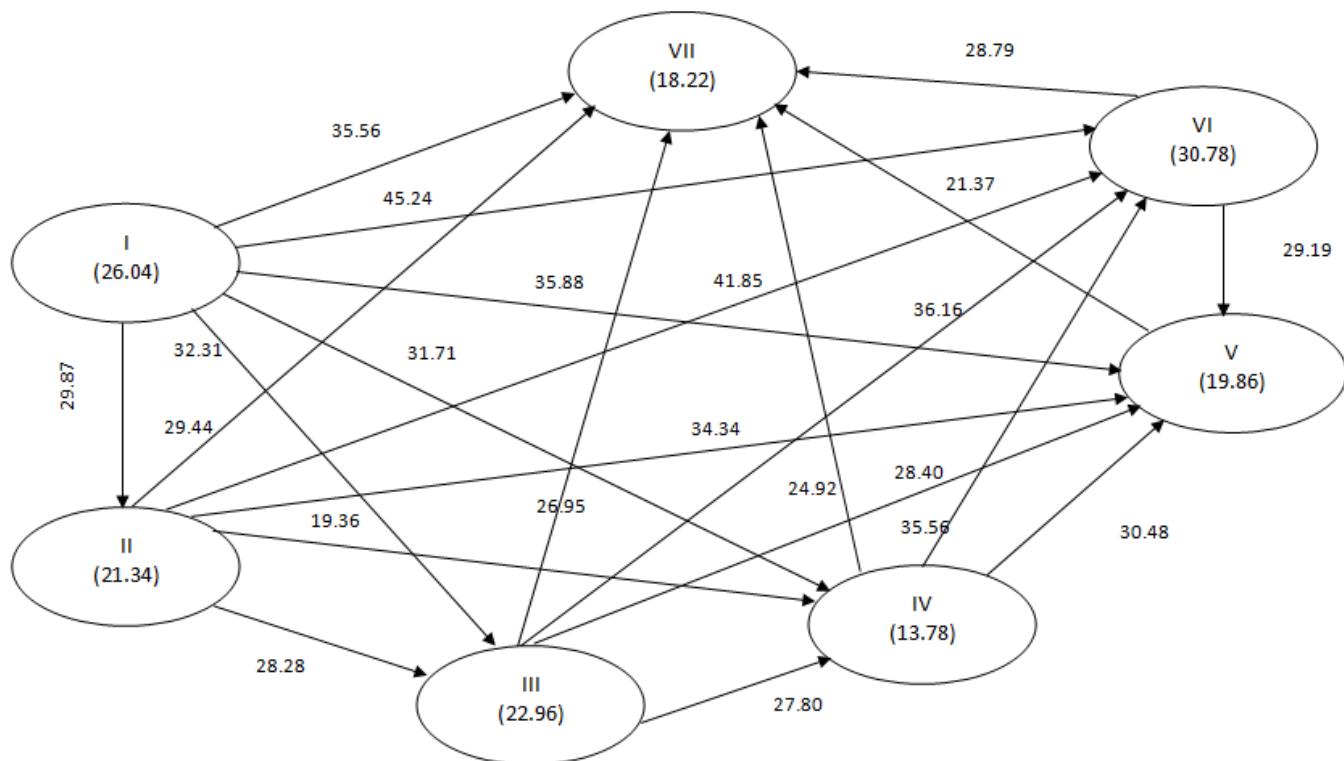


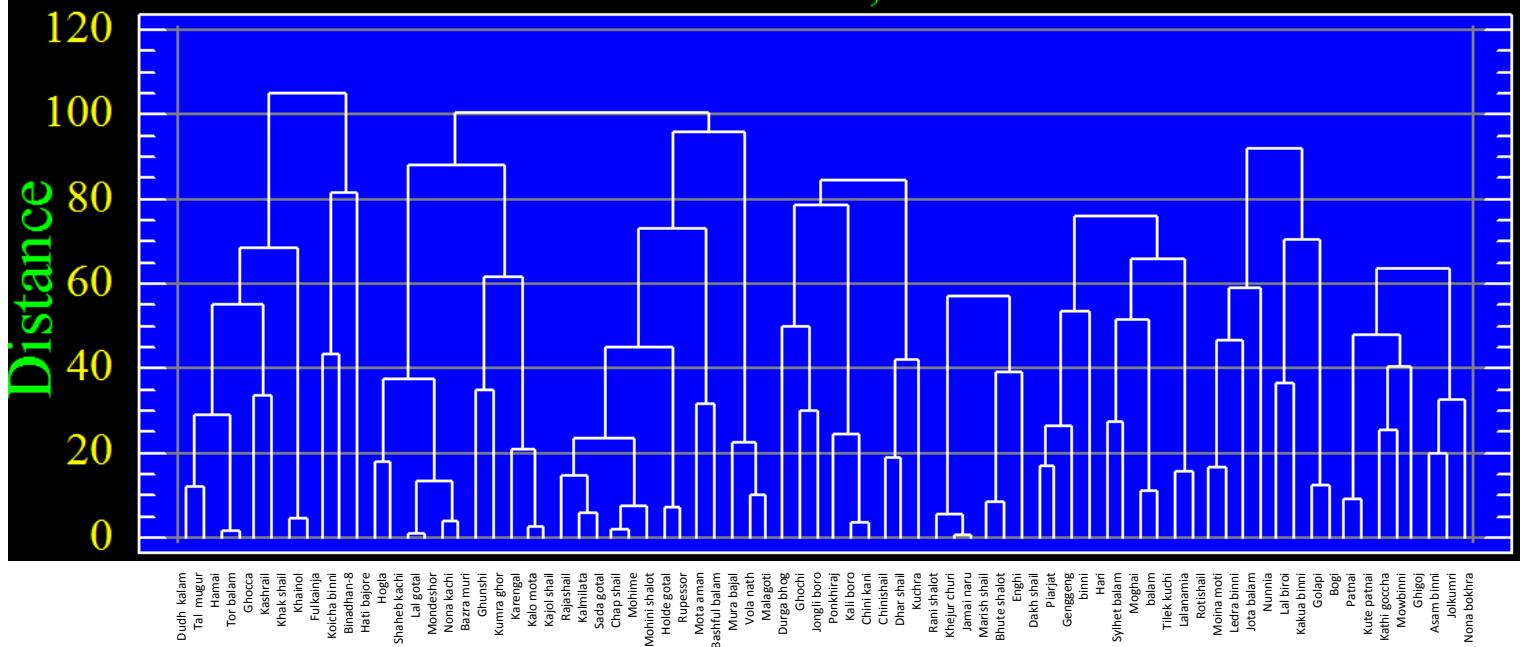
Fig. 1. Cluster diagram showing the average intra and inter cluster distances ($D = \sqrt{D^2}$ values) of 76 rice genotypes. The values along the lines inter cluster distances and the values within the circle indicate intra cluster distance

3.4 NATURE AND MAGNITUDE OF GENETIC DIVERSITY

Dendrogram based on Ward's method indicated grouping of 76 genotypes of rice into seven clusters (Fig. 2). Genetic distance of cluster I, cluster II, cluster III, cluster IV, cluster V, cluster VI and cluster VII was 26.04, 21.34, 22.96, 13.78, 19.86, 30.78 and 18.22, respectively. Highest genetic distance (30.78) was present in cluster VI and the lowest (13.78) was in Cluster IV. The mean values of each cluster for eleven characters are presented in Table 6. There was wide range of variation in the cluster mean values for all the characters. The mean values of all characters for the respective character were categorized into low (L), intermediate (I) and high (H) classes. With regards to plant height, cluster V showed low value (129.10 cm). Cluster I, II, III, VI and VII showed intermediate values (138.82 cm, 143.63 cm, 145.51 cm, 135.37 cm and 146.05 cm respectively) and cluster IV showed high value (146.83 cm). In panicle length, cluster VII showed low value (23.92 cm) and cluster V showed high value (27.67 cm). Cluster I required minimum (100.18) days for 50% flowering, cluster IV required maximum (134.83) days for 50% flowering and cluster II, III, V, VI and VII showed intermediate values (101.77-126.0). With regards to days to maturity, cluster I required minimum days (140.18) for maturity and cluster IV required maximum days (172.16). In number of tiller plant⁻¹, cluster VII showed low value (11.92) and cluster VI showed high value (19.60). In number of effective tiller plant⁻¹, cluster VII showed low value (11.52) and cluster VI showed high value (18.95). With regards to number of filled grains panicle⁻¹, cluster II showed low value (92.27) and cluster VI showed high value (167.42). For number of unfilled grains panicle⁻¹, cluster I showed high value (44.15) and cluster VII showed low value (20.5). With regards to 1000 seed weight, cluster IV showed high value (27.25 g) and cluster III showed low value (18.27 g). With regards to yield plant⁻¹, cluster VI showed high value (48.71 g) and cluster III showed low value (21.45 g).

Table 6 . Cluster mean for 10 yield and yield related characters in 76 rice genotypes

Characters	I	II	III	IV	V	VI	VII
Plant height (cm)	138.82 (I)	143.63 (I)	145.51 (I)	146.83 (H)	129.10 (L)	135.37 (I)	146.05 (II)
Panicle length (cm)	27.18 (I)	24.73 (I)	24.22 (I)	26.74 (I)	27.67 (H)	25.72 (I)	23.92 (L)
Days to 50% flowering	100.18 (L)	126.0 (I)	101.77 (I)	134.83 (H)	111.50 (I)	107.50 (I)	108.87 (I)
Days to maturity	140.18 (L)	165.87 (I)	142.11 (I)	172.16 (H)	151.30 (I)	145.87 (I)	146.62 (I)
Number of tiller plant⁻¹	13.74 (I)	12.39 (I)	13.39 (I)	16.10 (I)	12.84 (I)	19.60 (H)	11.92 (L)
Number of effective tiller plant⁻¹	12.60 (I)	11.68 (I)	12.49 (I)	15.30 (I)	12.44 (I)	18.95 (H)	11.52 (L)
Number of filled grains panicle⁻¹	109.67 (I)	92.27 (L)	130.59 (I)	102.96 (I)	166.86 (I)	167.42 (H)	149.48 (I)
Number of unfilled grains panicle⁻¹	44.15 (H)	23.84 (I)	24.46 (I)	20.67 (I)	27.66 (I)	22.29 (I)	20.5 (L)
1000 seed weight (g)	25.46 (I)	26.69 (I)	18.27 (L)	27.25 (H)	22.20 (I)	20.41 (I)	25.92 (I)
Grain yield plant⁻¹ (g)	28.62 (I)	24.47 (I)	21.45 (L)	32.91 (I)	40.42 (I)	48.71 (H)	40.80 (I)

*H= High value**I= Intermediate value**L= Low value***Dendrogram**
Ward's Method, Euclidean**Fig. 2. Dendrogram based on summarized data on differentiation among 76 genotypes of rice according to Ward's method**

3.5 SELECTION INDEX

Selection index was constructed to identify suitable genotypes among 76 genotypes of rice in order to recommendation for farmers' cultivars, following simultaneous selection model, considering 10 characters (Table 7). Among the genotypes studied Bhute shalot possessed the highest selection score index (301.41) and rank as the best followed by Hati bajore, Jamai naru, Bazra muri and Enghi with selection score 300.08, 299.73, 299.56 and 293.30, respectively. The genotype Binadhan-8 was the worst having the lowest selection score of 207.29 followed by Rupessor (233.82) and Ghigoj (235.45). The expected genetic gain (ΔG) was 37.32 at 5% selection intensity i.e. 3-4 highest scoring genotypes from these 76 rice genotypes might be recommended for farmers' cultivation for better yield.

Table 7. Selection score, rank and expected genetic gain of 76 genotypes of rice considering ten characters

Genotype Sl. No.	Genotypes	Score	Rank order	Expected genetic advance
14	Bhute shalot	301.41	1	
2	Hati bajore	300.08	2	
8	Jamai naru	299.73	3	
27	Bazra muri	299.56	4	
5	Enghi	293.30	5	
26	Bashful balam	288.92	6	
10	Dakh shail	287.41	7	
7	Hogla	286.87	8	
52	Tal mugur	286.39	9	
69	Gengeng binni	283.47	10	
3	Malagoti	283.34	11	
50	Nona kochi	282.98	12	
24	Rani shalot	282.13	13	
4	Kuchra	281.96	14	
30	Khainol	281.50	15	
62	Kakua binni	279.28	16	
54	Tor balam	277.98	17	
34	Khejur chori	277.97	18	
61	Asam binni	277.48	19	
57	Koicha binni	276.94	20	
15	Kute patnai	276.50	21	
49	Mondeshor	276.22	22	
56	Piarjat	275.75	23	
35	Shaheb kachi	273.81	24	
12	Marish shail	273.70	25	
48	Chap shail	273.52	26	
31	Ghunshi	273.28	27	
22	Jota balam	271.47	28	
51	Ghocca	270.60	29	
13	Patnai	269.09	30	
18	Sada gotal	268.25	31	
40	Kalmilata	268.24	32	
39	Lal gotal	267.83	33	
37	Hamai	267.66	34	
55	Fulkainja	267.35	35	
19	Khak shail	266.06	36	
38	Mura bajal	264.12	37	37.32

Table 7. Continued

Genotype Sl. No.	Genotypes	Score	Rank order	Expected genetic advance
45	Kalo mota	263.76	38	
20	Mohime	263.74	39	
23	Tilek kuchi	261.91	40	
71	Jolkumri	261.58	41	
16	Mohini shalot	260.58	42	
66	Ledra binni	260.41	43	
17	Moghai balam	260.19	44	
9	Hari	258.90	45	
58	Lal biroi	258.55	46	
41	Volanath	258.14	47	
74	Bogi	257.00	48	
1	Dudh kalam	256.59	49	
11	Moina moti	256.55	50	
33	Dhar shail	256.40	51	
25	Kathi goccha	255.95	52	
75	Kali boro	255.23	53	
32	Chinikani	255.22	54	
72	Ponkhiraj	254.92	55	
36	Raja shail	254.14	56	
6	Kajol shail	254.03	57	
65	Kashrail	252.74	58	
47	Ghochi	252.70	59	
59	Lalanamia	252.24	60	
60	Golapi	251.79	61	
29	Kumra ghor	251.35	62	
44	Karengal	250.65	63	
70	Chinisail	250.60	64	
21	Holde gotal	248.72	65	
43	Sylhet balam	247.12	66	
63	Nona bokhra	246.32	67	
64	Jongli boro	246.28	68	
28	Durga bhog	244.57	69	
67	Nunnia	244.56	70	
73	Mowbinni	244.48	71	
68	Rotisail	241.42	72	
46	Mota aman	236.97	73	
53	Ghigoj	235.45	74	
42	Rupessor	233.82	75	
76	Binadhan-8	207.29	76	37.32

4 CONCLUSION

The results clearly revealed that the number of tillers plant⁻¹, number of effective tillers plant⁻¹ and number of filled grain panicle⁻¹ were positively and significantly correlated with yield plant⁻¹ suggesting that genotypes with high partitioning efficiency gave increase in yield plant⁻¹. The maximum inter cluster distance was observed between genotypes of cluster I and VI followed by clusters II and VI. Thus, hybridization among genotypes drawn from these widely divergent clusters with high yield potential would likely to produce heterotic combinations and wide variability in segregating generations. Among 76 genotypes of rice Bhute shalot possessed the highest selection score index (301.41) and rank as the best followed by Hati bajore, Jamai naru, Bazra muri and Enghi with selection score 300.08, 299.73, 299.56 and 293.30, respectively. The expected

genetic gain (ΔG) was 37.32 at 5% selection intensity i.e. 3-4 highest scoring genotypes from these 76 rice genotypes might be recommended for farmers' cultivation for better yield or may be used for further varietal improvement program.

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A New form of an Electromagnetic band-gap structure

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ABSTRACT: Generally speaking, the structure to forbidden electromagnetic band gap (EBG) is defined as being periodic artificial structures (or sometimes not periodic) which prevent the propagation of the electromagnetic waves in a frequency band specified for all the angles of incidence and all the states of polarization. The EBG is normally realized by periodic arrangement of dielectric materials. Within this framework, a new type of metallic electromagnetic structure was finalized. A big impedance of surface and a very precise forbidden bandwidth of frequencies characterize it. It is the flat structure, that we shall call EBG in the shape of dome. To begin the study of this structure, we are going to analyze the coefficients of reflection and transmission feigned. We shall approach then the application of this structure on the environment close to a network of patch antenna, of a micro strip line and a guide of rectangular wave to show the importance of this material in microwave structures.

KEYWORDS: EBG (electromagnetic band gap), form of dome, microwave.

1 INTRODUCTION

These works join within the framework of a continuity of the research on the electromagnetic band gap structures (EBG). Since more than a decade, numerous works were undertaken and published concerning the structures EBG in the field of the high frequencies [4]. We distinguish the circular forms introduced by Pendry [5], the EBG of square shape [6], in the shape of "S" introduced originally by Prosvirnin [7], the EBG in the shape of " Ω " Introduced initially by Saadoum [8],[9]. Such structures introduce generally forbidden bands in the propagation of electromagnetic waves according to the frequency and create besides them resonance, a negative effective permittivity in a narrow band of frequency in the neighborhood of this resonance.

A new artificial element EBG in the shape of dome is finalized for its characteristics of forbidden band in the propagation. The objective of this article is to understand and to highlight the interesting properties of this element with the aim of applications in antennas and in microwave circuits. Therefore, we present the analysis of these structures, made by means of the CST software and we comment their answers in transmission and in reflection.

We present as possible application of this element, the realization of a filtering pass-band by using micro strip lines with an unmetallized ground plan.

A technique for the improvement of the performances of a network of patch antenna, is also suggested.

2 PRESENTATION OF THE NEW STRUCTURE

2.1 THEORETICAL ASPECT OF THIS STRUCTURE

The EBG structure to be studied, consists of two parts: a dielectric substrate and periodic metallic engravings on the top of the substrate. The geometry is similar to the shape of a dome. (figure1)

The mechanism of functioning of this structure can be explained by means of a model of an equivalent actual environment [12] to LC elements grouped as indicated in the figure 1.

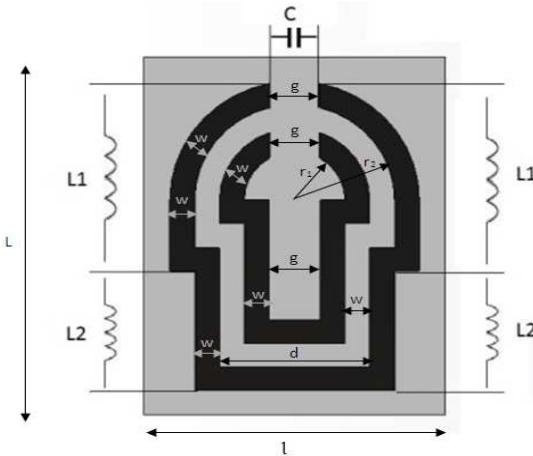


Figure 1: Geometry and dimensions of an electromagnetic band gap (EBG) structure in the shape of dome.

Condensers result from the gap "g" and the inductions result from the current along the metallic part of the patch. The impedance of a parallel resonant circuit LC is given by:

$$Z = \frac{j\omega L}{1 - \omega^2 LC}. \quad (1)$$

The angular frequency of resonance of the circuit is calculated as follows:

$$\omega_0 = \frac{1}{\sqrt{LC}}. \quad (2)$$

In low frequencies, the impedance is inductive and bears TM surface waves. It becomes capacitive for high frequencies, the supported surface waves are the ones of the TE mode. Near the Frequency of resonance, a high impedance is obtained and the EBG does not bear any more surface waves, where from a forbidden frequency band [10] [11]. To determine the value of the frequency in theory, we used the Lumped Element method [12]. The expression for the inductance of a micro strip line is:

$$L(nH) = 2.10^{-4} l \left[\ln \left(\frac{l}{w+t} \right) + 1.198 + \frac{w+t}{3l} \right] \quad (3)$$

The inductance of a circular spiral is:

$$L(nH) = 1,257.10^{-3} \cdot a \left[\ln \left(\frac{a}{w+t} \right) + 0.078 \right] \quad (4)$$

$$\text{With: } a = \frac{D_o + D_i}{4} \quad (5)$$

D_o and D_i represents respectively the internal and external radius of the spiral.

The expression of the capacity is:

$$C(F) = \epsilon_r \left(\frac{S}{d} \right) = \epsilon_r \left(\frac{w*t}{d} \right) \quad (6)$$

(l is the length of the micro strip line, w its width, d is the width of the gap and t the thickness of the used metal)

2.2 DIRECTION OF POLARIZATION OF THE EBG

In this part, four configurations are considered. These configurations are determined with compared with the possible orientations of an EBG inside a guide of waves. So, two of four configurations consist in placing the structure so that the magnetic field H penetrates through rings. Between these two configurations, there is one where the electric field E respects the symmetry of the EBG.

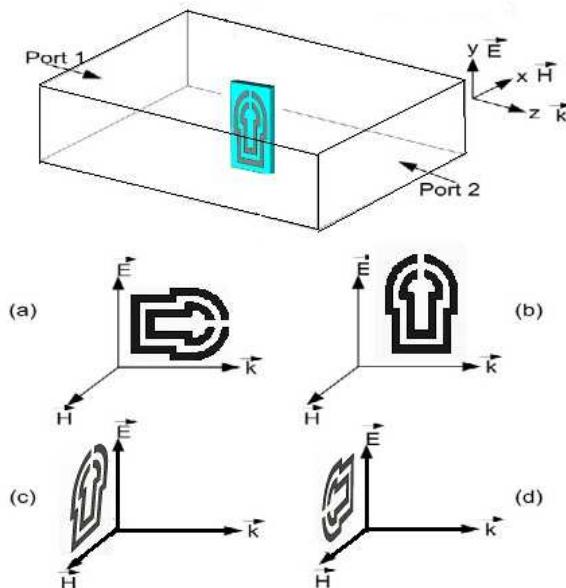


Figure2: The various configurations of the EBG inside the guide of waves.

Thus, the analysis of the resonator is made in four parts (figure2) which are:

- The resonator in the plan ($y\hat{O}z$).

Under this configuration, there are two cases:

- a) The magnetic field is parallel to the axis of rings:

Both openings are parallel to the small side of the guide of waves and thus the electric field do not respect the symmetry of the resonator (case (a)).

- b) The magnetic field is parallel to the axis of rings:

Both openings are parallel to the big side of the guide of waves and thus the field E respects the symmetry of the resonator (case (b)).

The resonator in the plan ($x\hat{O}y$).

