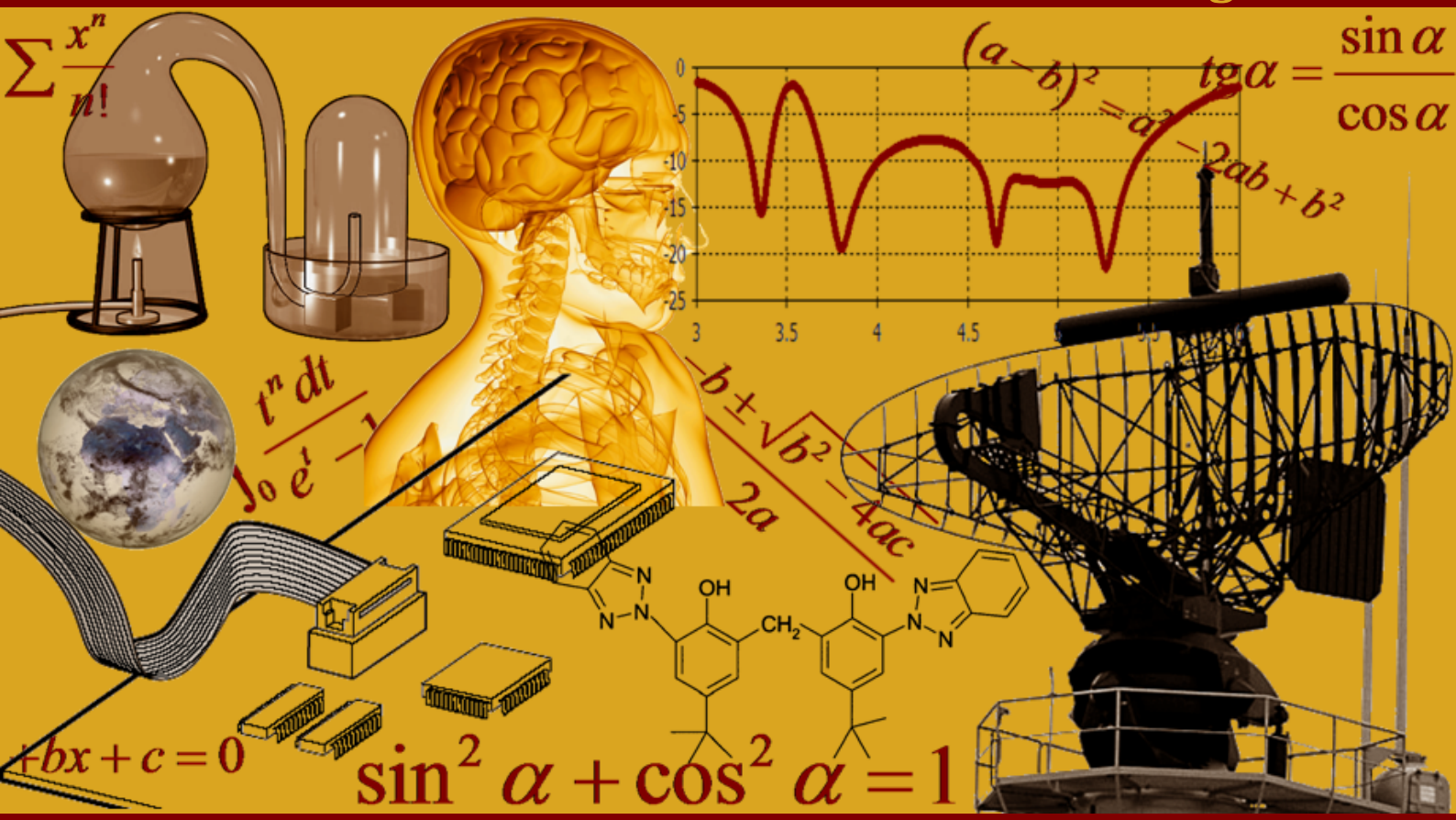
ISSN: 2351-8014 Impact Factor: 2.095

INTERNATIONAL JOURNAL OF INNOVATION AND SCIENTIFIC RESEARCH

Vol. 17 N. 2 August 2015



International Peer Reviewed Monthly Journal

Innovative Space of Scientific Research Journals
http://www.issr-journals.org/

International Journal of Innovation and Scientific Reseach

International Journal of Innovation and Scientific Research (ISSN: 2351-8014) is an open access, specialized, peer-reviewed, and interdisciplinary journal that focuses on research, development and application within the fields of innovation, engineering, science and technology. Published four times per year in English, French, Spanish and Arabic, it tries to give its contribution for enhancement of research studies.