- There are here also two cases:

- c) The magnetic field is perpendicular to the axis of rings:

Both openings are parallel to the big side of the guide of waves and thus the field E respects the symmetry of the resonator (case (c)).

- d) The magnetic field is perpendicular to the axis of rings:

Both openings are parallel to the small side of the guide of waves and thus the field E does not respect the symmetry of the resonator (case (d)).

In the case (d), the observed resonance is due only to the electric coupling, while in the case (b), this resonance is due to the magnetic coupling. In the case (a), it is due to a contribution of the electric and magnetic couplings. For the case (c), there is no resonance because there is no magnetic coupling and there is a cancellation of the electric coupling.

The application of an electromagnetic wave on the EBG results in the creation of an induction current in both concentric rings. This current is due either to the electric field or to the magnetic field or both. The curves of transmission for four configurations defined previously are presented on the figure 3.

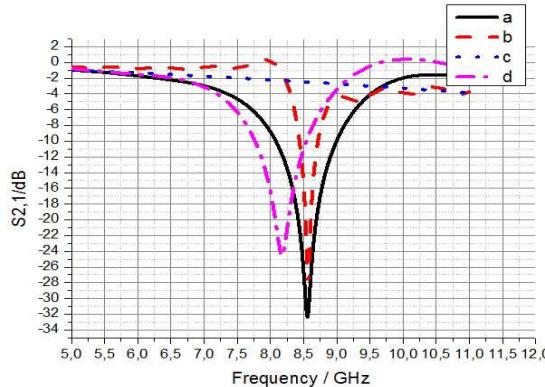


Figure3: Curves of transmission of four configurations of the EBG in a guide of waves.

A behavior cutting-band on narrow frequency band is observed for the cases (a), (b) and (d). On the other hand, in the case (d), the EBG has no effect on the transmission of the waves in the guide. For the cases (c) and (d), the magnetic field is perpendicular to the axis of rings and thus, does not penetrate through the EBG. Therefore, it does not contribute to the induction currents in the EBG. We can so assert that the induction currents are only caused by the electric field.

For the cases (a) and (b), the magnetic field H penetrates through both rings and generates currents which circulate on these. These currents disappear at the level of the cut and charges of opposite signs accumulate in both extremities of rings, giving birth to an intense electric field in the cut. This is why a resonance is observed in these two cases. The amplitude of the resonance is slightly more raised for the case (a) because we are in the presence of a contribution of two couplings, electric and magnetic.

2.3 RESULTS AND SIMULATIONS

The Resonator in the shape of dome was sized for a functioning in the band C [4 GHz; 8 GHz]. The radius of the external ring is $r_1=3\text{mm}$, the width of the copper track is $w=0,33\text{mm}$, the width of the cut of rings is of $g=0,33\text{mm}$, the spacing between both rings is $w=0,33\text{mm}$, the width of the patch is $l=4\text{mm}$ and its length is $L=5\text{mm}$. The substrate used for the simulation is the RO4003CR at ROGERS who presents a relative permittivity of 3, 38, tangential losses of the order of 0,0027 and a 0,81mm thickness. This substrate will also be used for all other simulations in this article.

If we apply the equations (3) and (4) with $l=2.5\text{mm}$, $w=0.33\text{mm}$, $t=0.18\text{mm}$, $d=0.66\text{mm}$, $D_i=1.33\text{mm}$ and $D_o=1.66\text{mm}$.

The value of the inductance is:

$$\begin{aligned} L_{eq}(nH) &= \sum(L_1(nH) + L_2(nH)) \\ &= 11,0485 \cdot 10^{-3} nH \end{aligned} \quad (7)$$

The value of the capacity is $C(F) = 0.3042 \cdot 10^{-3} F$

Afterward the value of the frequency of resonance is equal to:

$$f_r = \frac{1}{2\pi\sqrt{LC}} = 8.68\text{GHz}. \quad (8)$$

The simulations concern the calculation of the coefficients of reflection and transmission of this element.

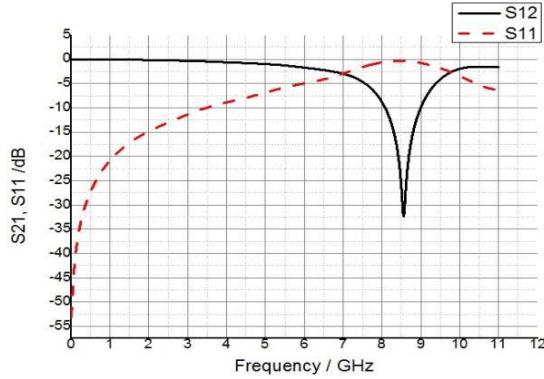


Figure 4: The parameters S according to frequency.

The figure 4 shows a frequency of resonance ($f_{\text{rés}}$) to 8.5GHz with a transmission of the order of -35dB.

The figure 5 shows the variation in frequency of the real and imaginary parts of the calculated effective permittivity. We can note that the real part of the permittivity is negative in a narrow band of frequencies around the resonance ($f_{\text{rés}} = 8.6$ GHz) and takes values varying from 0 to -3,5.

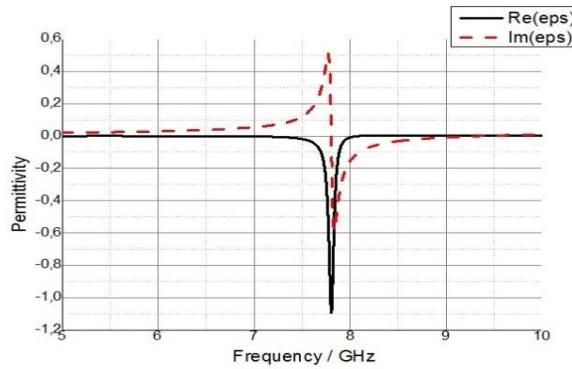


Figure 5: The effective permittivity according to frequency.

3 PRESENTATION OF THE COMPLEMENTARY SHAPE

In this part of this article, we study another resonant structure which is the Resonator in the shape of complementary dome.

This complementary structure includes two cracks in the shape of concentric interrupted domes made in a conductive plan as indicated in the figure 6.

This shape also has very low dimensions with regard to the wavelength but it must be differently stimulated so that it resounds. It is thus necessary to apply the configuration 4 described in the paragraph 2). The figure 7 shows the coefficients of reflection and transmission in dB.

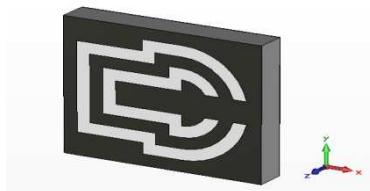


Figure 6: The complementary shape of the EBG in the shape of dome.

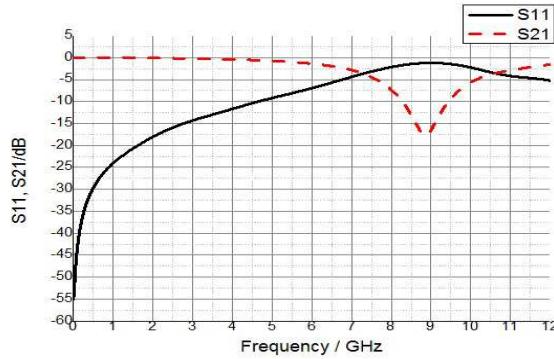


Figure 7: The parameters S according to the frequency.

The study of a periodic network (figure 8) formed by several cells of resonator in the shape of complementary dome allowed us to widen the forbidden band (figure 10). In fact, the juxtaposition of the frequencies rejected by different cells led to a forbidden band of 2.5GHZ, if we admit that the rate of rejection is at the level of -15db.



Figure 8: A periodic network formed by 8 cells in the shape of dome.

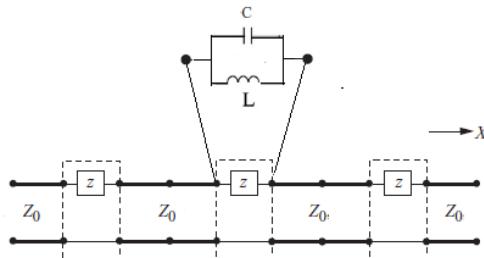


Figure 9: A periodic network modelled with LC elements.

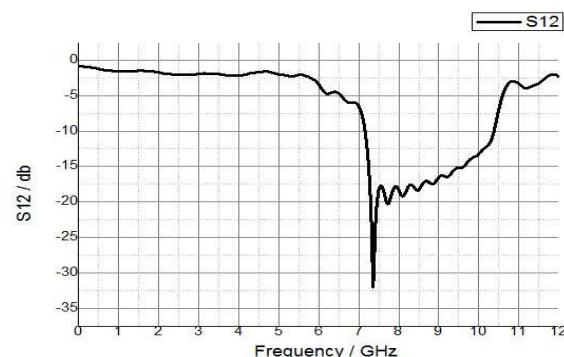


Figure 10: The coefficient of transmission according to the frequency

3.1 GUIDE OF WAVE WITH EBG

The results obtained above and works that have been performed [13] gave us the idea to conceive a guide of wave to forbidden band by replacing both lateral sides (figure11) of a guide by the structure of the figure9,

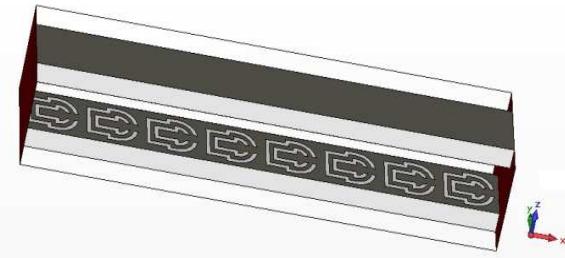


Figure 11: A guide of wave to forbidden band.

This structure is simulated under CST. The coefficient of transmission (S_{21}) is given into the figure12. The result obtained in simulation shows a behavior band gap around the central frequency of 8GHz. In fact, the stimulation of this guide is so that the electric-magnetic coupling is present for every cell of the network.

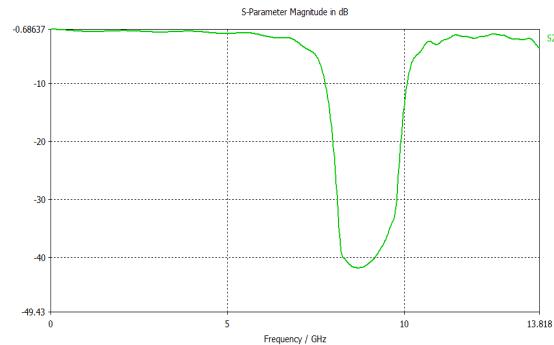


Figure12: The coefficient of transmission according to the frequency.

3.2 A FILTER CUTTING-BAND

These last years, the use of micro-strip lines with unmetallized groundplan allowed reducing the size of circuits in a significant way [14], [15]. We thus direct the study on planar structures and, more exactly on micro-strip lines of characteristic impedance 50ohms, having their unmetallized ground plan by type EBG's cracks in the shape of complementary dome. We shall thus present a new approach for the modeling of planars metamaterials.

This part is dedicated to the modeling of a cutting-band filter, its ground plan is unmetallized with EBG.

First, we present a structure cutting-band obtained by a network of 4×4 of the EBG in the shape of complementary dome (Figure 14).

The structure presented on figure 13 will be the ground plan for the filter.

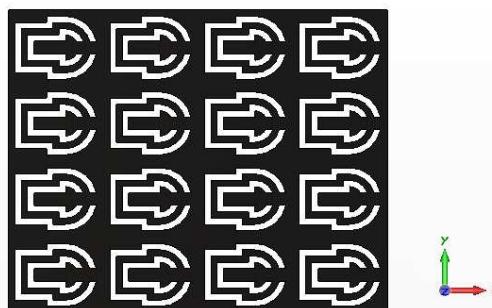


Figure 13: A network of 4×4 of the EBG in the shape of complementary dome.

The substrate has 0,81mm as thickness and a surface of $16,52 \times 16,52$ mm². The line of transmission has a 1,858mm as width and a 16,52mm as length. The periodicity of the network of the complementary EBG is 3,63mm and so, the network has $13,89 \times 13,89$ mm² as surface.

The ports of supply are placed in every end of the line and a box of radiation is used to simulate an open structure which shines on the free space.

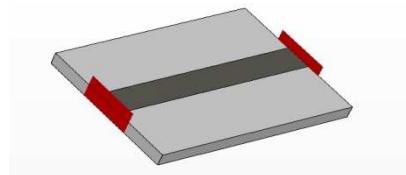


Figure 14: A filter cutting-band (unmetallized mass plan of a micro-strip line 50ohm).

The structure is simulated in the frequency band [5 GHz; 14 GHz] and the results are shown on the figure 15. A behavior cutting-band is obtained in the band [9GHz; 9.5 GHz] around the frequency of resonance of resonators.

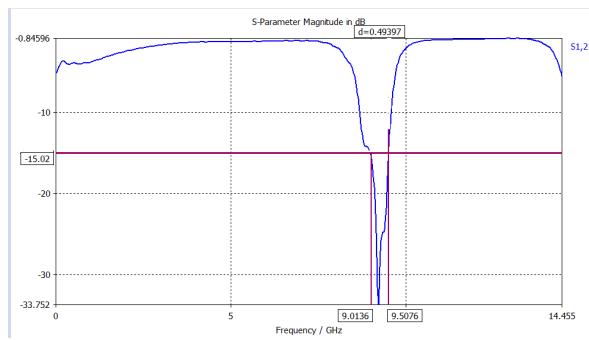


Figure 15: The coefficient of transmission S_{12db} according to the frequency.

3.3 ANTENNAS WITH EBG

Having highlighted the effect of the EBG structure introduced into the mass plan of a micro-strip line, we present now how the EBG in the shape of dome can help to improve the performances of a network of micro-strip antennas. A strong mutual coupling could reduce the efficiency of the network and involve the blindness of the scanning in the multi-element systems. Consequently, the structure (EBG) is used to reduce the coupling between the elements of the network[16],[17].

Two rows of EBG are inserted between both antennas of the network, as shown in the figure 16. Note that two rows of EBG cells are used here to obtain a satisfactory result.

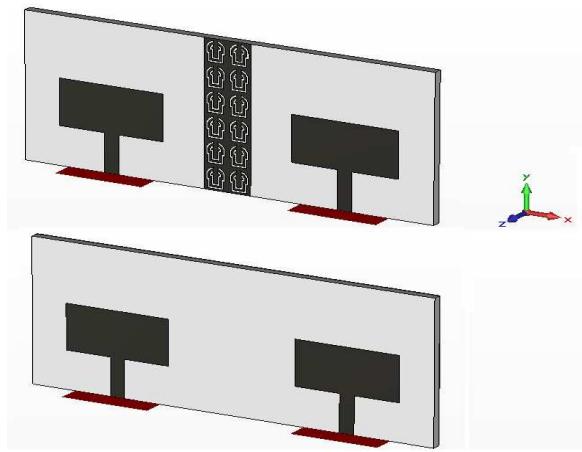


Figure 16: A micro-strip antennas separated by the EBG structures for a low mutual coupling.

CST Microwave Studio is used to simulate the plan E micro-strip antennas coupled on a dielectric substrate with $h = 2\text{mm}$ to and $\epsilon_r = 10.2$. The size of the antenna is $7\text{mm} \times 4\text{ mm}$ and the distance between both antennas is 38.8mm (0.75λ).

We observe that both antennas resound in 6.5GHz with a loss of efficiency superior to 10 dB . For antennas without the EBG structure, the mutual coupling to 6.5GHz is 30dB . In comparison, the mutual coupling of antennas with the structure EBG is 32.5dB . A reduction about 2.5 dB of mutual coupling is realized with the frequency of resonance of 6.5GHz .

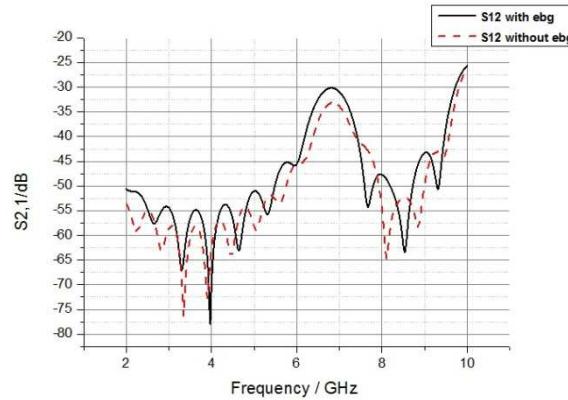


Figure 17: Mutual coupling results of the E-plane coupled patch antennas separated by EBG structures

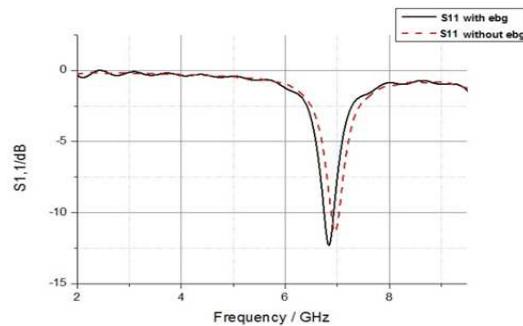


Figure 18: The return loss results S_{11db} of the E-plane coupled microstrip antennas separated by EBG structures

4 CONCLUSION

These last years, the structures with electromagnetic band gap (EBG) attracted the interest of several researchers because of their desirable electromagnetic properties that we cannot observe in the natural materials. In this respect, the EBG structure is a subset of metamaterials. Diverse activities of researches on the EBG structures are for the increase in the community of the electromagnetism and the antennas, and a wide range of applications was indicated, such as antennas with low profile, the networks of antennas with electronic scanning, the TEM guides of waves and the microwave filters. This article presents a contribution in this domain of research. In fact, this new structure of an EBG in the shape of dome could open the perspectives for other more and more successful forms.

ACKNOWLEDGMENTS

We are happy to acknowledge **Bhaskar Gupta** for helpful discussions with one of authors some years ago on this subject, his experiment about EBG were indispensable to give a rigorous formulation of this problem.

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ISRAEL-PALESTINE CONFLICT: WILL THERE BE AN ESTABLISHMENT OF PEACE IN HOLY LAND?

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ABSTRACT: The land of Palestine is also known as 'Holy Land'. It is holy because it is concerned with three great religions of the world i.e. Christianity, Islam and Judaism. It is an area roughly located between the Jordan River and the Mediterranean Sea. Presently, Jewish state of Israel and state of Palestine together form the ancient land of 'Palestine'. This sacred land after Second World War, particularly after the establishment of Independent State of Israel, has been turned in to a land of chaos, war, miseries and deaths. Thousands of innocent Palestinian Arabs and Jews from Israeli side have lost their lives in this conflict which is mainly concerned with a piece of land where communities i.e. Arabs and Jews, were living in harmony before the forceful mass immigration of Zionists from Europe to the holy land of Palestine. The involvement of Superpowers have further worsened the crisis. They have used the sentiments of both warring sides for their own benefits. The regional powers being militarily weak, failed to protect the legal rights of their coreligionists in Palestine. The younger generation in Israel and State of Palestine are brought up an environment of mutual hatred towards each other. The peace in the region is not possible until their mutual disputes are not resolved. But do they have such a higher level of maturity to solve their mutual disputes? In present paper an attempt have been made to study what are the causes, geopolitical effects and possible solutions to this conflict.

KEYWORDS: Holy Land, Establishment, Communities, Superpowers & Coreligionists.

1 INTRODUCTION

Conflicts with each other among various countries of the world are not a new phenomenon. It is a universal phenomenon that a powerful nation has always tried to subdue its weak neighbor so as to enhance its hegemony over the rival nations. But while enhancing their hegemony, they forgot that the impact of their fight to enhance their influence has to be borne by the common masses who suffer from acts like wars, trade sanctions, bans or restrictions on entry into other country's territory. Asia being the largest continent of the world has a large number of boundary as well as territorial disputes among its constituent countries. From Far East to extreme West and from its north to south there are a number of countries who are indulged in long pending disputes regarding their territories. These territorial disputes have led to a number of wars among these countries. But still after the end of wars, no permanent solutions to these problems till now have been arrived. This has resulted in strained relations among the disputed parties, mutual hatred among the nations, race of arms, human rights violation of prisoners of wars and economic drain of resources for the purchase of arms. It has resulted in mass poverty in these countries. Some important disputes among nations in Asia are Russia-Japan dispute over Kuril Islands, China-Japan dispute over Senkaku Island in East China Sea, China's dispute over South China Sea with ASEAN Countries, Kashmir dispute between India and Pakistan, India-China border dispute and last but not the least Israel-Palestine Conflict etc. The end of these disputes is not easily visible in near future.

Among these disputes the main discussion in the present paper will be done on 'Israel-Palestine conflict.' This conflict is a living example of how the native inhabitants of a particular area become internally displaced people and cornered to a very

small but fragmented area due to entry of a powerful & technically strong minority community. In other words, we can say that due to this conflict the native Arabs Muslims of Palestine were side cornered to very small fragmented pockets of the country by powerful Jewish state of Israel. Many countries in the world express their sympathy towards people of Palestine but no one has the courage to criticize openly the policies of planned killings of civilians of Palestine by the Israel. They just give 'Lip Service' of sympathy to Palestine but no real action on the ground against aggressor Israel.

2 OBJECTIVES OF STUDY

No study and research can be done without fixing its objectives. In the present paper we have following main objectives:

1. To know the main causes behind the Israel-Palestine dispute.
2. To assess the humanitarian situation in Palestine and effects this dispute on both Israel and Palestine.
3. Role of Global Super Powers and Regional Powers & United Nations in this dispute.

3 METHODOLOGY

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

4 AREA OF STUDY

Israel and Palestine states are situated in West Asia. Prior to existence of Independent State of Israel, the entire area was known as 'Palestine', but after the evolution of independent Jewish State after 1948 A.D. war, this area got divided into three parts (1) Jewish State of Israel (2) West Bank(of Jordan River) (3) Gaza Strip. (See the map).



Fig. 1. Political Map of Israel and State of Palestine

GEOGRAPHICAL & HISTORICAL DESCRIPTION PALESTINE REGION CONSISTING ISRAEL & PALESTINE AUTHORITY

Prior to establishment of the British Mandate for Palestine, there was no clear cut definition of the geographical and territorial limits of the area known as 'Palestine'. On the eve of First World War it was described by Encyclopedia of Britannica as a 'nebulous geographical concept under the British Mandate for Palestine' the first geopolitical framework was created that separated the Palestine from larger countries that surround it.

(See the Map of British Mandate for Palestine¹)

Presently Israel is a dominant independent state here therefore the latitudinal and longitudinal extent of Israel will be considered here. The entire area of Israel has latitudinal here. The entire area of Israel has latitudinal extent from $31^{\circ} 30' N$ to $34^{\circ} 45' N$ at eastern end of the Mediterranean Sea in West Asia. Longitudinal extant of Israel is $34^{\circ} 45' E$. Other areas West Bank, Gaza Strip and Golan Heights are captured by Israel Forcefully but presently these controlled areas are together known as 'Palestinian Authority' which has its own democratically elected government. But at international level Palestine has not much international acceptance. This may be due to heavy backing of Jewish State of Israel by United States of America and its western European allies in United Nations Security Council (UNSC). Geographically, West Bank (of Jordan River), Gaza strip and Golan Heights areas are detached, fragmented and separated from each other by the territory of Israel.

Climatically Israel in this region has Mediterranean climate with hot, dry, summers and cool, rainy winters. Heat waves are frequent. The climate conditions are highly variable within the state and modified locally by altitude, latitude and proximity to Mediterranean Sea.

'Jordan River' is the longest and lifeline of Israel and the West Bank settlements of Palestinian Authority. Israel physiographically is divided in to 'Mediterranean Coastal Plains' that extend from Lebanese border in the north to Gaza in South, 'Central Hills' including upper and lower Galilee, Samarian hills in West Bank etc., Jordan Rift valley and 'Negev Desert' which is an extension of Sinai Desert.

In Israel majority of population i.e. 76% is Jews, 16% Muslims, 2% Christians, 2% Druze and 4% are unclassified by choice. On the other hand in Palestinian Authority area of West Bank, Golan Heights and Gaza Strip, Sunni Arab Muslims are in majority followed by Jews and other religious affinities (as per 2013 census).

Historically, the origin of Palestine conflict goes back to First Zionist Congress in Basal in 1897 A.D. when a program for the colonization of Palestine by Zionist settlers was approved to pave the way for establishment of an exclusively Jewish state. "The Zionist scheme was launched with total disregard for the rights of indigenous Palestinians. Its inhabitants were mainly Arabs. The three communities of Palestine i.e. Muslim Arabs, Christians and Palestinian Jews were living in harmony. For Palestinian Jews, Zionism was both European and alien."¹

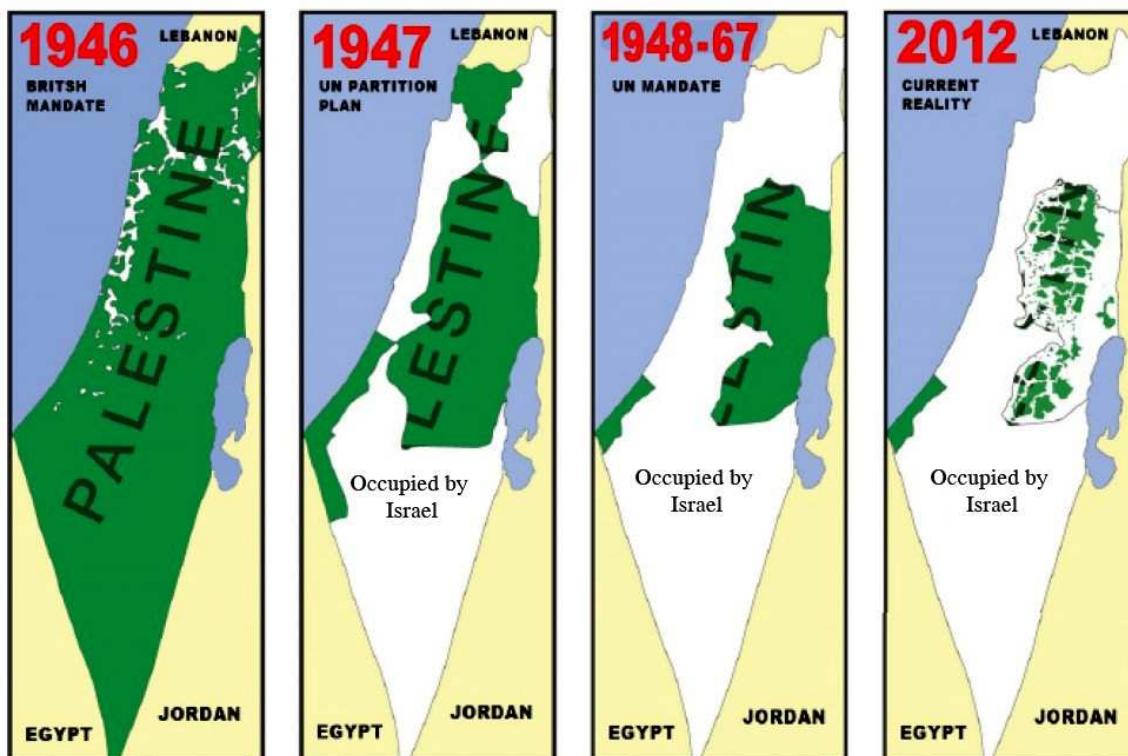
¹Giladi, G.N., *Discord in Zion*, Scorpion Publishing, London, 1990, P-35.

The Ottoman Empire of that time was well aware of the emerging threat of Zionism. But the real turn in this movement of a separate land for Jews grew strength before, during and after World War II. The massive persecution of Jews under European Nazis regime gave fresh sympathy to Zionist movements claim. With the outbreak of World War II, in order to gain Arab support, Britain under whom the territory of Palestine was in control, published a white paper restricting Zionist immigration and offering independence for Palestine within ten years.

The Arabs accepted the white paper but it was rejected by Zionists. Zionists terror groups mainly Haganah, Irgun and Stern gang unleashed a bloody campaign against British troops and officials and Palestinian civilians. In 1947AD; Britain decided to withdraw from Palestine. "The United Nations, under firm US pressure approved a partition plan under which Palestinian Arabs, comprising 70% population and 92% of land, were allocated 47% land of their country while the Zionists, comprising only 30% of population and only 8 % of land will get 53% of country, including its most fertile regions."²

This injustice of plan widened the rift between Palestinian Arabs and Zionists. In May, 1948, British forces completely withdrew from Palestine and Zionists proclaimed the State of Israel without defining its borders. Arab armies moved to defend the Palestinians and a full scale war between Arabs and Zionists erupted. Arabs were defeated. Finally in 1949AD; ceasefire was agreed. By the time Israel controlled 77% of Palestine, while rest of the area came under Jordan and Egypt's control. About half of Palestinian Arabs (880,000)³, had by 1949, been forced from their homes to become refugees. The exodus of Palestinians and their unexpected defeat are referred to as great catastrophe 'Al-Nakbah'. 'Al Nakbah' is the main event that led to declaration of Jewish state because if Palestinians remained living in the territory, then Jews would be in minority within the state.

SHRINKING PALESTINE



(Maps Showing Expansion of Israel since 1946 A.D.)

² Ryan, Sheyla & Muhammad Hallaj, *Palestine is but Jordan*.P-29.

³ Palestine, Research Center, PLO prints, Lebanon, P-28.

After the establishment of Jewish state, a continuous struggle for the rights of Independent State of Palestine for those people, who were uprooted from their territory by Israeli Zionists, started. In this direction, first under the leadership of Yasser Arafat in 1964 AD; PLO (Palestine Liberation organization) came into existence. In 1967 AD; Six Day War started up between Arab countries and Israel in which the later emerged victorious and expanded its more territory. Eventually in 1993 signing of 'OSLO Accord' led to the Israel-Palestinian Peace Process. This allowed PLO to relocate from Tunisia and settled in Gaza strip and West Bank. This led to establishment of 'Palestinian National Authority.' In 21st century in 2006 general election Hamas party came in control and again a bitter struggle started between Israel and Palestine Authority.

In 2011, a Palestinian Authority's attempt to gain UN membership as a fully sovereign state failed. In November 2012, the representation of Palestine in UN was upgraded to a non-member observer state, and mission title was changed from 'Palestine (represented by PLO)' to 'State of Palestine.' On July, 2014, due to continuous rocket firing by Hamas militias from Gaza in to Israel's territory has led to a strong Israeli Defense Forces counter attack from ground, air and a sea side blocked has led to more than 1900 civilian deaths in Gaza strip and a severe humanitarian crisis is existing there. This brutal action of Israel has led to widespread criticism of Israel. But Jewish state is not much worried about these criticisms, as they knew that their old ally U.S.A. has a full support to them.

CAUSES OF CONFLICT

The Israel-Palestinian Conflict has been going on for decades and has a number of somewhat complicated causes but the main issues are concerned with land and borders. Both sides believe that they have a God-given right to this territory and both sides have their claims based on the basis of the pact that was made by God with Abraham in Bible's Old Testament. Both sides were once a part of the same group who inhabited what was considered the 'Promised Land.' Who controls Jerusalem; issues of water rights, problems of force and a host of other caused have fueled the conflict particularly in 21st century. Following in brief are some causes:

1. **Origin:** - The country of Israel was not formally created until 1948, so from a technical stand point that would be the earliest beginning, but some scholars believe that the Jewish exile that happened in ancient time when the land was conquered by Romans. Later it was taken over by Arabs, who can still be found there today.

In late 19th century Jews created a Zionist movement in which they would relocate to the land that they felt was given to them by God; based on the accounts of Bible. This occurred with little regard to the already residing Arab Muslim population in that area. These people were against such moves of Zionists. Thus, tensions become serious among local Arab and Jewish immigrants.

2. **Implications of Holocaust:-** During the Holocaust, more than 6 million Jews were killed by Nazis (in their Auschwitz, Concentration camps and in public shoot outs) in Germany, Poland and other areas of Europe. Many who survived wanted to return to their land that they believe was their biblical birth right. Leaders petitioned Great Britain to allow Jews to migrate to Palestine and finally, in 1948 A.D. formal state of Israel were formed. There was again feelings of local Arab were hurt, they were of the view that why the punishments of sins committed by Europe be borne by them. This was another cause of rift between Arabs and Jews

3. **The Occupation:** - Israel, with U.S. support, has militarily occupied Gaza Strip (along with West Bank and East Jerusalem) since 1967A.D. This belligerent occupation till to date have taken lives of thousands of innocent Palestinian civilians.

Up until 2005 A.D. Israel maintained illegal Jewish colonies in Gaza strip as well. It has since disbanded these colonies and thus, claims that it is no longer occupying the Gaza strip. The illegal occupation of Israel and construction of its settlements in disputed area has led to anger in the mind of Palestinian Arabs against Israel.

4. **Control of Jerusalem:** - One of the most hotly bedeviled issue is, who or what should have control over 'Jerusalem?' Jerusalem is a religiously significant city for Jews, Christians and Muslims alike. It is believed that the city was originally founded by King David, and is also widely believed to be the site of crucifixion of Jesus Christ. Both Israel and Palestine consider Jerusalem to be their capital.

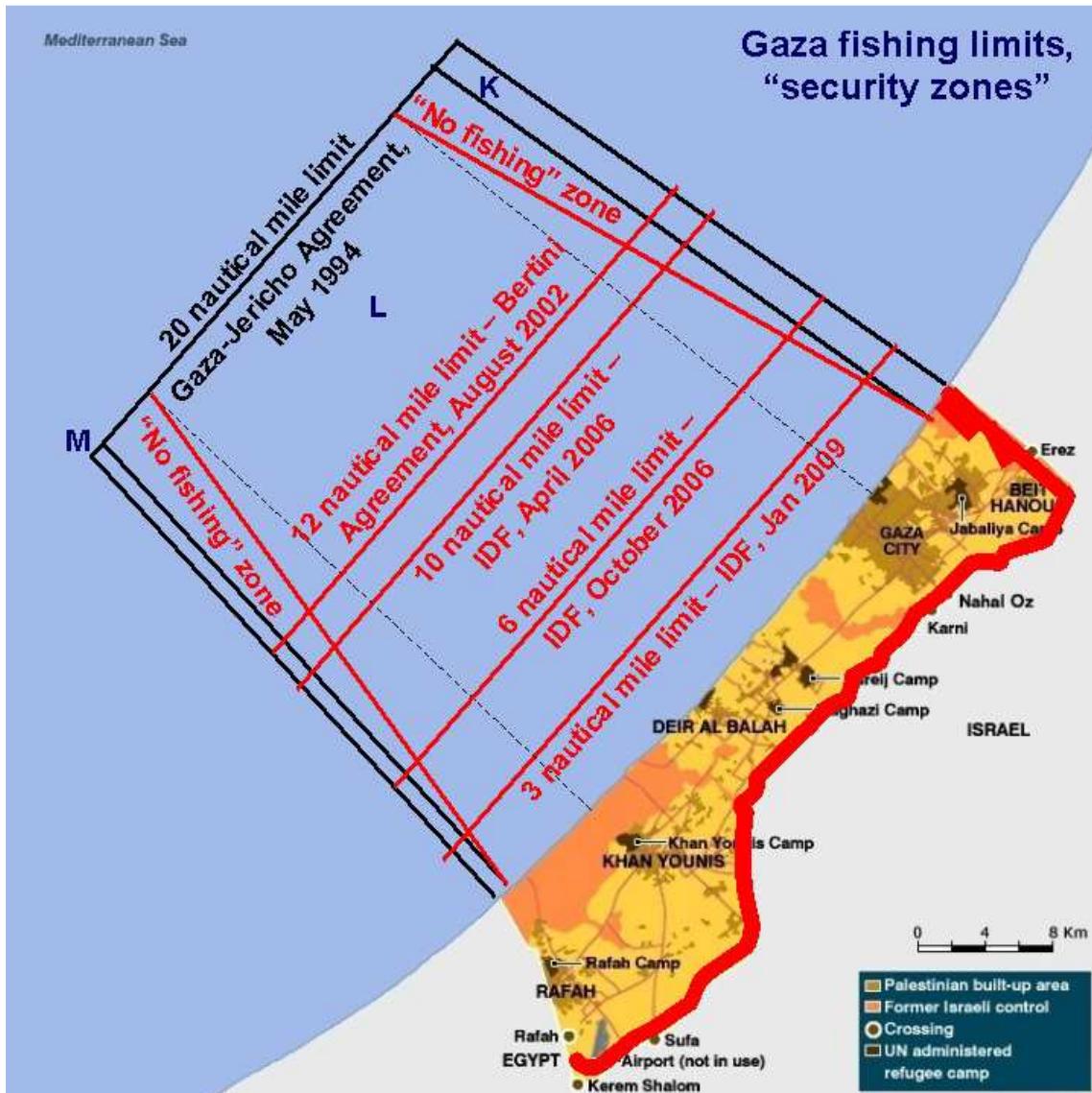
5. **The Siege:** - Israel with U.S. banking, has laid a brutal siege In Gaza strip since 2007 A.D. It has blocked off air, land and water access to the strip. This area is one of the most densely populated areas of the world. Due to its cage-like set up, Gaza has been aptly described as 'World's Largest Open Air Prison.' The siege has destroyed the economy of Gaza. Today almost 80% of Gazans are dependent up on international aid as a result of this blockade. The UN has warned that Gaza will be in hospitable by 2020A.D. if the siege continues. This is a height of cruelty. (See maps showing siege around Gaza Strip and West Bank)



6. The Water Crisis: - Control over fresh water is also a pressing issue. The disputed land is situated in a desert area where fresh water is scarce. Well drilling, plumbing and the ability to move this resource from place to place is a matter of intense debate and strife. Israel severely damaged the sewage treatment infrastructure in Gaza during 2009 assault. The blockade means, the resources needed for repairs are unavailable. As a result untreated contaminated water is thrown in Mediterranean Sea every day. About 90% of water supply in Gaza strip is unfit for consumption. This is also a main cause of confrontation between both sides.

7. Scarcity of Final and Electricity: - Due to siege, the Gaza strip and other areas i.e. in West Bank, are under chronic power shortage. Israel has severely limited the power supply to the region. There is only one power plant in Gaza which supplies two-third of Gaza's power needs, has been blown over by heavy shelling by Israel Defense Forces on July, 2014. It has plunged many parts of Gaza under darkness and rendered electrically operated medical services useless.

8. Restriction on Fishing: - Israel has announced that the access to the sea six nautical miles beyond Gaza shore is prohibited for fishing. This means 85% of fishing waters granted to Palestinians under OSLO Accord is now inaccessible, which in turn is effecting adversely to the Gazans inhabiting near coastal areas.



9. The Refugee Crisis: - Out of 1.5 million people living in Gaza, 1.2 million are the registered refugees spread across 8 camps. Since, the newly created State of Israel denied their right of return; they have been trapped in refugee camps for the past 66 years. The condition of refugees in these camps, which cannot be renovated due to siege, is pitiable. Humanitarian crisis in Gaza is higher than the rest of Palestine, unemployment is high, food is scarce and fuel is scant.

10. Tunnels of Gaza: - This is one of the main causes behind recent attacks by Israel on Gaza. Due to siege on land, restriction on air movements and blockade on the seaside resulted in creation of these tunnels. Earlier i.e. before first Intifada (December 1987 to 1993), these tunnels were used by Palestinians for their movements in and out of Gaza. But during first Intifada these tunnels were started to be used by Hamas and other terror groups for smuggling of arms and ammunition. The present July, 2014 attacks launched by Israel are also aimed at destroying the entire network of tunnels in Gaza.



These were some important causes which are responsible for the present day situation in Palestine.

ROLE OF SUPERPOWERS IN ISRAEL-PALSTINE CONFLICT

The involvement of superpowers i.e. U.S.A and former U.S.S.R. in Middle East was gradual. As the cold war developed in 1950's and 60's so did the involvement of U.S.A. and the former U.S.S.R. in the Middle East. By 1973, their involvement had become so crucial that both sides in the conflict were being supplied millions of dollars' worth of armaments. Moreover, in the Yom Kippur war of 1973, there was a fear that the superpower might even go to war against each other.

Both U.S.A. and former U.S.S.R helped the warring sides with millions of dollars as well as weapons. But after the disintegration of U.S.S.R.; now U.S.A. is a very strong power in this region and portraying itself as a sole mediator in Israel - Palestine conflict. But the role of U.S.A. is seen as partial in most of cases as due to its very strong Jewish lobby back home in U.S.A, it has to support Israel even if it is taking wrong and oppressive steps against the Palestinians. Jewish lobby in U.S.A. is one of the richest and one of the largest contributors of funds to political parties. So, none of the U.S leaders want to make them angry. Moreover, as per Reuter's news agency on July 2014, U.S government has decided to provide millions of dollars help to Israel to replenish its dangerous arsenal of arms and also to replenish its 'Iron Dome' missile interceptors. This partial attitude has resulted in creation of more problems in the way of peaceful solution of Israel-Palestine conflict. Russia on the other side these days is busy on its western borders with Ukraine, NATO and European Union, over the issue of Ukraine's membership of European Union.

Britain and France are the passive powers as they are supporting the US plans in Middle East.

ROLE OF REGIONAL POWERS

The important regional powers involved on Israel-Palestine Conflict are the members of 'Arab League' mainly Egypt, Saudi Arabia, Jordan, Syria, Lebanon, Qatar, State of Palestine etc. All members of Arab league have disputes with Israel. But after 2000 A.D. a change of positivity towards the solution of Palestine conflict has been noticed in the attitude of these nations particularly Egypt, Qatar and Saudi Arabia whereas Lebanon, Jordan are still anti-Israel. In 2002 A.D. the Arab Peace Proposal initiated by Saudi Arabia was endorsed by Arab league in Beirut. In 2007 A.D. also Arab League endorsed another peace initiative in Riyadh Summit which was also welcomed by the state of Israel who for the first time achieved the official delegation of Arab league.

Other than Arab League, the components of united government of state of Palestine i.e. Hamas and Fatah group are also very important regional players in the solution of this Israel-Palestine Conflict.

GEOPOLITICAL EFFECTS OF ISRAEL-PALESTINE CONFLICT

Under this heading we will discuss only current i.e. after 2000 A.D. geopolitical effects of this conflict. Some important effects are:

1. **Failure of American Policies:** - The US policy of showing itself as a sole mediator to the solution of this problem has been failed. U.S.A.'s continuous monetary as well as military help to Israel and back home importance of Jewish Lobby in domestic politics has presented a negative image of U.S.A. in the world. It may seriously affect the credibility of U.S.A, as an agent of peace in the world.
2. **Weaknesses of UNO Exposed:** - Recent attacks launched by Israel to destroy the underground tunnels network in Gaza and resultant deaths of more than 1900 people and United Nations' only verbal criticism of Israel and no concrete actions against aggressor Israel is also showing the weakness of UNO in front of superpowers like U.S.A.
3. **Negative Image of Israel:** - Such an unprecedented step taken by Israel as a result of which more than 1900 people of Palestine in Gaza died in which most of the people were common women and children. All these incidents have presented a negative image of Israel to the entire world.
4. **Threat to War against Terrorism:** - Brutal attacks and poor conditions of Palestinian refugees has led to a worldwide anger and hatred for Jewish Israel and U.S and its allies. In the Islamic world of Middle East Asia and also Palestinian supporters in many parts of the world, particularly fundamentalists, may provide both armed as well as monetary support to the terror outfits to launch terror attacks on U.S.A and its citizens as well as Israel and its citizens in any part of the world. This will be a big threat to war against terrorism.

POSSIBLE REMEDIES AND SOLUTIONS

The Israel and Palestine conflict cannot be solved in one day. The problem between these two states has been since after Second World War due to declaration of Israel as an independent state. Both sides need a great level of maturity to find a solution to their problems. Some important possible solutions given by experts are as follows:

1. **Two State Solution:** - Essentially a comprehensive settlement that would create a state of Palestine on the land seized by Israel in 1967 war with Arab state. This could be a better solution for both sides.
2. **One State, Two Peoples:** - Under this suggestion Jews and Arabs would be joined in one state, with all having same citizenship whether Israeli or Palestinian. But considering murderous hatred among the two sides, this solution doesn't seem to be viable.
3. **Regional Solution:** - Israel should talk to Jordan and Egypt on redrawing their border and incorporating the Palestinians of West Bank and Gaza strip into those neighboring countries.
4. **Unilateral Withdrawal:** - Except border areas for security, Israel should unilaterally withdraw its troops from Palestinian territory, remove the siege around Gaza and other areas of Palestine. This may help in easing the tension between Israel and Palestine.
5. Israel, Palestinian government should also imposed a ban on the unnecessary cross boarder rocket fires by Hamas and other terror groups as these fires are always retaliated severely by Israel. Therefore, for the security of common masses, the Palestinian Government should put a stoppage on the activities of these outfits.
6. Both Israel and Palestine State have committed war crimes. Hamas is a powerful group in Gaza Strip, its unreasonable rocket firing on Israeli settlements along the border cannot be justified. On the other hand, attacking UN sponsored refugee camps, mosques, busy markets and small children playing in gardens by mortars and missiles knowingly are grave and unpardonable war crimes by Israeli Defense Forces. Therefore, for ensuring peace, both sides should punish the culprits and in future peaceful solutions should be sought through diplomatic means rather than a war.

5 CONCLUSION

The conflict of Israel-Palestine is a modern phenomenon that began around the turn of 20th century. Although Arabs and Jews have different religions but religious differences are not a cause of conflict. It is essentially a struggle for land, which before 1948 A.D. was known as 'Palestine'. Both sides have fought a number of wars against each other but till to date no solution has come forward rather those who were living in Palestine much before the immigration of Jews from Europe are

now refugees in their own land. Recent 'Operation Protective Edge' taken by Israeli Defense Forces has led to 1900 deaths a majority of which consists of innocent women and children.

Every individual in this world has the right to live a decent, respectable life. Both sides are responsible for this carnage. Had the Hamas in Gaza not pounded hundreds of rockets in the territory of Israel, 'The Operation Protective Edge' then might not be taken by Israeli Defense Forces. Moreover, these precious 1900 lives could have been saved. Therefore, both parties are responsible for this conflict, therefore they should sit together and chalk out plans for future solutions of their conflicts. Though the process of solution is very slow and long but it is not impossible. (Following Table shows the Causalities, suffered by people in Palestine-Israel conflict. In 2014 this conflict has taken the toll of 1900 people of Palestine till the Ceasefire between two sides.)

Vital Statistics:
Total Casualties, Arab-Israeli Conflict
(1860 - Present)

Event	Year(s)	Jews/Israelis		Arabs/Palestinians	
		Killed°	Wounded^	Killed°±	Wounded^
<u>Arab Riots</u>	1920	6	200		
<u>Arab Riots</u>	1921	43			
<u>Arab Riots</u>	1924	133		116	
<u>Arab Riots</u>	1929	135	399	87	91
<u>Arab Riots</u>	1936-1939	415		5,000	15,000
<u>War of Independence</u>	1948	6,373	15,000	10,000	
<u>Sinai Campaign</u>	1956	231	900	3,000	4,500
<u>Six Day War</u>	1967	776	2,586	18,300	
<u>War of Attrition</u>	1968-1970	1,424	2,700	5,000	
<u>Yom Kippur War</u>	1973	2,688		19,000	
<u>First Lebanon War</u>	1982	1,216	2,383	20,825	30,000
<u>First Intifada</u>	1987-1993	200		1,162	
<u>Second Intifada</u>	2000-2005	1,100	8,000	4,907	8,611
<u>Second Lebanon War</u>	2006	164	1,489	1,954	4,400
<u>Operation Cast Lead</u>	2008-2009	14	1,272	1,434	5,000
<u>Operation Pillar of Defense</u>	2012	6	240	158	
<u>Operation Protective Edge</u>	2014	43	134	1,062	
Terrorism/Other	1860-Present	9,927			
TOTAL:		24,894	35,730	91,105	67,602

* - Casualty numbers only placed when a verifiable source was identified.

** - This number reflects total casualties by Palestinians in Israel as well as invading Arab countries Egypt, Syria, Lebanon, Jordan and Saudi Arabia.

^ - Number of wounded, for both Israel and the Arabs, are estimates.

° - Number of killed reflects combination of military and civilians.

± - Number of Arab killed are all estimates.

Sources: Wars, Israel Ministry of Foreign Affairs, The Palestinian Human Rights Monitor, The Palestinian Human Rights Monitoring Group

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Self-Organizing Map Based Fault Detection and Isolation Scheme for Pneumatic Actuator

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ABSTRACT: Fault diagnosis is an ongoing significant research field due to the constantly increasing need for maintainability, reliability and safety of industrial plants. The pneumatic actuators are installed in harsh environment: high temperature, pressure, aggressive media and vibration, etc. This influenced the pneumatic actuator predicted life time. The failures in pneumatic actuator cause forces the installation shut down and may also determine the final quality of the product. A Self-Organizing Map based approach is implemented to detect the external faults such as Actuator vent blockage, Diaphragm leakage and in correct supply pressure. The Self-Organizing Map is able to identify the actuator condition with high accuracy by monitoring five parameters. The parameter selection is based on the committee of DAMADICS (Development and Application of Methods for Actuator Diagnosis in Industrial Control Systems). The Self-Organizing Map Systems were implemented in real time using MATLAB and the results prove that the system can effectively classify all the types of external faults.

KEYWORDS: Actuators, Fault Diagnosis, Fault Isolation, External Fault, Neural Network.

1 INTRODUCTION

A common element in the modern industries is nothing but the pneumatic actuator and it is used to control the fluid and gas flow. Presence of fault in these actuators is accountable for some changes in the operating conditions, which create disturbances in the overall process. In consequence of a deviation of process output and in sometime a severe failure, it makes an unscheduled process shut down. The rising complexity of process industries as well as the necessity to reduce the overall manufacturing costs, demands the evolution of appropriate methods not only finding but also attributing causes to pneumatic actuator failures. Different types of techniques for Fault Detection and Isolation (FDI) of nonlinear systems were formed and could be applied to pneumatic actuator. In general, the FDI technique monitors some critical, measurable characteristics or parameters are related to the operation of the plant system [1]. When the measurable parameters deviate

from their normal values, it is affirmed that a fault has occurred. If the critical performance parameters are properly selected, there is possibility for identifying each fault. The design technique of an effective FDI system requires that: (i) a method for obtaining performance parameters correlated to the system performances, which have high information about the faults, and (ii) a decision making technique that identifies the specific fault condition pertaining to a particular set of measurable parameters [1].

For the past two decades, many numbers of techniques, that proposed different method for the fault diagnosis. Beard (1971) and Jones (1973) have developed an observer-based fault detection called Beard-Jones Fault Detection Filter [2], [3]. Mehra & Peschon (1971) and Willsky & Jones (1974) use statistical approaches to fault diagnosis [3]. Clark, Fosth & Walton (1975) applied Luenberger observers [4]. Mironovsky (1980) proposed a residual generation scheme for the purpose of checking on the system input and output over a time limit [5]. Artificial Intelligence researchers (1980) proposed a fault diagnosis based on First-Order Logic. Frank (1987) introduced observer based method [6] and Isermann (1991) proposed parity relation method [7] also Basseville and Nikiforov (1993) proposed parameter estimation method [8]. In 1993 Fault Detection and Isolation community was formed based on the classical fault diagnosis methodologies. The analytical redundancy method was introduced by SAFEPROCESS called Steering Committee (1991) with IFAC (International Federation of Automatic Control). Hamscher et al. (1992) proposed a Model-Based Diagnosis (MBD) [9]. Patton et al. (1999; 2000) delivered tutorial on the use intelligence techniques [10]. Recently, hybrid intelligent systems methods are also introduced by Negoita et al. (2005) [11]. Right now, Neural Network based fault detection was introduced by Prabakaran K et al. (2013) using Back Propagation algorithm [19]. Fuzzy logic based fault detection was also introduced by Prabakaran K et al. (2014) using Sugeno-Type Fuzzy logic [22] and Radial Basis Neural Network was developed by Prabakaran K et al. (2014) [23].

In accordance with modern methodologies to solve Fault Diagnosis problems in nonlinear dynamic systems can be broadly classified into three categories. The first one is a mathematical model based approach. But it is clear that constructing mathematical models for complex systems are very difficult. Even though a mathematical model is designed, experimental evaluation of the model is also difficult. This method does not seem to be easy for complex system. The third method is to use artificial intelligence techniques as fault classifiers to solve Fault Diagnosis problems [12], [22]. This paper has proposed Self-Organizing Map to diagnose faults in the Pneumatic actuator. This approach is a novel method which achieves effective fault diagnosis by feedback algebra and developed to give an alternative mythology for conventional estimation techniques.

2 PNEUMATIC ACTUATOR

The most used final control element in the automation industries is the pneumatic actuator control valve. It adjusts the flowing fluid, such as water, steam, gas or chemical compounds to compensate for the load variable and keep the controlled process variable as close to the required input set point [13], [19]. The input of the actuator is the output of the process controller (flow or level controller) and the actuator modifies the position of the valve allowing a direct effect on the primary variable in order to accompany the flow or level set-point [13], [19]. The internal structure of pneumatic servo-actuator, which is used as a testing element for fault detection as illustrated in Fig. 1.

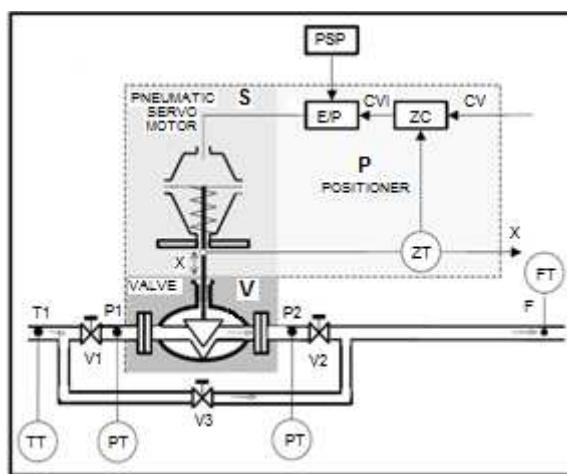


Fig. 1. Internal structure of pneumatic control valve

2.1 ACTUATOR MAIN COMPONENTS

The pneumatic actuator control valve includes three main parts: control valve, spring-and-diaphragm pneumatic servomotor, positioned as shown in the Fig. 1 [22].

2.1.1 CONTROL VALVE

The control valve is a mean used to prevent and/or limit the flow of fluids. Changing the position of the control valve is done by a servo motor [22].

2.1.2 SPRING AND DIAPHRAGM PNEUMATIC SERVOMOTOR

It can be defined as a compressible pressure powered device in which the pressure acts upon the flexible metallic diaphragm, to provide a linear motion to the stem.

2.1.3 POSITIONER

The positioner is a device applied to eliminate the pneumatic actuator stem improper positions produced by the internal sources or external sources such as pressure unbalance, hydrodynamic forces, friction, etc. It consists of an inner loop with a P controller of a cascade control structure, including the output signal of the outer loop of the flow or level controller and the inner loop of the position controller [14], [19]. The internal parts of the actuator are indicated in notation and the measurable parameters are designated as the transmitter.

2.2 INTERNAL PARTS OF ACTUATOR

- S -Pneumatic servo-motor
- V -Control valve
- P –Positioner
- ZC -Position P Controller (internal loop Controller)
- E/P -Electro-Pneumatic Transmitter

2.3 ADDITIONAL EXTERNAL PARTS

- V1 -Cut-Off Valve
- V2 -Cut-Off Valve
- V3 -By-Pass Valve
- PSP -Positioner Supply Pressure
- PT -Pressure Transmitter
- FT -Volume Flow Rate Transmitter
- TT -Temperature Transmitter

2.4 MEASURED PHYSICAL PARAMETERS

- CV -External (Level or Flow) Controller Output (%)
- P1 -Valve Input Pressure (kPa)
- F -Flow Measurement (m³/h)
- P2 -Valve Output Pressure (kPa)
- T1 -Liquid Temperature (°C)
- X -Rod Displacement (%) [22].

3 CONTROL VALVE FAULTS

The Manuscripts of DAMADICS project focuses on pneumatic actuators fault detection methodology. DAMADICS committee has concentrated on the evolution of actuators Fault Detection and Isolation (FDI). The real time FDI algorithms

are applicable in industrial environment [15]. DAMADICS discovered the 19 types of pneumatic actuator faults which occur in the pneumatic actuator valve during the overall process [16].

The pneumatic actuator faults are classified into the following four categories: General faults/external faults, Control valve faults, Positioner faults and Pneumatic servo-motor faults. Probably, single actuator faults are observed in industrial process while multiple faults rarely occur. Referring to Fig. 1, it is observed that the measurable parameters describe the main characteristics of the actuator. When a fault occurs, the measurable parameters would vary from a normal operating condition. So these measurable parameters enable us to characterize the changes in the operation of the actuator due to the occurrence of the faults [17].

3.1 FAULT CONSIDERED FOR DIAGNOSIS

In real time process plenty of faults may occur in pneumatic actuator. Three commonly occurring faults which are considered for the fault diagnosis process are

- Incorrect supply pressure
- Diaphragm leakage
- Actuator vent blockage [19].

3.2 MEASURABLE PARAMETERS CONSIDERED FOR FAULT DIAGNOSIS

The following five measurable parameters are considered for the diagnosis process to identify the three faults which are approved by the DAMADICS [15], [19].

- Rod Displacement (%)
- Valve Output Pressure (kPa)
- Valve Input Pressure (kPa)
- Flow Measurement (m³/h)
- External (Flow or Level) Controller Output (%) [22].

4 SELF-ORGANIZING MAP

Self-organizing map is a Kohonen network. Such a network is able to gain knowledge to detect regularities and connections in their input and adapt their upcoming output to that input accordingly. The network parameters are updated by a learning procedure based on input patterns only (unsupervised learning). Different to the standard supervised learning techniques, the unsupervised ones use input signals to dig out information from data. Throughout learning, there is no comment or feedback to the surroundings or the inspected process. As a result, weighted connections and neurons should have a definite level of self-organization. Moreover, unsupervised learning is only helpful and efficient when there is an idleness of learning models. Neurons and inputs in the aggressive layer are associated completely. In addition, the parallel layer is the network output which causes the response of the Kohonen network. The weight parameters are updated by means of the winner takes all rules as follows [18].

$$i = \arg \min_j \{ \|u - w_j\| \} \quad (1)$$

where u is the input vector, i is the index of the winner, w_j is the weight vector of the j -th neuron. On the other hand, as an alternative for updating only the winning neuron, all neurons surrounded by a definite region of the winning neuron are adjusted or learned according to the method

$$w_j(k+1) = w_j(k) + \eta(k)C(k)(u(k) - w_j(k)) \quad (2)$$

where $\eta(k)$ is the learning rate and $C(k)$ is a region. The learning rate and the region size are changed through two phases: an ordering phase and a tuning phase. An iterative nature of the learning rate escorts to steady establishing of the characteristic map. Throughout the first phase, neuron weights are anticipated to order themselves in the input space dependable with the connected neuron places. Throughout the second phase, the learning rates keep on to reduce, but very gradually. The little value of the learning rate delicately tunes the network even as keeping the ordering learned in the earlier phase stable. In the Kohonen learning rule, the learning rate is a monotone diminishing time function.

Frequently used functions are $\eta(k) = 1/k$ or $\eta(k) = ak^{-\alpha}$ for $0 < \alpha \leq 1$.

The concept of region is tremendously vital during the network processing. A correctly clear region powers the numbers of adjusting neurons, e.g. 7 neurons related to the region of radius 1 defined on the hexagonal grid even as the region of radius 1 approved on the rectangular grid contains 9 neurons. A self-motivated change of the region size constructively powers the swiftness of characteristic map ordering. The learning process establish with a huge region size. Then, as the region size reduces to 1, the map leans to order itself topologically over the presented input vectors. Once the region size is 1, the network should be practically well planned and the learning rate gradually reduces over a longer time to provide the neurons time to spread out consistently across the input vectors. A classic region function is the *Gaussian* one [20], [21]. After designing the network, an extremely significant task is conveying clustering consequences generated by the network with preferred results for a specified problem. It is essential to decide which regions of the characteristic map will be dynamic throughout the occurrence of a specified fault.

5 HARDWARE DESCRIPTION

The pneumatic actuator of normally closed type with positioner is used up for the fault diagnosis. The control signal is applied to the control valve through the National instrument USB DAQ card. The experimental setup for the fault diagnosis is shown in the Fig. 2.



Fig. 2. The experimental setup of pneumatic actuator fault diagnosis

The Table 1 show the appropriate sensors which are employed to measure the five parameters.

Table 1. Sensors used for measuring the parameters

S.No	Measuring Parameter	Sensors
1	Rod Displacement (%)	Potentiometer
2	Valve Output Pressure (kPa)	Differential Pressure Transmitter (Yokogawa)
3	Valve Input Pressure (kPa)	Differential Pressure Transmitter (Yokogawa)
4	Flow Measurement (m^3/h)	Magnetic type flowmeter (Yokogawa)
5	External (Flow or Level) Controller Output (%)	Differential Pressure Transmitter (ABB)

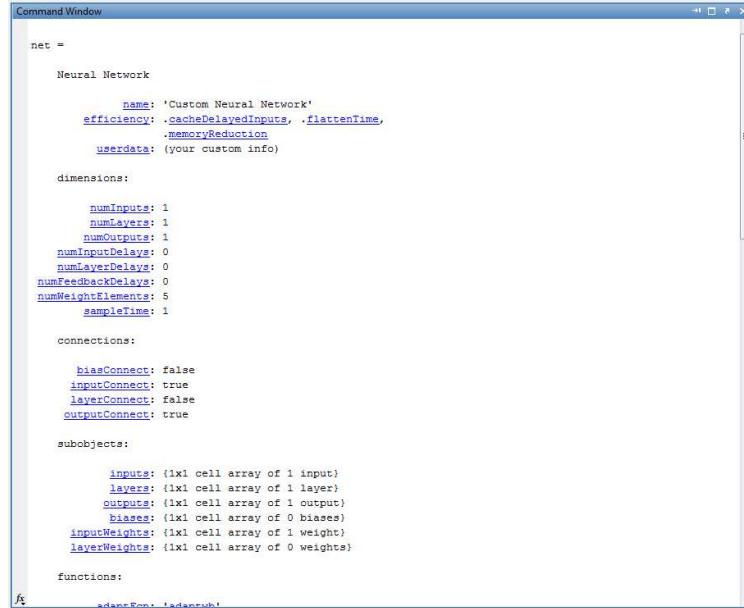
The data from the sensor are collected in the computer using USB DAQ card. From the hardware setup, 3500 data are collected to study the changes in each parameter in each faulty condition and as well in normal circumstance. The gathered data are processed by self organizing map which is developed in MATLAB, to identify the condition of the pneumatic actuator.

6 RESULTS AND DISCUSSION

The real time data which were collected at the time of the fault and no fault are fed as input to the Self-organizing map. The output is compared with known data to calculate the efficiency. Table 2 shows the output result of Self-organizing map while running in MATLAB.

Table 2. Result of Self-organizing map MATLAB

S.No	Parameters	Self-organizing map output
1	No. of training data	1500
2	No. of checking data	2500
3	Classification error	1.45
4	Computational time	0.876163 sec
5	Computational Accuracy	99.01%
6	Training error	0.00099567



```

Command Window

net =
Neural Network
    name: 'Custom Neural Network'
    efficiency: .cacheDelayedInputs, .flattenTime,
    .memoryReduction
    userdata: (your custom info)
dimensions:
    numInputs: 1
    numLayers: 1
    numOutputs: 1
    numInputDelays: 0
    numLayerDelays: 0
    numFeedbackDelays: 0
    numWeightElements: 5
    sampleTime: 1
connections:
    biasConnect: false
    inputConnect: true
    layerConnect: false
    outputConnect: true
subobjects:
    inputs: {1x1 cell array of 1 input}
    layers: {1x1 cell array of 1 layer}
    outputs: {1x1 cell array of 1 output}
    biases: {1x1 cell array of 0 biases}
    inputWeights: {1x1 cell array of 1 weight}
    layerWeights: {1x1 cell array of 0 weights}
functions:
ft
adadelta, fadapnwhl

```

Fig. 3. First Part of the Self-organizing Map Structure

```

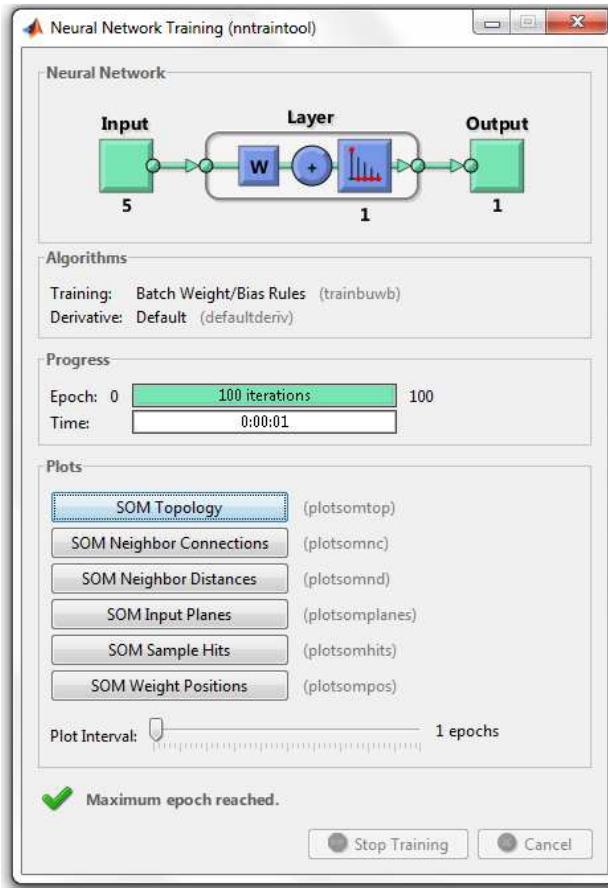
Command Window
    biases: (1x1 cell array of 0 biases)
    inputWeights: (1x1 cell array of 1 weight)
    layerWeights: (1x1 cell array of 0 weights)

functions:
    adaptFcn: 'adaptwb'
    adaptParam: (none)
    derivFcn: 'defaultderiv'
    divideFcn: (none)
    divideParam: (none)
    divideMode: 'sample'
    initFcn: 'initlay'
    performFcn: (none)
    performParam: (none)
    plotFcn: ('plotsomtop', plotsomnc, plotsomnd,
               plotsomplanes, plotsomwhite, plotsompos)
    plotParams: (1x6 cell array of 0 params)
    trainFcn: 'trainbubb'
    trainParam: '.showWindow, .showCommandLine, .show, .epochs,
                .time'

weight and bias values:
    IW: (1x1 cell) containing 1 input weight matrix
    LW: (1x1 cell) containing 0 layer weight matrices
    b: (1x1 cell) containing 0 bias vectors

methods:
    adapt: Learn while in continuous use
    configure: Configure inputs & outputs
    gensim: Generate Simulink model
    init: Initialize weights & biases
    perform: Calculate performance
    sim: Evaluate network output given inputs
    train: Train network with examples
    view: View diagram
    unconfigure: Unconfigure inputs & outputs

```

Fig. 4. Second Part of the Self-organizing Map Structure**Fig. 5. Training of Self Organizing Map**

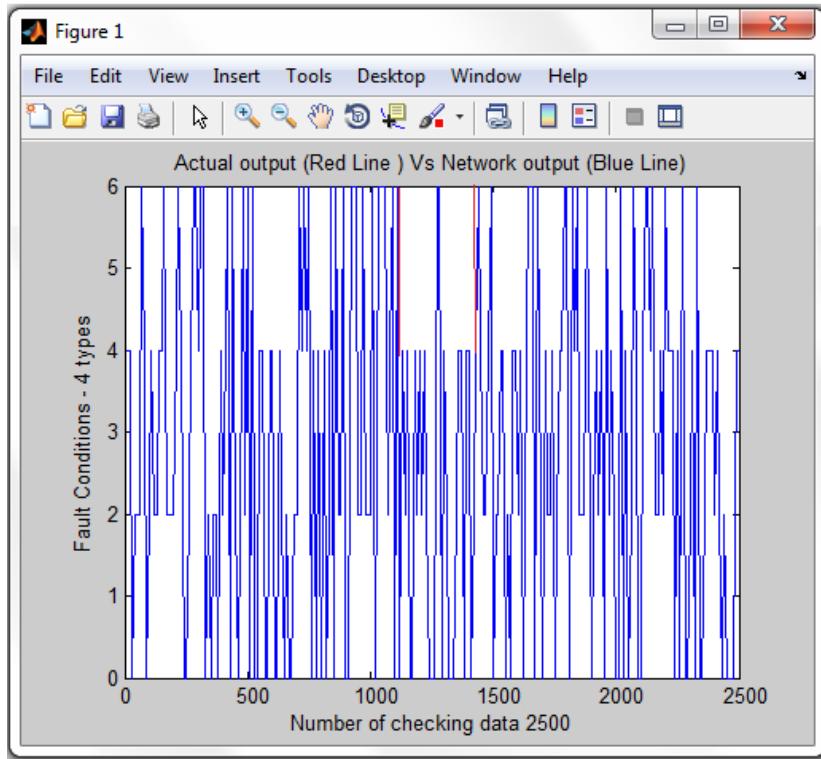


Fig. 6. Self Organizing map output Vs Actual known output

From the Table 2 it has been identified that the classification error value was only 1.45. It shows that the Self-organizing map have computational accuracy of 99.01%. The Self-organizing map classifies all the type of faults with the minimum number of error.

The Fig. 3 and Fig. 4 Shows the structure of self organizing map created for the fault diagnosis process. In that the numbers of weight elements are minimum of 5 so that training of the network and the checking of the network takes only the minimum time. Fig. 5 shows the training of self organizing map to make the adjustment in the intermediate layer weight also the minimum number of epoch is attained with the short period of time.

The efficiency of the Self-organizing map was computed using the know fault data. The fault which is already known is feed as input to the Self-organizing map and the output was compared same. The Fig. 6 shows the comparison plot of Self-organizing map output and known fault. The red line in the graph represents the Actual known output of four types of fault conditions and the blue line indicates the Self-organizing map output. The merging of two plots means that the Self-organizing map classifies the fault as correctly. In this method the two plots of fault conditions are merged 99.01% exactly while compare with other existing techniques such as Neural Network, Fuzzy logic and Radial Basis Neural Network are presented by Prabakaran K et al. (2013) [19], Kaushik S et al. (2014) [22] and Prabakaran K et al.(2014) [23]. From the analysis Self-organizing map has the perfect ability to diagnosis pneumatic actuator faults.

7 CONCLUSION

In this paper, a Self-organizing map based fault diagnosis technique for detection and identification of pneumatic actuator faults was proposed. The faults of interest are various. The specific values of five measurable parameters are observed to detect the type of fault. For each operating condition, the parameters formed a discriminatory fault signature that was subsequently learned by Self-organizing map with the goal of successfully detecting and identifying the faults. The simulation results proved that the Self-organizing map has a capability to detect and identify the various magnitudes of the faults with high accuracy.

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Hepatitis awareness among the general public in Cameroon: A survey study

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ABSTRACT: *Introduction:* Viral hepatitis affects millions of people around the globe. The burden of disease is significantly higher in developing countries such as those in Africa. Lack of awareness coupled with inadequate information about the disease amongst general public is the major reason for the spread of infection. Awareness of the disease can help in building advocacy and improving access to care. In order to assess the awareness levels of hepatitis among general public in Cameroon, we designed and conducted a cross-sectional study.

Materials and Methods: The objective of the study was to assess the awareness of hepatitis in a set population of Cameroon. A cross-sectional study was conducted in a small population in Cameroon. A total of 88 people aged between 18 to 70 years participated in the survey.

Results: On a scale of 0 to 10 the average awareness level of the survey respondents was 5.38. Although the results indicated that the survey participants had some knowledge about hepatitis, it was observed that there was lack of awareness in some key areas of the disease such as modes of transmission and vaccination. There is a need for initiatives at a population level to increase the awareness about viral hepatitis, modes of transmission, treatment and prevention in Cameroon.

KEYWORDS: Awareness, Hepatitis, Knowledge, Cameroon, Africa.

1 INTRODUCTION

Hepatitis refers to inflammation of the liver. Hepatitis is caused by various factors; however, viruses are the leading etiological agents. Viral hepatitis is mainly caused by Hepatitis A, B, C, D and E viruses. The World Health organization (WHO) and Centre for Disease Control (CDC) estimate that currently, over 500 million people are living with chronic viral hepatitis. Of these, nearly 1 million die every year of the consequences of hepatitis like cirrhosis or liver cancer. More exactly, an estimated 57% of liver cirrhosis and 78% primary liver cancer cases are believed to result from hepatitis B (HBV) or hepatitis C (HCV) infection [1], [2], [3], [4]. Individuals with chronic hepatitis are at risk of developing a wide range of liver related complications, worst being liver cancer and death.

The burden of viral hepatitis in Africa is not accurately known but is believed to be significantly high. The prevalence of HBV is estimated at 8% in West Africa and 5-7% in Central, Eastern and Southern Africa [2]. It is estimated that approximately 70-95% of the adult population in Africa show evidence of past exposure to HBV infection with an estimated HBsAg seroprevalence of 6-20% [5]. While the WHO estimates the prevalence of HCV in the African continent as 5.3%, it is markedly higher in some areas, reaching levels of up to 17.5% in Egypt [6].

Viral hepatitis continues to be a major threat in Africa. Cameroon in particular has a very high prevalence of HCV in West Africa ~13.8% [6]; while the prevalence of HBV in Cameroon stands at 8% [7]. However, these figures likely represent only a fraction of the true burden. Despite hepatitis affecting a considerable portion of Cameroon's population, it still does not receive the attention it deserves. Cameroon does not have a written national policy or a strategy to combat viral hepatitis [8]. Moreover, hepatitis is often a 'silent' disease; while most patients recover from acute infections, many of them progress to

the chronic stage and serious life-threatening complications. Often due to low awareness, most of the patients are diagnosed at a stage when the disease becomes irreversible.

Studies have been conducted earlier to assess awareness and level of knowledge among medical students of Cameroon [9]. But so far no study focusing exclusively on the general public has been reported. The knowledge and awareness of the disease amongst the public is important to assess and review the existing health care systems and implementing new strategies to fight against the disease. This study was therefore conducted, to assess the awareness among patients with viral hepatitis in Cameroon. In line with the WHO's intent to combat the widespread ignorance of hepatitis, FSRC as part of its continued efforts to create awareness for hepatitis, conducted a hepatitis awareness survey among the general public in Cameroon.

2 MATERIALS AND METHODS

2.1 STUDY SETTING

A cross-sectional study was conducted in a select population from Cameroon. The study was conducted in December 2013. A total of 88 people participated in the survey. The participation in the study was voluntary and the participants were included after obtaining informed verbal consent. Only completed survey results were evaluated. The study was performed after receiving the ethical clearance from the internal ethical committee of FSRC, Bangalore.

2.2 STUDY TOOL

To assess the patients' awareness about hepatitis, a set of simple multiple-choice questions were created. The questionnaire was based on the basic knowledge of viral hepatitis which an individual is expected to know, like etiology, modes of transmission, symptoms, vaccination, prevention and treatment for hepatitis etc. Following an extensive literature review the primary version of the questionnaire was developed [10]. The questionnaire was evaluated for its reliability and validity. Physicians and experts assessed the face, content and convergent validity of the questionnaire. The questionnaire was self-administered and the participants were requested to tick a single most appropriate response. The answers were grouped based on a score ranging from 0 (low awareness) to 10 (high awareness).

2.3 STATISTICAL ANALYSIS

The participants' demographic characteristics were illustrated using descriptive statistics. Categorical variables were shown as percentages while continuous variables were depicted as mean \pm standard deviation. In addition, frequencies of variables were calculated. The statistical software (SPSS) was used to compile and analyse the data.

3 RESULTS

A total of 88 people in Cameroon responded to the survey. All the participants included in the study were from the general public. Their ages ranged from 18 to 70 years. A greater part of the survey takers (~61.35% or 54/88) had the knowledge that hepatitis is mainly caused by the hepatitis viruses (A, B, C, D and E). However, 38.63% (34/88) of the survey responders believed that smoking and junk food were the main factors for hepatitis. According to the survey responses, a majority of the survey participants (~63.64% or 56/88) in Cameroon were aware of the fact that hepatitis is a disease that primarily affects the liver. About 43.18% (38/88) of the survey responders believed that the hepatitis A infection can lead to hepatitis B and C sequentially. Although some of the survey takers were familiar with the fact that Hepatitis A/E is commonly transmitted through contaminated food or water, it is important to note that a significant number of them (~68.18% or 60/88) lacked that knowledge. Less than half (~44.31% or 39/88) of the individuals who took the survey had the basic awareness on the methods of transmission of HBV and HCV.

The survey responses comprehended that there is a lack of awareness (~2.27% or 2/88 did not know if there was a vaccine and ~ 70.44% or 62/88 did not know for which hepatitis infection was the vaccine available) about vaccines for hepatitis infections. A substantial number of survey takers were aware of the fact that hepatitis B virus is more infectious than HIV (~79.54% or 70/88). As per the survey results around 69.32% (61/88) of the respondents were aware of the fact that Hepatitis C is treatable. A large number of people regarded that smoking and alcohol were the common causes of liver cancer (~60.23 % or 53/88). A good number of the respondents (~71.59% or 63/88) were aware that chronic hepatitis can lead to liver cancer.

Overall, on a scale of 0 to 10 the awareness levels of the survey takers was 5.38 showing lack of awareness in some key areas (Table 1 and Table 2).

Table 1: Awareness of hepatitis among the general public in Cameroon (continued in Table 2)

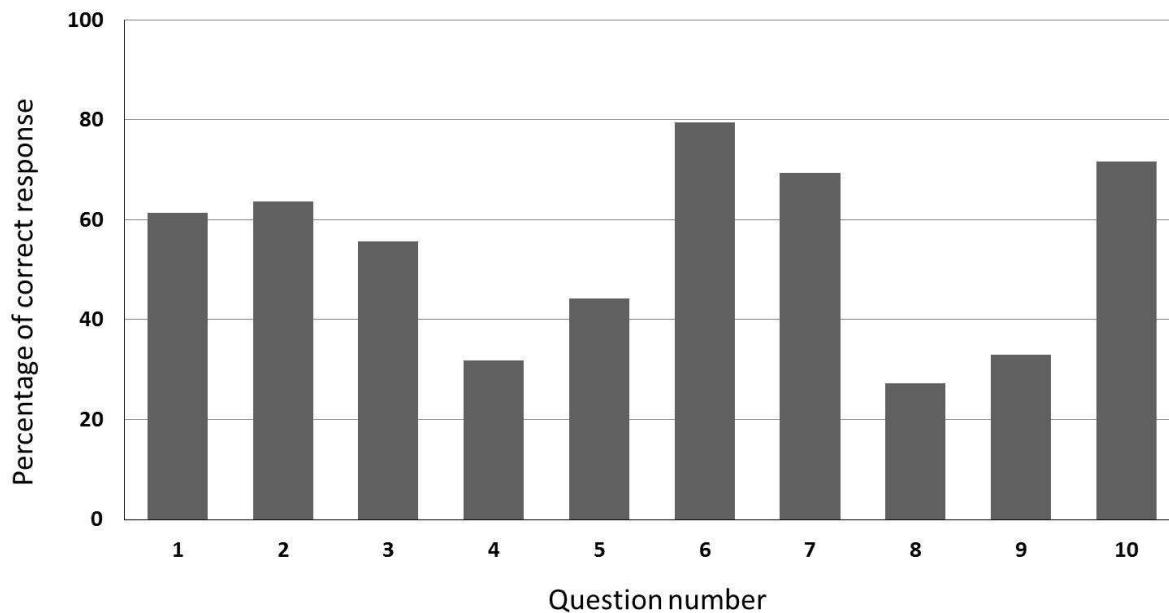
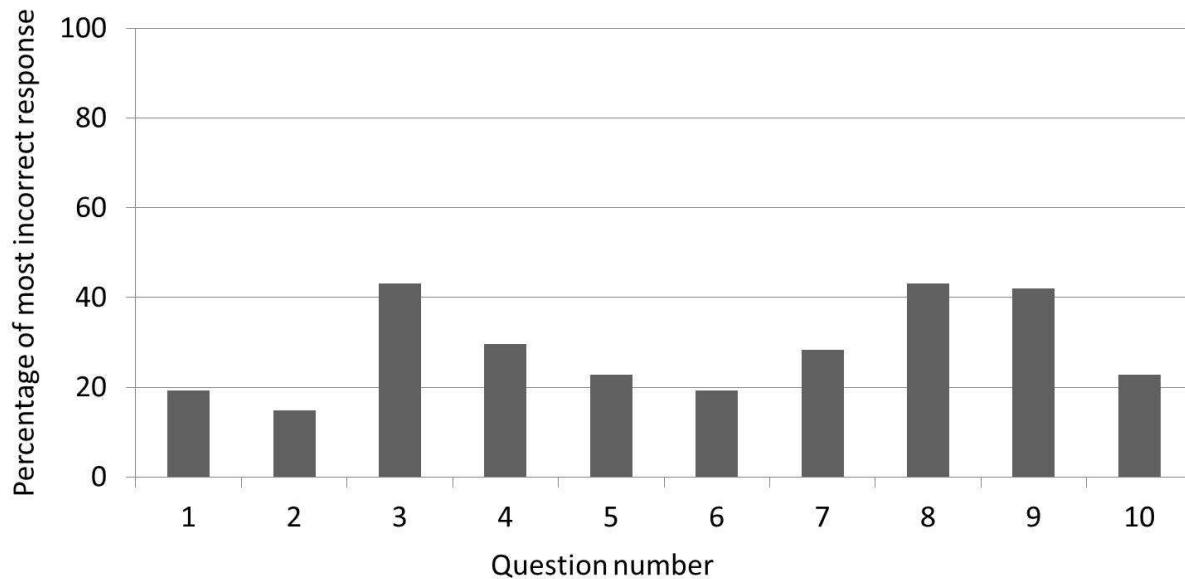
No		Number (n)	Percentages (%)
	Cause of hepatitis		
1	Which of the following is the most likely cause of viral hepatitis		
	Smoking	14	15.90
	*Hepatitis viruses (A, B, C, D and E)	54	61.35
	Junk food	3	03.41
	All of the above	17	19.32
	Adverse effects of hepatitis		
2	Hepatitis primarily affects		
	Kidney	8	09.09
	*Liver	56	63.64
	Heart	13	14.77
	Stomach	1	01.14
	Skin	10	11.36
	Don't know	0	0
3	Hepatitis A leads to Hepatitis B, which then leads to Hepatitis C		
	True	38	43.18
	*False	49	55.68
	Don't know	1	01.14
	Transmission of hepatitis		
4	Hepatitis A/E is most commonly transmitted through		
	Air	12	13.64
	*Contaminated food or water	28	31.82
	Blood transfusion/ Injection Drug Use	26	29.55
	Sexual Transmission	21	23.85
	Don't know	1	01.14
5	Hepatitis B/C is most commonly transmitted through		
	Air	4	04.55
	Contaminated food or water	12	13.64
	Blood transfusion / Injection Drug Use	20	22.73
	Sexual Transmission	10	11.36
	*Blood transfusion, Injection drug use, sexual route	39	44.31
	Don't know	3	03.41
Correct answers are marked with asterisk *			

Table 2: Awareness of hepatitis among the general public in Cameroon (continued from Table 1)

No		Number (n)	Percentages (%)
	Infectious nature of HBV		
6	Hepatitis B is more infectious than HIV		
	*True	70	79.54
	False	17	19.32
	Don't know	1	01.14
	Treatment of hepatitis		
7	Hepatitis C is treatable		
	*True	61	69.32
	False	25	28.41
	Don't know	2	02.27
	Vaccinations for hepatitis		
8	Vaccination is available for		
	Hepatitis A	14	15.90
	*Hepatitis A and B	24	27.29
	Hepatitis A, B and C	10	11.36
	All types of Hepatitis	38	43.18
	Don't know	2	02.27
	Complications of hepatitis		
9	Most common cause of liver cancer is		
	*Hepatitis B and C	29	32.95
	Hepatitis E	4	04.55
	Alcohol	16	18.18
	Smoking	37	42.05
	Don't know	2	02.27
10	Chronic hepatitis can lead to		
	*Liver cancer	63	71.59
	Heart attack	20	22.73
	HIV	3	03.41
	Don't know	2	02.27
Correct answers are marked with asterisk *			

4 DISCUSSION

The results indicate that there was some awareness (Table 1, Table 2 and Figure 1) about hepatitis and the basic information related to the disease. At the same time, we cannot ignore the fact that majority of the survey participants lacked knowledge (Figure 2) in areas such as modes of transmission and vaccination.

*Fig 1. Percentage of correct responses for the survey questions**Fig 2. Percentage of most incorrect responses for the survey questions*

Many survey respondents believed that smoking and consumption of junk food were the main causes for hepatitis. Although junk food and smoking might have a role in the prognosis of hepatitis they are not the leading cause of liver diseases. The media focus and various campaigns related to the spread of awareness on anti-smoking and alcoholism might have influenced this phenomenon. Hence, distinguishing the public health messages from one another may aid the spread the awareness about hepatitis in general.

According to the survey responses, a majority of the survey participants in Cameroon were aware of the fact that hepatitis is a disease that primarily affects the liver. All the five types of hepatitis viruses (A, B, C, D and E) can independently infect a person (although HDV requires co-infection with HBV). HAV and HEV viruses spread through contaminated food and water, practicing unhygienic methods and poor sanitation [11], [12]. Sexual transmission, blood transfusion and use of injecting drugs (through reuse and sharing of needles and syringes) are other insignificant routes of spread of HAV and HEV. On the other hand, Hepatitis B, C and D usually occur as a result of contact with infected body fluids like, receipt of

contaminated blood or blood products, invasive medical procedures using contaminated equipment, vertically from mother to child in pregnant women, horizontally among house-hold and peer contacts, and also by sexual route [12], [13], [14]. However, close to half of the survey responders believed that the hepatitis A infection can lead to hepatitis B and C sequentially. In a similar type of cross-sectional survey conducted in Cameroon amongst medical students who are at a higher risk of developing HBV, about 83.2% were aware about the risk factors of HBV infection [9]. This shows a discrepancy in the awareness of the disease amongst medical students and general public. This highlights the need for public awareness initiatives.

According to the cross-sectional survey amongst the medical students in University of Yaoundé, Cameroon, only 44.6% of them answered correctly on vaccinations and 17.5% acknowledged that their unvaccinated status was due to a lack of information on vaccines [9].

Licensed vaccines are available for HAV and HBV. According to CDC, children, adolescents and adults should be vaccinated against HAV and HBV. As per CDC guidelines, Hepatitis A vaccine is given between 12-23 months of age in children and at any age in the case of unvaccinated adults at risk [15]. Hepatitis B vaccine is given as 3 doses at birth, 1-2 months of age and 6-8 months of age [15]. A fourth dose is administered if a combination vaccine is used. Adults above 18 years who did not receive the HBV vaccine during childhood should get vaccinated [15]. Awareness about vaccination, the resulting advocacy and vaccine seeking behavior would help in controlling the spread of infection.

Currently there are no hepatitis specific programs in the country. Although recommended, HBV vaccination for at risk groups is not completely implemented in Cameroon [9]. HBV vaccination is currently given to children below 1 year as a part of the national program of immunization routine [16]. Apart from vaccination there are programs currently being run in Cameroon to prevent the spread of blood-borne infections among the general public and health care workers [17]. Therefore, significant strides taken to spread the awareness about vaccination against hepatitis and safe injection practices would go a long way in assisting prevention.

Although alcohol or smoking can contribute to liver cancer, HBV and HCV are the major causative factors. Both HBV and HIV have similar routes of transmission like; exposure to infected blood and body fluids via sexual route, blood transfusion, reuse of needle and syringes, tattooing and vertically from mother to child. As per CDC data, HBV is 50-100 times more infectious than HIV. The burden of viral hepatitis superimposed on the existing HIV epidemic in Africa leaves many at a risk of developing co-infection resulting in accelerated disease in HBV/HIV co-infected individuals [17].

Many survey respondents were aware of the fact that there is treatment available for HCV infection. In routine, patients are assessed on various grounds such as the viral load, the genotype, stage of the liver disease etc. Subsequently, the appropriate antiviral therapy is administered for the required duration. An early diagnosis and treatment of infection has a better prognosis. However, treatment options for HCV do not seem to be affordable to the majority of the population [18]. However, to enhance access to treatment of HCV patients, the Ministry of Public Health, Cameroon is negotiating a 35% cost reduction for interferons which are used for HCV treatment; while at the same time the Government of Cameroon is ensuring the free availability of another anti-HCV drug, Ribavirin [16].

As per a news report in "Cameroon Tribune", 13% and 10% of Cameroon's population suffer from HCV and HBV respectively, which amounts to 4,500,000 people battling against viral hepatitis [16]. The burden of hepatitis in Cameroon mandates immediate action. Hepatitis needs focus like HIV, malaria, or tuberculosis as the general public lack knowledge about the disease and its complications. There is a need to impart awareness among the general public about the viral infections, their modes of transmission and methods of prevention. There is a need to create awareness about vaccination among the general public.

The annual Health Survey for England (HSE) on the health of residents in England is used in planning National Health Service (NHS) facilities, formulating methods to improve people's health [4], [19]. This survey has given an insight about the current awareness of hepatitis among the general public in Cameroon. As the survey was conducted in a small population from Cameroon, it may not represent the true awareness of hepatitis in the entire region. Hence, further research in the area involving larger sample size need to be conducted. The data collected from such a research can be utilized in the formulation of plans and strategies to combat viral hepatitis.

5 CONCLUSION

The survey participants lacked the information on critical issues like vaccination, modes of transmission and preventive measures. This mandates the need for health education and awareness campaigns for the general public and at risk population. Improved access to treatment and hepatitis prevention initiatives will aid in controlling the spread of the disease.

More than focusing on what is known; we call attention to the most common errors that people make in the understanding of hepatitis. Hepatitis is a preventable disease and the public awareness campaigns should aim at not just dispelling the myths, stigma and mis-information associated with hepatitis, but the fact that safe practices can prevent hepatitis. Awareness campaigns should focus on developing content for various channels of communication and the content pedagogy should be aligned to achieve behavior change to ensure that the awareness campaigns are successful. There is clearly a need for awareness campaigns at the general public level and this needs the active involvement of not just patient groups, but also physicians, Ministry of Health and the media to empower the general public with trustworthy and actionable information.

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Notice of Retraction

The authors of the following article have requested that it be retracted from publication in the *International Journal of Innovation and Applied Studies*:

Mohamed Louzazni and Elhassan Aroudam, "State Feedback Linearization Control Approach of Three-Phase Photovoltaic Inverter," *International Journal of Innovation and Applied Studies*, vol. 8, no. 3, pp. 1377–1389, September 2014.

Evaluation of *Moringa oleifera* Carbon for the As(III) Removal from Contaminated Groundwater

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ABSTRACT: Removal of trivalent arsenic from contaminated groundwater was studied using steam activated carbon prepared from the leaf, seed and pod of *Moringa oleifera* (MO) plant of the indigenous-cultivar of Bangladesh. Batch adsorption experiments were performed as a function of contact time, adsorbent doses and variants. The removal efficiency of the MO-leaf-carbon and MO-seed-carbon was substantial, while it was trivial for MO-pod-carbon. The pseudo-first- and second-order and intra-particle diffusion equations were used to evaluate the sorption mechanism of the MO carbon options. The MO is a common plant variety of the arsenic-affected Bengal delta. Therefore, it can be exploited as a cheaper resource of carbonaceous adsorbent for the economical removal of arsenic from the water.

KEYWORDS: *Moringa oleifera*, leaf, seed, pod, arsenic, water treatment.

1 INTRODUCTION

Arsenic, a toxic trace element, have incorporated in different environmental compartments, food chains and ultimately in humans due to the geogenic arsenic contamination of the groundwater [1]. The chemical forms of arsenic species determine the corresponding toxicity of arsenic in humans. Arsenite [As(III)] and arsenate [As(V)] are the most common water-soluble As-species as existed in the natural water systems, and the trivalent species is 10 times more toxic than the pentavalent variant. The As(III) mostly exists in reducing ground waters and hydrothermal waters, while As(V) is more commonly found in surface waters and oxidizing ground waters [2]. In terms of the extent of groundwater arsenic contamination and potable water exploitation source, the most people are at risk in Bangladesh followed by West Bengal, India. Hence, an unavoidable risk causing both cancerous and non-cancerous health effects is assumable to the mentioned populations due to the exposure to high level of arsenic [3, 4], unless the groundwater-supply chain is combined with any treatment procedures.

The treatment techniques available for the processing of arsenic contaminated groundwater for the end-of-the-pipe drinking water supply are several [5-8], which include the application of ion-exchange resins, membranes and adsorption onto coagulated flocs or sorptive media. Arsenic removal by low-priced adsorbents has been the most promising technique, which can be implemented within a simplistic scheme and require least maintenance or operating cost [9]. There is increasing research interest in using alternative adsorbents prepared from low-cost or of minimum economic value materials

for arsenic removal, such as, laterite [10], sugarcane bagasse [11], rice husk [12], sawdust [13], coconut husk, oil palm shell [14], neem bark [15], peat, compost, leaf mold, straw, wool fiber, soybean and cottonseed hulls, etc. [16, 17].

Biodegradability and low sludge production are some advantageous factors, which promote the use of natural coagulants for water treatment in developing countries [18, 19]. The use of natural coagulant, such as *Moringa oleifera* (MO) is better than other chemical coagulants [20, 21] mostly in terms of the amount of produced sludge [22], while its coagulation mechanism consists of adsorption and neutralization of the colloidal charges [20]. The MO, which is a small deciduous tree, is the most widely naturalized species of *Moringaceae* family [23, 24]. It is native in Asia Minor, Africa, India, Pakistan and Bangladesh [25, 26]. The potential of MO or other *Moringa* species-variants for the removal of arsenic [27-31], lead [32], cadmium [33], or other waterborne toxins [34-36] has been reported [22, 37]. However, the mentioned studies are mostly concentrated on the exploitation of *Moringa* seed.

The objective of the present work is to check the potential of MO carbon powder prepared from the different usable parts of an MO plant, e.g., leaf, seed and pod for the removal of trivalent arsenic from the contaminated groundwater, which has not been reported before.

2 MATERIALS AND METHODS

2.1 REAGENTS

Analytical reagent grade commercial products were used throughout. The As(III) stock solution (10 mg L^{-1}) was prepared from sodium arsenite (BDH Chemicals, India), and the working standards were prepared by dilution on a weight basis. Double-distilled deionized water was used throughout.

2.2 COLLECTION OF SAMPLES

The origin of the *Moringa oleifera* (MO) plants used in this study was a private grove located in the hilly area of the Chittagong district, Bangladesh. The mature pods of MO were collected and the seeds were separated from the pods. The MO leaves were also picked up from the matured MO plants. All the masses were sorted, sun-dried and ground to powder. The powdered samples were stored at $20 \pm 1^\circ\text{C}$ until further use.

2.3 PREPARATION OF THE MO CARBON

The carbonization of the MO plant parts (leaf, seed and pod) was performed in a muffle furnace at 200°C for 2 h. The carbon thus obtained was further treated following the process as described by the Warhurst *et al.* [38]. A set of three samples of treated carbon were prepared using leaf, seed, or pod of the MO plant ensuing the same procedure, followed by drying in an oven at 100°C . The products of each set were mixed together, homogenized, sieved, and stored in desiccators. The MO carbons representing the leaf, seed and pod parts are mentioned hereafter as MO-leaf-carbon (MO-LC), MO-seed-carbon (MO-SC) and MO-pod- carbon (MO-PC).

2.4 PREPARATION OF THE SIMULATED GROUNDWATER

Simulated groundwater resembling the typical groundwater characteristics available in the arsenic-prone regions of Bangladesh is prepared as described by Leupin *et al.* [39]. The composition is given in the Table 1. The simulated water was spiked with 0.5 mg L^{-1} of As(III).

Table 1. Composition of the simulated groundwater (GW) and the typical groundwater in Bangladesh (BGD-GW)

	Simulated GW	Typical BGD-GW ^a
pH _{ini}	7.0 ± 0.05	7.0 ± 0.2
HCO ₃ ⁻ (mM)	8	7.8 ± 2.7
Ca (mM)	2.5	1.9 ± 1.4
Mg (mM)	1.6	1.3 ± 0.8
Si (mg L ⁻¹)	20	19.2 ± 4.7
P (mg L ⁻¹)	2.0	1.47 ± 1.48
As (mg L ⁻¹)	0.5	0.199 ± 0.166
Fe (mg L ⁻¹)	0	5.3 ± 4.8
Mn (mg L ⁻¹)	0	0.57 ± 0.75
DOC (mg L ⁻¹)	0	3.3 ± 2.8

^a Data source: Leupin et al. [39] based on the database of BGS and DPHE [40]

2.5 ARSENIC REMOVAL EXPERIMENTS USING THE MO CARBON

A series of batch studies was performed by adding the MO carbons (MO-LC, MO-SC and MO-PC) at varying dose (1 to 3 g L⁻¹). The solution pH was maintained at 8.0 ± 0.5 and was adjusted using either HCl or NaOH (1 mol L⁻¹). The mixtures were stored in stoppered tubes, and were agitated at room temperature (25 ± 2 °C) using an end-to-end shaker at a fixed speed of 300 ± 20 rpm for various time intervals (0–24 h). The supernatant was separated from the solid residue via filtration with Whatman filter paper. An atomic absorption spectrometer (AAS) of the iCE 3000 Series (Thermo Scientific, Franklin, MA, USA) was used to determine the As(III) concentration in the supernatant. All the experiments were conducted in triplicates, and an averaged value is reported.

3 RESULTS AND DISCUSSION

3.1 EQUILIBRIUM STUDY: EFFECT OF CONTACT TIME

The change in the residual arsenic concentration with contact time with varying adsorbent doses is shown in Figure 1. The pattern indicates that the adsorption of As(III) by MO carbons is a rapid process and often reaches equilibrium within 12 to 24 h. The observed trend confirms that the removal of As(III) by MO carbon occurs at a higher rate in the first 5 hours, while it becomes slower at the subsequent hours approaching gradually to the equilibrium state. The comparative difference between the concentration of As(III) in the bulk solution and the number of the adsorbent sites are high at the initial hours, which causes a rapid uptake. The rate tends to be slowed down as the saturation of the adsorbent sites occurs at the late hours. The decrease in As(III) concentration with time occurs up to 12 h and then the curves seem to be flattened, i.e., an equilibrium condition is achieved.

The comparative uptake rate of As(III) in the adsorbent phase can be expressed using the term q_t (mg g⁻¹). The initial As(III) concentration (C_i) (mg L⁻¹), the concentration of As(III) in solution at any time (C_t) (mg L⁻¹), the total volume of the solution (V_f) (L) and the mass of the adsorbent (m) (g) are used to calculate the q_t using the following equation [41]:

$$q_t = (C_i - C_t) \frac{V_f}{m} \quad (1)$$

The trend in the change of the q_t of the MO carbons (MO-LC, MO-SC and MO-PC) at different doses (Figure 2) indicate that the As(III) uptake rate in the adsorbent phase has a reciprocal relationship with the adsorbent doses. The pattern might be attributable to the step up in the adsorbent sites with the increasing dose. Hence, the most suitable dose of MO carbon to treat the contaminated groundwater will be required to be determined based on the initial arsenic content of the raw water.

A comparison of the As(III) removal efficiencies of the MO carbons (MO-LC, MO-SC and MO-PC) at different doses is illustrated in the Figure 3. The As(III) removal performance of the MO-PC is considerably low compared to the other two options, and is not recommended as a viable option for the said purpose. A moderately comparable rate of the As(III) removal was achieved with the MO-LC or MO-SC, and the order can be shown as MO-SC > MO-LC for being to be more precise. Therefore, any of those options can be chosen based on the resource conditions.

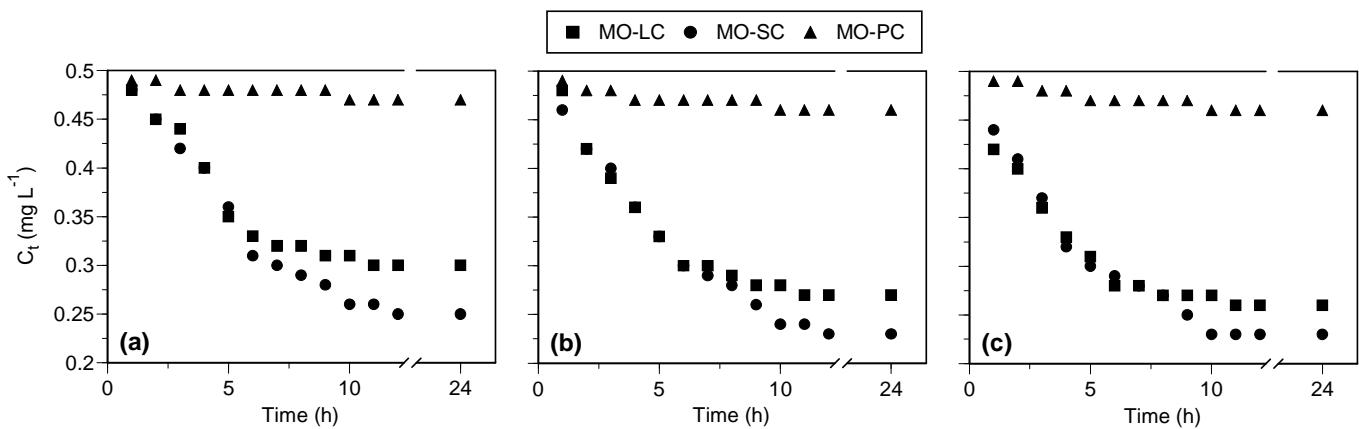


Fig. 1. The effect of contact time on the As(III) uptake rate at varying MO carbon doses: (a) 1 g L^{-1} , (b) 2 g L^{-1} , (c) 3 g L^{-1}
 MO-LC, MO-leaf-carbon; MO-SC, MO-seed-carbon; MO-PC, MO-pod-carbon
 $t, 0 - 24 \text{ h}; C_0, 0.5 \text{ mg L}^{-1}; T, 25 \pm 2 \text{ }^\circ\text{C}; n = 3$

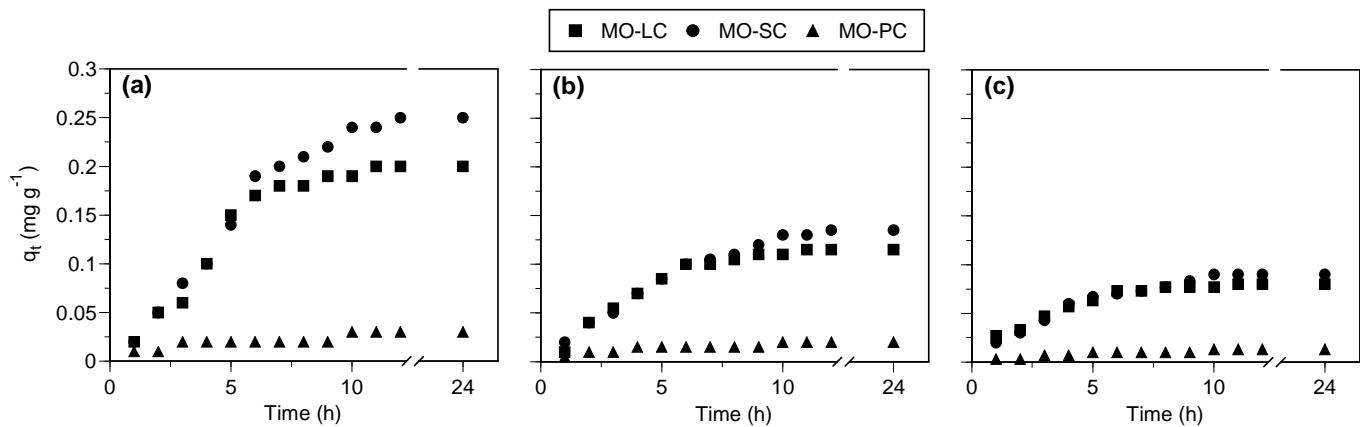


Fig. 2. The change in the q of the MO carbon variants with time at varying MO carbon doses: (a) 1 g L^{-1} , (b) 2 g L^{-1} , (c) 3 g L^{-1}
 MO-LC, MO-leaf-carbon; MO-SC, MO-seed-carbon; MO-PC, MO-pod-carbon
 $t, 0 - 24 \text{ h}; C_0, 0.5 \text{ mg L}^{-1}; T, 25 \pm 2 \text{ }^\circ\text{C}; n = 3$

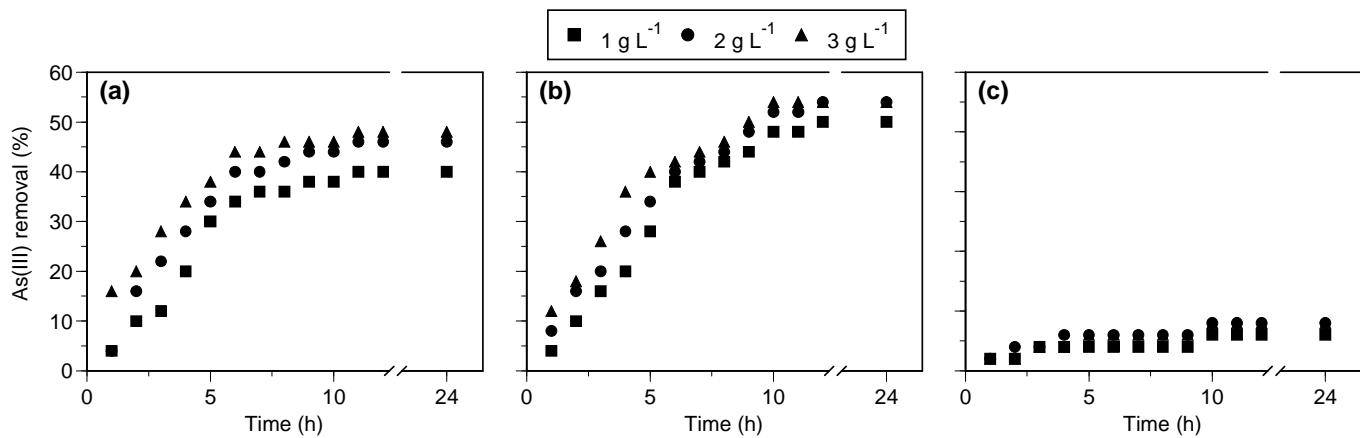


Fig. 3. The arsenic removal efficiency of the MO carbon variants: (a) MO-LC, (b) MO-SC, (c) MO-PC
 MO-LC, MO-leaf-carbon; MO-SC, MO-seed-carbon; MO-PC, MO-pod-carbon
 $t, 0 - 24 \text{ h}; C_0, 0.5 \text{ mg L}^{-1}; T, 25 \pm 2 \text{ }^\circ\text{C}; n = 3$

3.2 ADSORPTION DYNAMICS

The kinetics of arsenic uptake by MO carbons is evaluated using the Lagergren's pseudo-first-order and Ritchie's pseudo-second order rate equations as derived using the adsorbent phase concentrations of As(III) (mg L^{-1}) against time (h) data.

The Lagergren's kinetics equation has been widely used for the adsorption of an adsorbate from an aqueous solution [42, 43]. The most applied style of the equation has been proposed by Trivedi *et al.* [44], which is as follows:

$$\ln(1 - q_t/q_e) = -k_1 t \quad (2)$$

The second-order empirical equation proposed by Ritchie [45] has been used to test the sorption of gases onto a solid, which has later been applied to the sorption systems of solution and solid [46, 47]. The linearized form of the equation [41, 48] is as follows:

$$\frac{t}{q_t} = \frac{1}{kq_e^2} + \frac{1}{q_e} t \quad (3)$$

In Eq 2 and 3, q_t is the amount of arsenic adsorbed at any time (mg g^{-1}), q_e is the amount of arsenic adsorbed at equilibrium (mg g^{-1}), k_1 and k are the rate constants of a pseudo-first-order and pseudo-second-order adsorption reactions as expressed, respectively, in min^{-1} and mg min^{-1} .

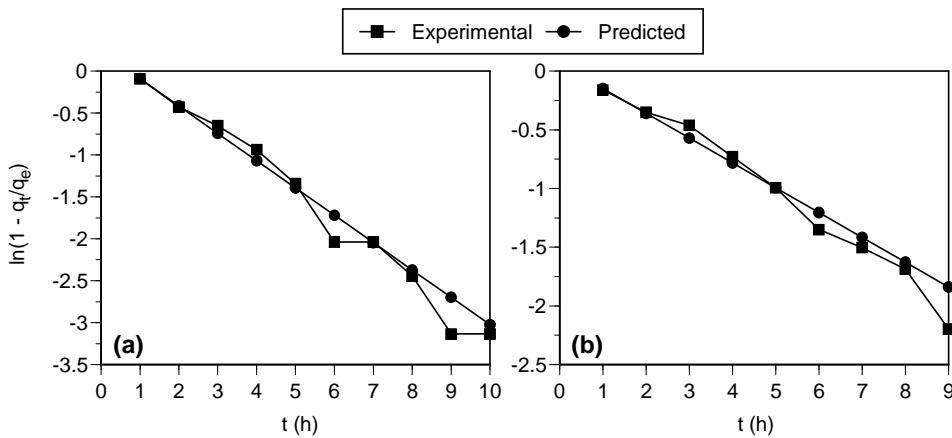


Fig. 4. Lagergren pseudo-first order kinetic plots for the MO carbon variants (dose 2 g L⁻¹): (a) MO-LC, (b) MO-SC
MO-LC, MO-leaf-carbon; MO-SC, MO-seed-carbon. C_0 , 0.5 mg L⁻¹; T, 25 ± 2 °C; n = 3

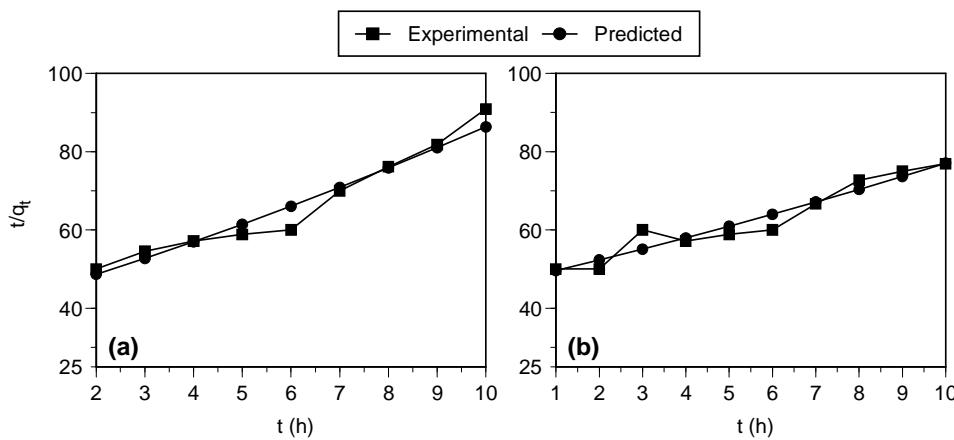


Fig. 5. Ritchie's pseudo-second order kinetic plots for the MO carbon variants (dose 2 g L⁻¹): (a) MO-LC, (b) MO-SC
MO-LC, MO-leaf-carbon; MO-SC, MO-seed-carbon. C_0 , 0.5 mg L⁻¹; T, 25 ± 2 °C; n = 3

The batch kinetic data for the adsorbent phase was fitted to the Lagergren's pseudo-first-order and Ritchie's pseudo-second order models, which are shown in Figure 4 and 5, respectively. The regression calculation of the data-sets was performed using the non-linear optimization by Levenberg–Marquardt algorithm, and the most favorable fit between the experimental and theoretical data were observed for Ritchie's model. Therefore, it can be said that the pseudo-second order model best describe the behavior of As(III) adsorption by MO carbon variants.

3.3 ROLE OF TRANSPORT IN ARSENIC UPTAKE

The process of adsorption in a solid from solution might consist of the transport of the adsorbate from the bulk phase to the laminar liquid film at the surface, transport of the particles through the film and uptake into the interior of the adsorption sites. Besides the reaction kinetics, the transport processes, such as, film and pore diffusion also controls the mechanism of the adsorption. A plot of $\ln(C_t/C_i)$ versus time (Figure 6), based on Eq 4, was used to evaluate whether the film resistance to mass transfer controlled the As(III) uptake during the batch adsorption experiments with the MO carbons.

$$\ln \frac{C_t}{C_i} = -\frac{K_f W S_w}{V_f} t \quad (4)$$

In Eq 4, the K_f is the mass transfer coefficient for film diffusion, S_w is the specific external surface of adsorbent on weight basis, W is the adsorbent dosage, V_f is the volume of the fluid, C_i is the initial adsorbate concentration and C_t is the concentration of the adsorbate at any time. A linear pattern in the data-sets would indicate that the mechanism of adsorption is controlled by film diffusion [41]. However, all the data-trends confirms a non-linear pattern postulating that the rate of As(III) uptake was not controlled by the film diffusion. The solid-solution mixtures were agitated at a high speed (300 ± 20 rpm) during the kinetic experiments to ensure a high shear on the particle surface. As a result, the thickness of the film surrounding the particles was low and any possible rate-limiting effect due to the film diffusion was minimized [41, 49].

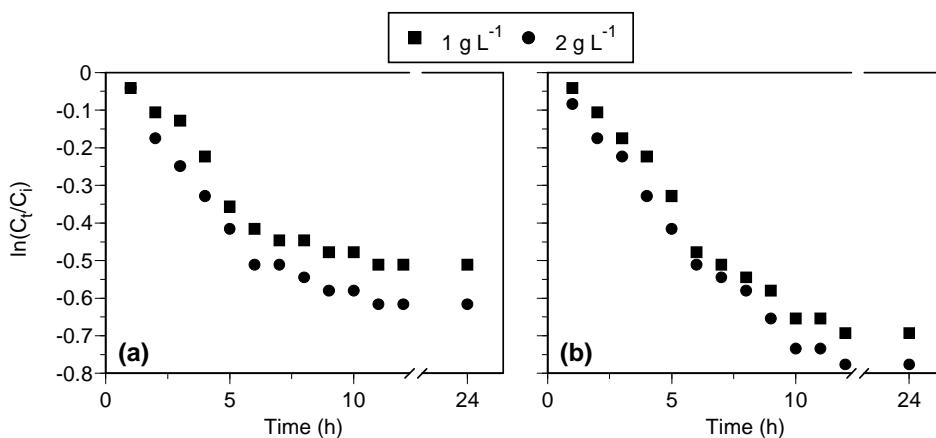


Fig. 6. Test for film diffusion as a rate controlling step in the As(III) uptake by the MO carbon variants: (a) MO-LC, (b) MO-SC
MO-LC, MO-leaf-carbon; MO-SC, MO-seed-carbon. $T, 0 - 24$ h; $C_0, 0.5$ mg L^{-1} ; $T, 25 \pm 2$ °C; $n = 3$

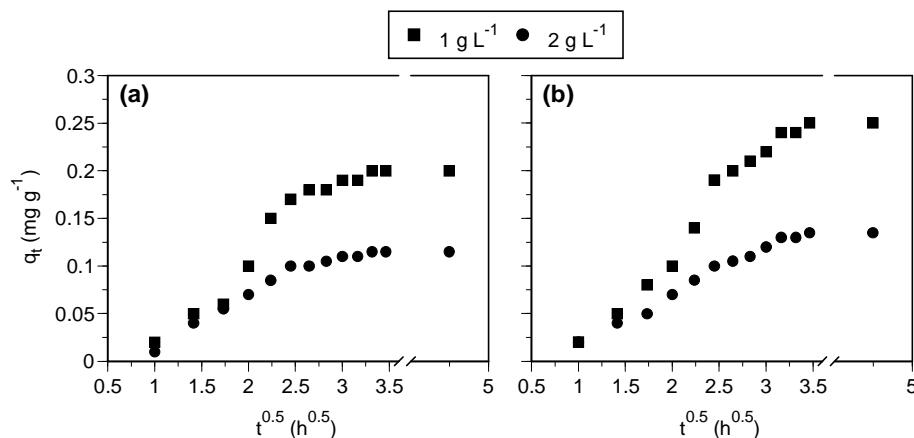


Fig. 7. Intra-particle mass transfer curve for the adsorption of As(III) by the MO carbon variants: (a) MO-LC, (b) MO-SC
MO-LC, MO-leaf-carbon; MO-SC, MO-seed-carbon. $T, 0 - 24\text{ h}$; $C_0, 0.5\text{ mg L}^{-1}$; $T, 25 \pm 2^\circ\text{C}$; $n = 3$

The intra-particle diffusion model [50, 51] have been used to describe the competitive adsorption occurs in a liquid-solid system. The initial rate of intra-particle diffusion can be calculated using the relationship between amount of adsorbed arsenic and square root of time (Figure 7):

$$q_t = k_{id} t^{0.5} \quad (5)$$

In Eq 5, q_t is the amount of arsenic adsorbed (mg g^{-1}) at time t (h) and k_{id} is the intra-particle diffusion rate constant ($\text{mg g}^{-1}\text{h}^{-0.5}$). The multi-linearity in the plots indicates that two or more steps occur in the adsorption processes. The initial sharper section of the plots represents the external surface adsorption or instantaneous adsorption stage. The next section of the plots is the gradual adsorption stage when the intra-particle diffusion is rate-controlled. The intra-particle diffusion starts to slow down due to the extremely low solute concentration in solution in the final step as represented by the plateau to the equilibrium. The linear portion of the plots for a wide range of contact time between adsorbent and adsorbate does not pass through the origin, which might be attributable to the difference of mass transfer rate in the initial and final stage adsorption [52]. Although the intra-particle diffusion is the major rate determining step, this variation from the origin or near saturation also represents that the contribution due to the surface adsorption cannot be ignored [53, 54].

4 CONCLUSION

The removal of As(III) from contaminated groundwater by MO carbon variants (leaf, seed and pod) is experimentally investigated in this study. It is explored that MO-LC and MO-SC can be effectively used for the As(III) removal, while the efficiency of the MO-PC is not significant. The As(III) uptake to the adsorbent phase occurred at a high rate in the initial hours followed by a slower subsequent removal rate with a gradual approach to a steady-state condition. The adsorption of As(III) can be better described by a pseudo-second order equation, e.g., Ritchie's model equation. It was confirmed that the intra-particle diffusion from the solution to the adsorption sites of the MO carbons can be considered as a major rate determining factor. *Moringa oleifera* can be harvested abundantly in the weather condition of the worst arsenic-affected area of Bengal Delta. Therefore, the use of *Moringa oleifera* derived carbonaceous materials for arsenic contaminated water treatment is expected to be economical and feasible. However, there is scope of improvement in the As(III) removal efficiency of the MO carbons via treatment with suitable chemicals. Moreover, column experiments are required to be conducted to explore the appropriate design of the As(III)-separation module, and a methodology should also require to be planned for the treatment of the spent MO carbons.

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Application de la méthode ESU pour la cartographie de la vulnérabilité à la contamination des eaux du Barrage de l'Oued Martil (Maroc; septentrional)

[Application of the ESU method for mapping vulnerability to contamination of water Martil's river dam (Morocco, North)]

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ABSTRACT: A surface water contamination vulnerability mapping has been carried out to contribute to water quality protection of the Martil river dam. The applied methodology (ESU) depends on three parameters *i*) density of the hydrographic network *ii*) soil hydrologic potential and *iii*) agricultural drainage. The vulnerability degree is a result of a typological interaction between these three parameters through there different possible combinations Results indicate that high vulnerability classes are shown within almost 85 %of the catchment area. Otherwise, some southern, northern and south western areas (14 %) are of mean vulnerability, while a very restricted area (1 %) shows low vulnerability to contamination.

KEYWORDS: Barrage, water surface, vulnerability, contamination, SIG, mapping method ESU.

RESUME: Afin de contribuer à la protection de la qualité de l'eau du barrage de l'oued Martil, il a été objet d'une cartographie de la vulnérabilité à la contamination des eaux de surface par des produits polluants. La méthode appliquée est la méthode ESU ; celle-ci dépend de trois paramètres *i*) la densité du réseau-hydrographique *ii*) le fonctionnement hydrique des sols et *iii*) le drainage agricole. Le degré de vulnérabilité est le résultat du croisement typologique des classes de ces trois paramètres à travers des différentes combinaisons possibles. Les résultats obtenus montrent que les classes de vulnérabilité très forte et forte envahissent environ 85% du bassin versant. La première recouvre presque la totalité du bassin de Martil, à l'exception de sa partie est où domine la classe forte. Pour la classe de moyenne vulnérabilité, avec 13,7% de surface totale de la zone d'étude, elle marque le Sud, le Sud-ouest et le Nord du bassin. Finalement, vers le Sud et le Sud Est, se localise la classe de faible vulnérabilité avec une superficie de l'ordre 1,37%.

MOTS-CLEFS: Barrage, eau de surface, cartographie de la vulnérabilité, contamination, SIG, méthode ESU.

1 INTRODUCTION

Sur l'ensemble des ressources en eau disponibles, résultant de la pluie efficace, évaluées à 22.2 Milliards de m³, seulement 16.9 Milliards de m³, sont mobilisables dans des conditions techniques et économiques acceptables dont 13,1 milliards sont des eaux superficielles [1]. Les réalisations en relation politique de la construction des barrages au Maroc sont

importantes: 117 barrages; près de 1,5 million d'hectares de terres irriguées; près de 100% d'accès à l'eau potable en milieu urbain et plus de 75% en milieu rural, production de l'énergie, protection contre les inondations, etc.... Sans doute, ces réalisations représentent aujourd'hui l'une des grandes réussites du Maroc contemporain [2].

2 CARACTERISTIQUES DE LA ZONE D'ETUDE

Le bassin versant de l'oued Martil se situe dans la chaîne montagneuse du Rif au NW du Maroc entre les latitudes Nord $35^{\circ}10'$ et $35^{\circ}45'$ et les longitudes Ouest $5^{\circ}17'$ et $50^{\circ}38'$, localisée entre les coordonnées Lambert : $X_{\text{max}} = 510026,386035$ et $Y_{\text{max}} = 544222,33586$, $X_{\text{min}} = 484200,139029$ et $Y_{\text{min}} = 516578,078511$. Il draine une superficie d'ordre de 380 Km^2 et un périmètre de 107 Km. Il est caractérisé par une topographie plus ou moins accidentée et une altitude qui varie entre 41 m (digue du barrage de l'Oued Martil) et 1808 m à Jbel Alliouiyine (fig. 1).

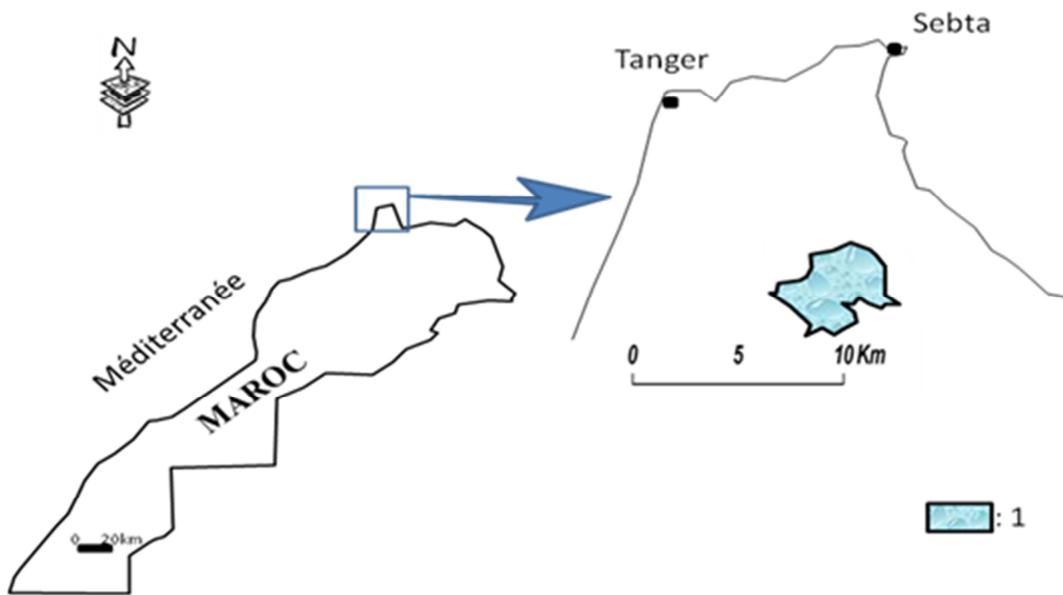


Fig. 1. Situation du Bassin Versant et du barrage de l'Oued Martil. 1 : Zone d'étude

Le réseau hydrographique est composé d'un cours d'eau principal qui est Oued Mhajrate d'une longueur de 37,50 Km et ses affluents qui sont : Nakhla, Hamma et Krikra [3].

Le barrage de l'Oued Martil de $3,8 \text{ km}^2$ de surface de retenue, disposera d'une capacité de stockage de 120 millions de m^3 et d'un apport annuel de 175 millions de m^3/an , il régularisera un volume annuel de 70 millions de m^3 [4].

Le bassin versant de l'oued Martil se caractérise par un climat de type méditerranéen, avec deux saisons bien distinctes, une saison estivale, chaude et sèche entre le mois de Mai et le mois d'Octobre et une deuxième saison pluvieuse et fraîche qui s'étale du mois de Novembre jusqu'au mois d'Avril. La pluviométrie annuelle varie de 293 mm enregistrée pendant l'année hydrologique 1994/95 et 1333 mm en 1995/96 ; la pluviométrie moyenne annuelle pour la période (1979/80 – 2011/12) étant de l'ordre de 719 mm. La température moyenne mensuelle la plus élevée (27°C) est mesurée au mois d'Août et la plus basse ($12,1^{\circ}\text{C}$) au mois de Janvier, la température moyenne annuelle pour la période (1984/85 – 2004/05) est de l'ordre de $18,05^{\circ}\text{C}$.

Géologiquement la zone d'étude est composée des formations suivantes :

- **La dorsale calcaire** : située à l'extrême partie du bassin versant du barrage vers l'Est. Elle est formée principalement par des calcaires et des dolomies allant du Trias au Jurassique. De part les phénomènes de Karstification qui accompagnent les calcaires, cette chaîne constitue le meilleur aquifère des zones montagneuses [4,5] ;
- **L'unité d'Amettrasse Betarra** : fait partie de la dorsale calcaire, elle est située aussi vers l'Est du bassin versant composées essentiellement par les grès et les conglomérats et rarement de marnes, d'âge Oligocène.
- **L'unité de Tanger** : cette formation essentiellement argileuse à matériau crétacé supérieur et Tertiaire, forme la partie centrale Est du bassin versant ;

- **La nappe des flyschs de Tisirène :** c'est un flysch immature d'âge essentiellement Oligocène, à grains de quartz anguleux et nombreux autres éléments détritiques : micas, felspaths, éléments lithiques divers, en particulier des éléments de roches métamorphiques : phyllades et micaschistes [7] ;
- **La nappe des flyschs de Bnil-der :** cette formation s'étale sur la partie centrale et elle repose directement sur l'unité de Tanger. Elle résulte de la juxtaposition de lames gréseuses de quelques centaines de mètres d'épaisseur. Le matériau principal de cette nappe correspond à un flysch à tendance molassique à grès fins micacés et argilites, d'âge Oligocène [8] ;
- **La nappe des grès numidiens :** localisée vers l'Ouest et l'Ouest-Sud de la zone d'étude, elle est formée par un flysch gréseux alternant avec des pélites d'âge Oligocène Miocène inférieur [8] ;
- **Les colluvions :** ce sont des dépôts colluviaux, avec agencement locale en glacis pendant des millions d'années grâce à l'érosion du paysage. elles se trouvent vers l'est et l'ouest du bassin versant.

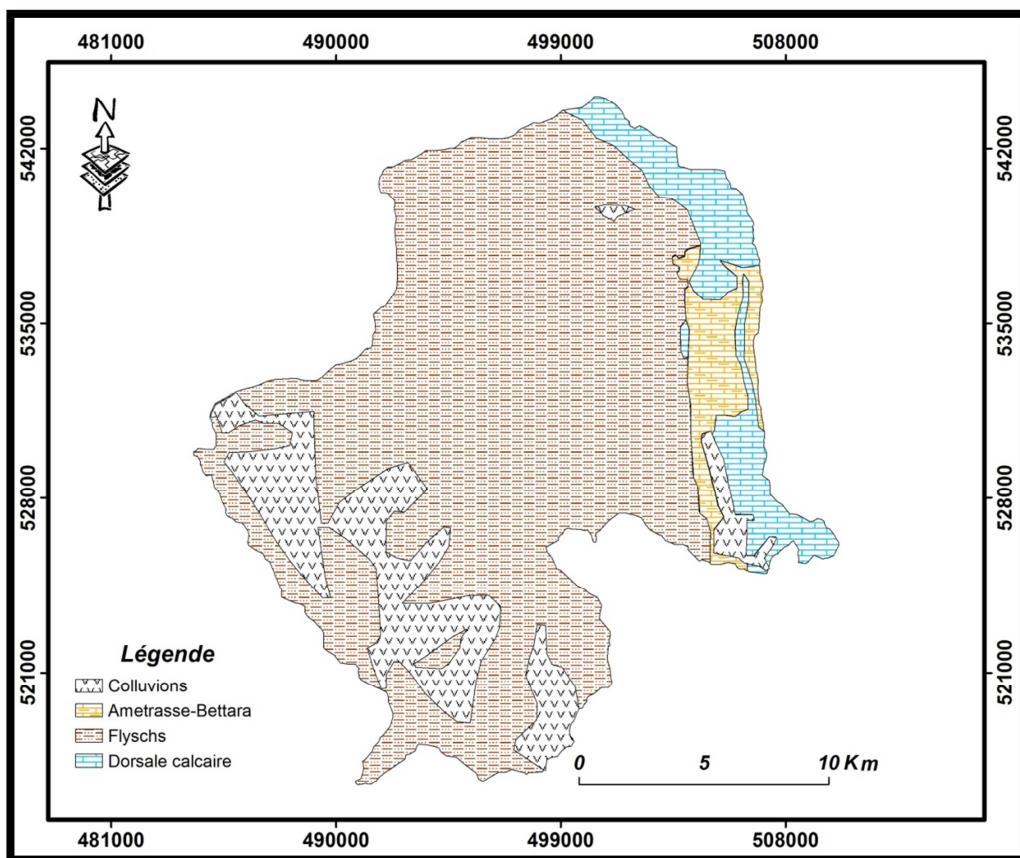


Fig. 2. Carte lithologique du bassin versant de l'Oued Martil

3 METHODOLOGIE

ESU est la méthode adoptée pour la cartographie de la vulnérabilité à la contamination de l'eau de barrage de l'oued Martil, elle consiste à subdiviser la surface du bassin versant en plusieurs parties selon leur capacité à protéger la qualité de l'eau de ruissellement vis-à-vis des produits polluants émis par les différentes activités localisées à la surface suite à une synthèse de données de divers natures : pédologiques, géologiques et hydrologiques. Elle est basée sur la quantification de certains paramètres [9], à savoir :

- Le type de fonctionnement hydrique des sols ; en effet le sol conditionne la partition entre les eaux d'infiltration, qui migrent préférentiellement vers les ressources souterraines, et les eaux de ruissellement qui s'écoulent vers les cours d'eau. A partir d'une expertise pédologique, les unités de sols seront classées en fonction de leurs caractéristiques (battance, hydromorphie, texture...) en unités de fonctionnement hydrique [9].

- La densité du réseau hydrographique : ce paramètre permet d'appréhender la plus ou moins grande proximité des ressources aquatiques de surface aux émissions de produits polluants. Les transferts interviennent à travers la dérive des embruns de pulvérisation et par les phénomènes de ruissellement de surface et de sub-surface lorsque la perméabilité des sols est insuffisante pour permettre l'infiltration totale des eaux de pluies [9].
- **L'importance du drainage agricole :** on considère qu'il accentue les phénomènes de migration des produits polluants vers les eaux superficielles en augmentant les surfaces contribuant à l'alimentation des cours d'eau et en interceptant une partie des eaux qui devraient s'infiltrer [9].

Chacun de ces paramètres est quantifié par une typologie, selon son rang naturel qui exprime son importance dans la caractérisation du degré de vulnérabilité à la contamination (Tab. 1) [9].

Table 1. Types de fonctionnement hydrique des sols selon méthode ESU

Code Esquisse	Type de sol	Typologie	Circulation	Observation	RU
8, 11, 14, 18, 25, 27, 28,30	Roche mere Substratum impermeable	8	Circulation latérale (surface et sub-surface) prédominante	Sol à engendrement temporaire de surface	moyenne
9, 10, 19, 26, 31,35	Sols profonds à forte RU Nappe perché temporaire	7	Circulation latérale (surface et sub-surface) dominante	La plus part du temps drainés	forte
39	Sols profonds à forte RU Nappe permanente	6	Circulation dominante	Dans les cuvettes en relation avec les cours d'eau	forte
40, 41,42	Sols de grandes vallées (Meurthe-et-Moselle) Submersion possible	5	Circulation mixte		faible
1, 13, 36, 37,38	Sols profonds à forte RU Sols sains	4	Circulation Verticale prédominant		forte
2, 22, 32, 33,34	Sols profonds Sableux à forte RU Faible à moyenne	3	drainage Verticale prédominant		Faible à moyenne
15, 20, 21,29	Sols peu profond à ressuyage lent	2	drainage Verticale prédominant	Alternance zones saines et zones humides beaucoup cailloux	moyenne
4, 6,12	Sols superficielle Faible réserve en eau	1	Circulation Verticale prédominant	Sur plateau calcaire	faible
5, 7, 16, 17, 23,24	Zones de sources. Bords Cuesta	9	Drainage verticale dans les colluvions calcaires puis migration sur les marnes ou argiles	Interface Calcaire/argile zones de côtes « Singularité »	

La carte de vulnérabilité à la contamination des eaux de surface de la méthode ESU est obtenue par combinaison des typologies relatives des trois paramètres selon les regroupements du tableau 2.

4 APPLICATION DE LA METHODE ESU A LA ZONE D'ETUDE

4.1 ELABORATION DES CARTES TYPOLOGIQUES

Pour cartographier la vulnérabilité à la contamination des eaux de surface on commence par l'élaboration des cartes typologiques qui présentent la répartition spatiale des typologies accordées aux trois paramètres adoptés par la méthode ESU [9].

4.1.1 CARTE TYPOLOGIE DU TYPE DE FONCTIONNEMENT HYDRIQUE DES SOLS

La connaissance de la géologie d'un bassin versant s'avère importante pour mieux cerner l'influence des caractéristiques physiographiques. La géologie du substratum influe non seulement sur l'écoulement de l'eau souterraine mais également sur le ruissellement de surface. La zone d'étude se divise en quatre unités géologiques :

- La dorsale calcaire est constituée par les calcaires, les grès et les argiles;
- L'unité Ametrasse Betarra, elle fait partie de la dorsale calcaire mais composée essentiellement des grès et des conglomérats.
- Les nappes des flyschs sont caractérisées par la présence des grès grossiers, alternance de grés et pélites, marnes, alternance de grés et argiles;
- Les colluvions sous forme de dépôts superficiels issues de l'érosion de la roche mère.

Table 2. Regroupements typologiques réalisés pour constituer les classes de vulnérabilité

Classe de vulnérabilité	Regroupement typologiques
Classe 1 : Vulnérabilité très faible Zone à infiltration prédominante, à réseau de surface très peu développé	A : sols superficiel à infiltration d'eau prédominante, à réseau hydrographique faible, surfaces drainées inexistantes ;
Classe 2: Vulnérabilité faible Zones où les phénomènes d'infiltration sont majoritaires, le réseau hydrographique est peu à moyennement développé	B : sols superficiel à infiltration d'eau prédominante, à réseau hydrographique faible, surfaces drainées moyenne ; D : sols filtrant profond à infiltration d'eau prédominante, à réseau hydrographique moyen, surfaces drainées inexistantes ; C : sols l à infiltration d'eau prédominante, à réseau hydrographique faible, surfaces drainées importantes ; E : sols l à infiltration d'eau prédominante, à réseau hydrographique moyen, surfaces drainées moyennes ; G : transferts mixte de l'eau, à réseau hydrographique moyen, surfaces drainées inexistantes ;
Classe 3: Vulnérabilité moyenne Ensemble de situations intermédiaires, à réseau hydrographique moyennement développé	F : sols l à infiltration d'eau prédominante, à réseau hydrographique moyen, surfaces drainées importantes ; H : transferts mixte de l'eau, à réseau hydrographique moyen, surfaces drainées moyennes ; K : ruissellement de surface prédominant, à réseau hydrographique moyen, surfaces drainées inexistantes ;
Classe 4: Vulnérabilité forte Zone moyennement proches des surfaces mais fortement drainées ou à ruissellement de surface important	I : transferts mixte de l'eau, à réseau hydrographique moyen, surfaces drainées importantes ; L : ruissellement de surface prédominant, à réseau hydrographique moyen, surfaces drainées moyennes ;
Classe 5: Vulnérabilité très forte Zone à proximité immédiate de cours d'eau ou fortement drainées.	N, O, P : transferts mixte de l'eau, à réseau hydrographique très important, surfaces drainées moyennes à importantes ; M : ruissellement de surface prédominant, à réseau hydrographique moyen, surfaces drainées importantes.

La typologie est attribuée à une lithologie donnée sur la base de sa perméabilité, tel que : plus la perméabilité est faible plus la typologie du fonctionnement hydrique est élevé. A l'échelle du bassin versant de l'Oued Martil, les typologies obtenues et leur répartition spatiale sont représentées sur la carte de la figure 3. Celles-ci montre que :

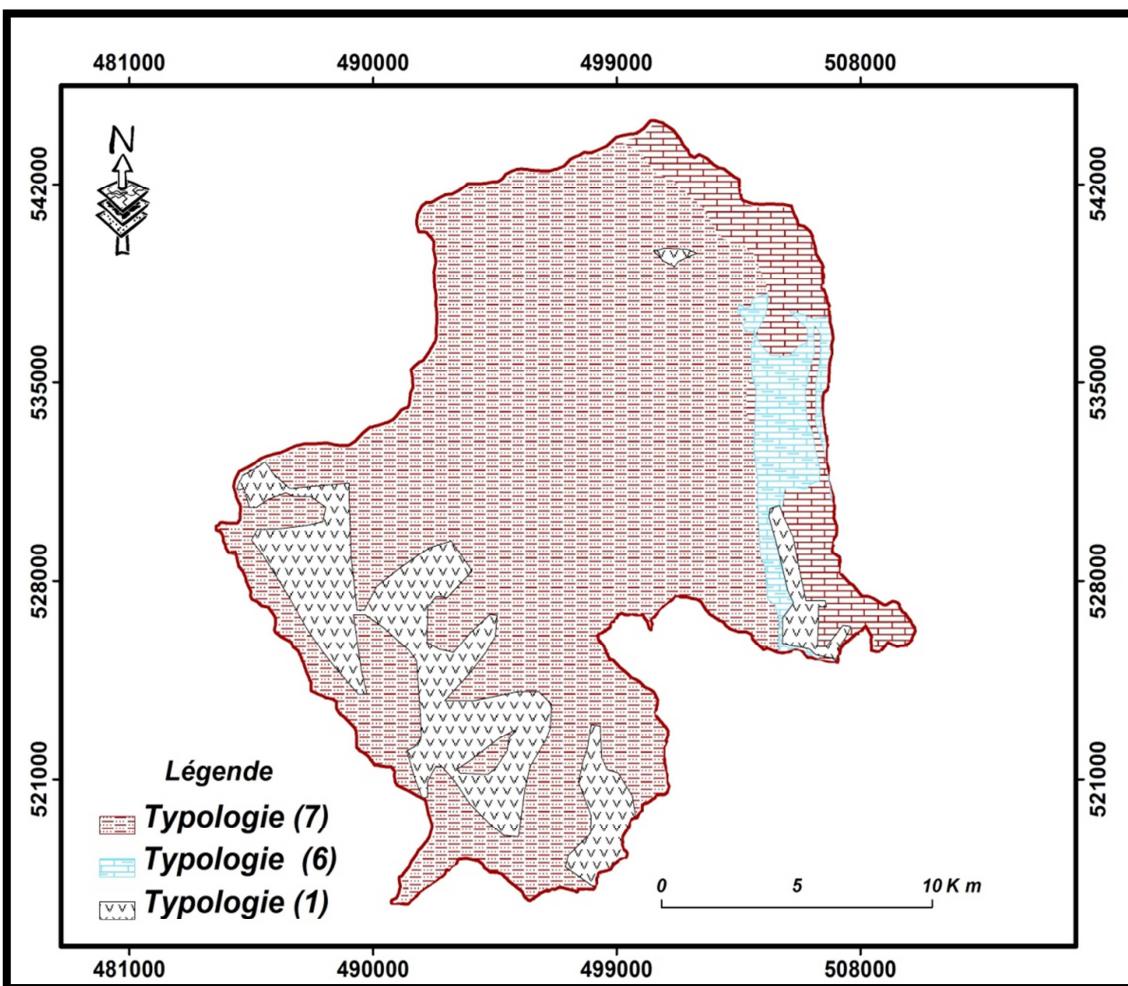


Fig. 1. Fig. 3. Typologie du fonctionnement hydrique du bassin versant de l'oued Martil

- La typologie (7), relatif à la dorsale calcaire et aux flysch sur une superficie correspondant respectivement à 8,53% et 71,7% de la surface totale du bassin versant, domine la partie centrale et l'extrême Est du bassin versant étudié ;
- La typologie (6) coïncide avec les grès et les conglomérats de l'unité d'Ametrasse Bettara qui affleurent à l'Est du bassin tout en couvrant environ 4,7% de sa surface totale ;
- La partie Sud-ouest est caractérisée par la présence de la typologie (1) relative aux colluvions déposées sur les flyschs (13,7%). La même typologie imprègne sur une petite surface (1,37%) la typologie (7) à l'Est de la zone d'étude.

4.1.2 CARTE TYPOLOGIQUE DE LA DENSITE DU RESEAU HYDROGRAPHIQUE

Ce paramètre permet d'exprimer la proximité des ressources aquatiques de surface aux émissions de produits polluants, sachant que, plus les activités polluantes sont proches du réseau hydrographique, plus la classe correspondante est importante. La densité du réseau hydrographique est le rapport des longueurs de cours d'eau sur un territoire donné par la surface de ce territoire.

Dans le bassin versant de l'oued Martil deux classes typologiques ont été définies pour ce paramètre. Leur répartition spatiale est représentée dans la figure 4:

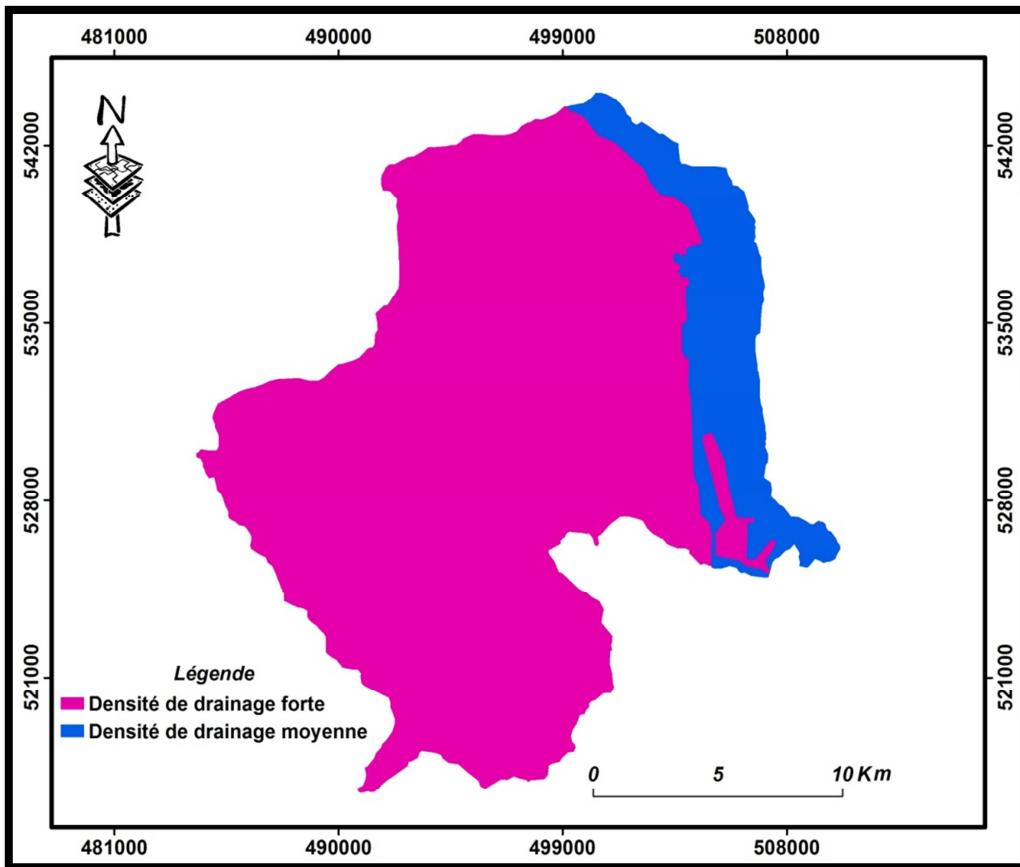


Fig. 4. Carte typologique de la densité du réseau hydrographique du bassin versant de l'oued Martil

A l’exception de la partie Est dominé par la dorsale calcaire et l’unité d’Ametrasse Bettarra, présentant une lithologie compétente correspondant principalement au calcaire, grés et conglomerat, et par la suite une densité hydrographique moyenne, le reste du bassin versant montre une forte densité hydrographique due à une incompétence des flyschs.

4.1.3 CARTE TYPOLOGIQUE DE DRAINAGE AGRICOLE

Ce facteur accentue les phénomènes de migration des produits polluants vers les eaux superficielles. Dans notre cas, et en raison du manque de données concernant le recensement général de l’agriculture dans le bassin versant concerné, et vu la relation étroite entre la nature du sol et celle de la roche mère, nous nous sommes basés sur la perméabilité et la porosité des faciès des différentes unités géologiques traversées par les eaux de ruissellement pour l’estimation du drainage agricole. Quatre classes de drainage agricole ont été définies et représentées dans le bassin versant de l’oued Martil (figure 5) :

- Drainage très fort : caractérise la dorsale calcaire avec une forte perméabilité due essentiellement à une importante fissuration ;
- Drainage fort : distingué dans l’unité d’Ametrasse Betarra à laquelle s’associe une perméabilité notable induite par la fissuration des grès et des conglomerats;
- Drainage moyen : s’associe aux flyschs et aux colluvions moyennement perméables.
- Drainage faible : détermine les colluvions déposées sur la dorsale calcaire, sachant que cette dernière favorise l’infiltration.

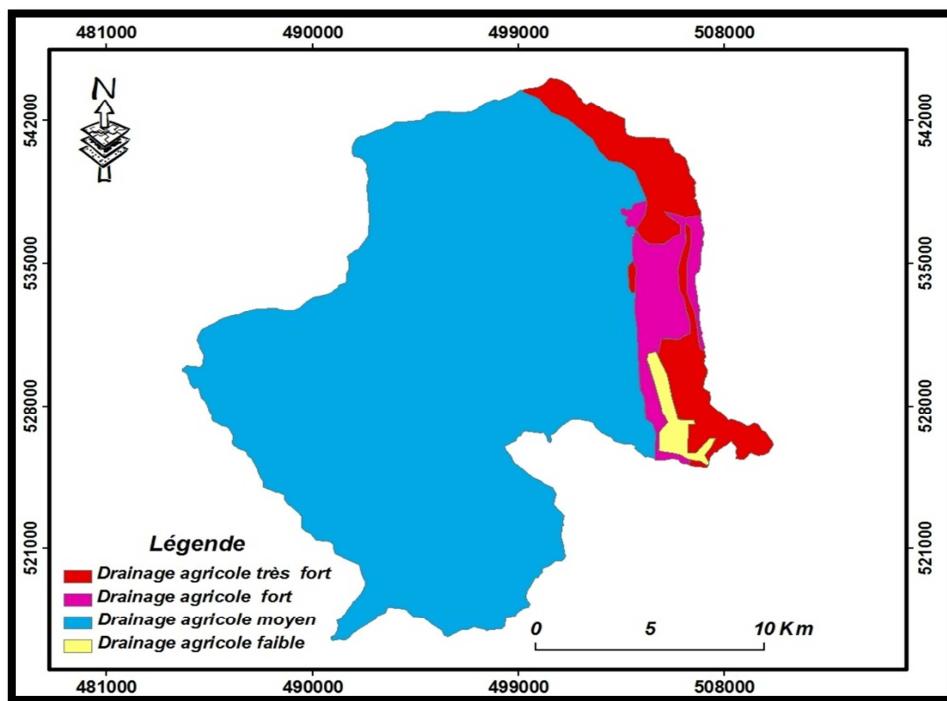


Fig. 5. Carte typologique du drainage agricole du bassin versant de l'oued Marti

La carte typologique de drainage agricole, permet de distinguer deux zones importantes:

- L'Ouest du bassin versant, caractérisée par un drainage agricole moyen couvrant environ 85,4% de la surface totale de la zone d'étude. Elle coïncide avec les flyschs essentiellement;
- L'extrême Est du bassin versant, dominée par un très fort drainage agricole (8,53%) caractéristique de la dorsale calcaire, tout en étant imprégné d'une part par un fort drainage (4,7%) spécifique de l'unité d'Ametrasse Bettara et d'autre part par un faible drainage agricole qui détermine les colluvions surmontant les calcaires.

5 RESULTATS ET DISCUSSIONS

Selon la méthode ESU, la détermination des classes de vulnérabilité se fait à travers une combinaison des typologies relatives aux trois paramètres utilisés. Dans notre zone d'étude, cinq combinaisons et par la suite cinq classes de vulnérabilité à la contamination des eaux du barrage de l'Oued Martil ont été mises en évidence (Tab. 3), et dans la répartition spatiale est représentée dans la figure 6.

Table 3. Différentes combinaisons des typologies des paramètres de la méthode ESU et classes de vulnérabilité correspondantes dans le bassin versant de l'Oued Martil

	Fonction hydrique	Densité du réseau hydrographique	Drainage agricole	Classe de vulnérabilité	% des classes de vulnérabilité
Combinaison 1	7 : circulation latérale (surface et subsurface) dominante	Moyenne	Très Fort	Très forte	8,53%
Combinaison 2	6 : circulation mixte dominante	Moyenne	Fort	Forte	4,7%
Combinaison 3	7 : circulation latérale (surface et subsurface) dominante	Forte	Moyen	Très forte	71,7%
Combinaison 4	1: circulation verticale prédominante	Forte	Moyen	Moyenne	13,7%
Combinaison 5	1: circulation verticale prédominante	Forte	Faible	Faible	1,37%

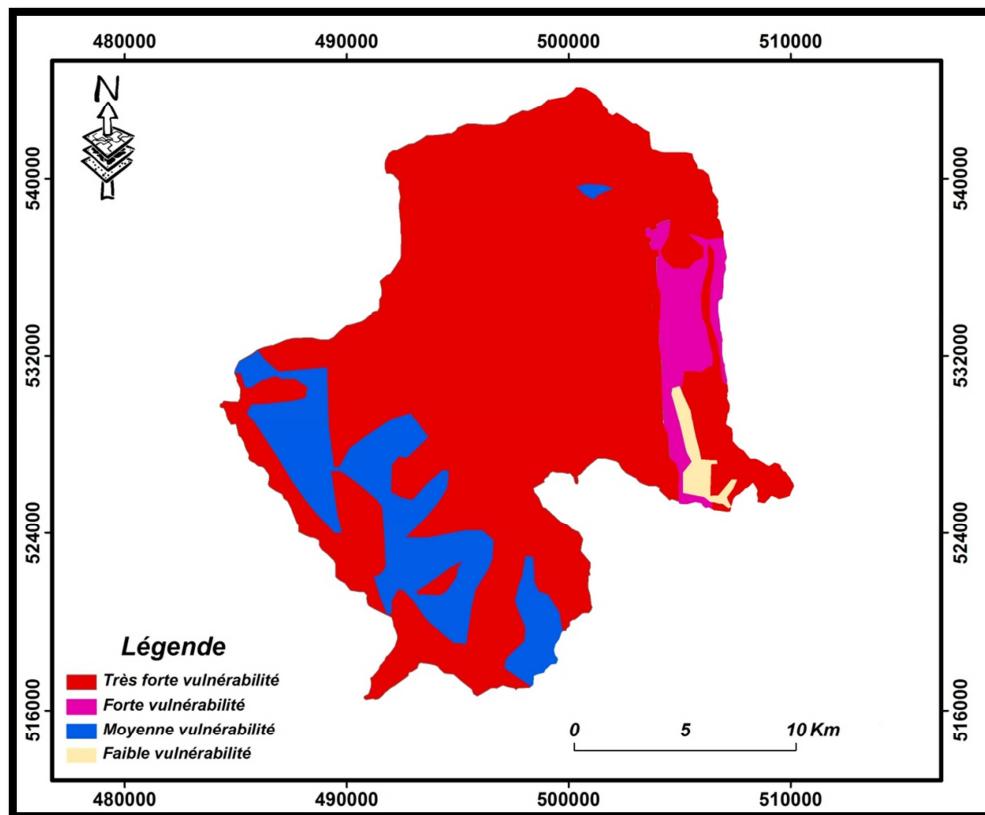


Fig. 6 : Carte de vulnérabilité à la contamination des eaux du barrage de l'oued Martil

- Les classes **très fortes et forte** vulnérabilité: occupent la majorité de la zone d'étude sur une superficie de l'ordre de **85 %** du bassin versant. Elle s'associe à la dorsale calcaire de la combinaison **(1)**, les flyschs de la combinaison **(3)** et l'unité d'Ametrasse bettara de la combinaison **(2)**. Les deux premières unités sont caractérisées par un fonctionnement hydrique dominant avec une circulation latérale importante (surface et sub-surface) autrement dit un fort ruissellement. La densité du réseau hydrographique est moyenne à forte (de **1,01 à 3,48 Km⁻¹**), alors que le drainage agricole varie de moyen à très fort tout étant favorisé par la haute perméabilité de la dorsale calcaire. Concernant l'unité d'Ametrasse bettara, elle coïncide avec une forte vulnérabilité due à une circulation mixte, une densité hydrographique moyenne (**0,96 Km⁻¹**) et un fort drainage agricole.
- La classe de **moyenne** vulnérabilité, apparaît principalement à l'ouest du bassin versant recouvrant environ **13,7%** de sa surface totale. Elle caractérise la combinaison **(4)** avec des colluvions déposées sur les flyschs et auxquelles s'associent une circulation verticale prédominante, une forte densité de réseau hydrographique (**3,05 Km⁻¹**) et un drainage agricole moyen.
- La classe de **faible** vulnérabilité spécifique de la combinaison **(5)**, coïncide avec les colluvions surmontant la dorsale calcaire, en leur attribuant un faible drainage agricole, une forte densité hydrographique (**3,05 Km⁻¹**) et une infiltration prédominante. Elle se trouve localement englobée par la classe de très forte vulnérabilité au SE de la zone d'étude sur une superficie qui n'excède pas **1,4%**.

6 CONCLUSION ET RECOMMANDATIONS

Selon la méthode ESU les classes très forte et forte vulnérabilité occupent la majorité de la zone d'étude, et par la suite l'eau du barrage de l'oued Martil montre un degré de contamination élevé ; et ce en relation essentiellement avec le type du fonctionnement hydrique et le drainage agricole, qui sont en intime dépendance de la lithologie.

S'intéressant à des zones de très forte à forte degré de vulnérabilité à la contamination des eaux de surface du bassin versant étudié, plusieurs mesures peuvent être recommandées dans le but de participer à la préservation de la qualité de l'eau de barrage de l'oued Martil, et parmi lesquelles on cite:

- Mettre en place un réseau d'assainissement autonome pour interdire tout rejet clandestin des eaux usées dans les oueds et leurs affluents.
- Implanter des décharges publiques pour la collecte et le traitement des déchets.
- Procéder à des campagnes de sensibilisation de la population sur de telles pratiques.
- Contrôler la quantité et la qualité utilisées des pesticides et des engrains suite à un accompagnement des agriculteurs par la Direction provinciale d'agriculture.
- Interdire l'installation de toute activité polluante au niveau des zones qui montrent un fort degré de vulnérabilité.

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