All research articles, review articles, short communications and technical notes are sent for blind peer review, with a very fast and without delay review procedure (within approximately two weeks of submission) thanks to the joint efforts of Editorial Board and Advisory Board. The acceptance rate of the journal is 75%.

Contributions must be original, not previously or simultaneously published elsewhere. Accepted papers are available freely with online full-text content upon receiving the final versions, and will be indexed at major academic databases.

Table of Contents

International Journal of Innovation and Scientific Research
ISSN 2351-8014 Vol. 17 No. 2 Aug. 2015, pp. 230-235
© 2015 Innovative Space of Scientific Research Journals
http://www.ijisr.issr-journals.org/

Study, Design & Manufacturing of Mobile Transformer Oil Filter Plant, Degassing & Drying Unit

Vishal Birajdar and Ganesh D. Deshmukh

Department of Mechanical Engineering,
Faculty of sciences, Pune University, India

Copyright © 2015 ISSR Journals. This is an open access article distributed under the ***Creative Commons Attribution License***, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT: Main objective is to manufacture a mobile oil filter plant with the ability of degassing & drying of oil. And also to increase the quality of used transformer oil. Manufacturing of this oil Filtration plant is done with the help of paper filter, magnetic filter and micron filter. Removing of moisture present in the oil with the help of vacuum pump. Sample of used oil of 500 Litre is tested with the manufactured mobile filter plant, the results were very positive. The moisture content in the oil is 3 ppm after the filtration of oil. The Di-Electric strength of oil increased as expected.

KEYWORDS: Transformer oil, Di-Electric strength, Filtration, Mobile plant, Degassing and Drying.

1 INTRODUCTION

A Transformer is an electrical device that transfers energy between two or more circuits through electromagnetic induction. The main components of transformer are core, winding, insulation and tank. The purpose of transformer core is to provide a low reluctance path for the magnetic flux linking the primary and secondary windings. The primary and secondary windings are arranged so as to reduce leakage flux in transformer. In doing so the core experiences iron losses due to hysteresis and eddy currents flow, which manifest themselves as heat. To dissipate this generated heat, coolant is used.

It is normally obtained by fractional distillation and subsequent treatment of crude petroleum. That is why it is known as Mineral Insulating Oil or Transformer Oil.

Transformer oil serves mainly two purposes one is liquid insulation in electrical power transformer and two is it dissipates heat of transformer i.e., acts as coolant

In addition to these, this oil serves other two purposes, it helps to preserve the core and winding as these are fully immersed inside oil and another important purpose of this oil is, it prevents direct contact of atmospheric oxygen with cellulose made paper insulation of windings, which is susceptible to oxidation.

Generally there are two types of Transformer Oil used in transformer:

1. Paraffin based transformer oil.
2. Naphtha based transformer oil.

The objective of current work is to study Manufacturing and testing results of transformer oil. Using various types of filters.

NEED FOR TRANSFORMER OIL FILTERATION MACHINE:

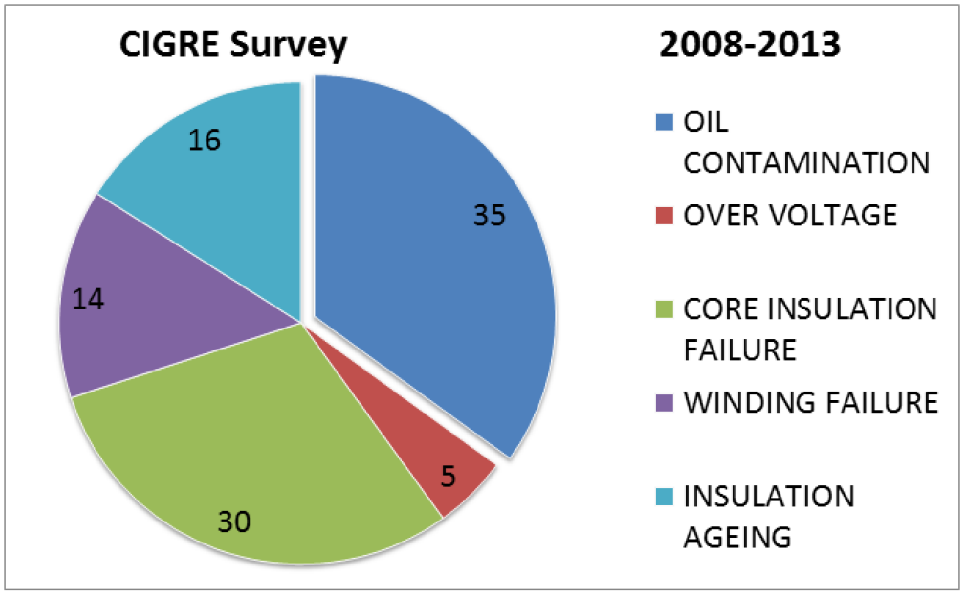
Reliable performance of transformer depends on certain basic oil characteristics which can affect overall performance of the electrical equipment. These characteristics include:

1. High dielectric strength to withstand stresses in service.
2. Proper oxidation resistance to ensure long life in service.
3. Good resistance to emulsion to prevent holding water in suspension in it.
4. Free from inorganic acid, alkali and corrosive sulphur which causes corrosion of metal parts and accelerate the production of sludge.
5. Low water content.
6. Appearance of oil shall be clear, transparent and free from suspended matter or sediments.

- The condition of oil greatly affects the performance and service life of transformers. A combination of electrical, physical and chemical tests is performed to measure the change in the electrical properties, extent of contamination and degree of deterioration in the insulating oil.
- The results are used to establish preventive maintenance procedures to avoid costly shut downs and premature equipment failure and the service life of equipment.
- To avoid such drastic consequences a machine is required to filter the oil and restore its working conditions.

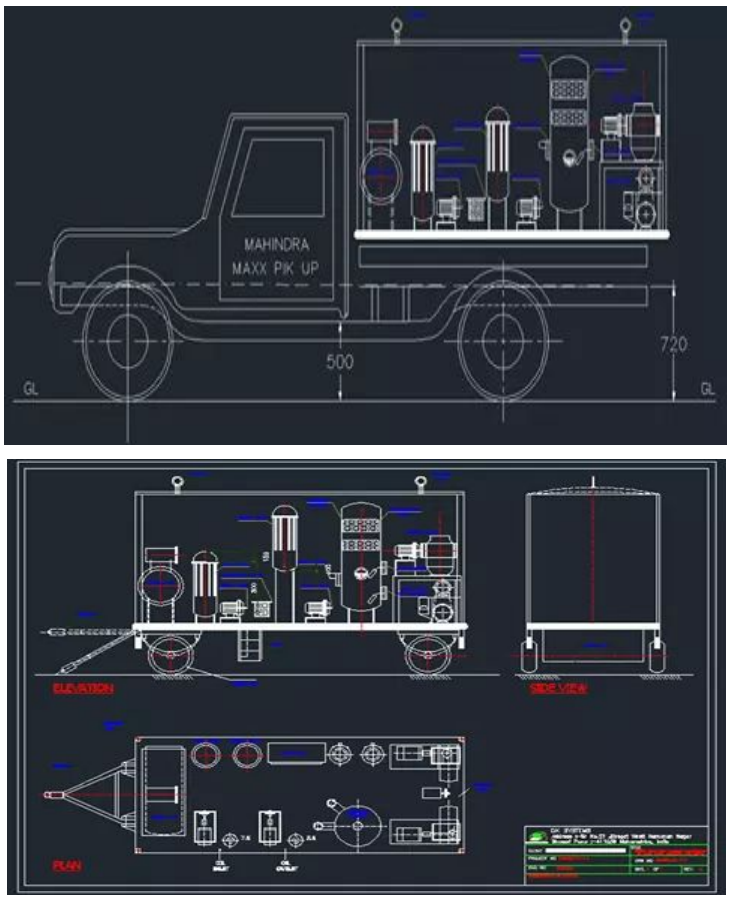
CAUSES OF FAILURE:

A survey conducted by The International Council on Large Electric Systems (CIGRE) indicates that main causes of transformer failures (51 percent in a last five year period) are due to following reasons:



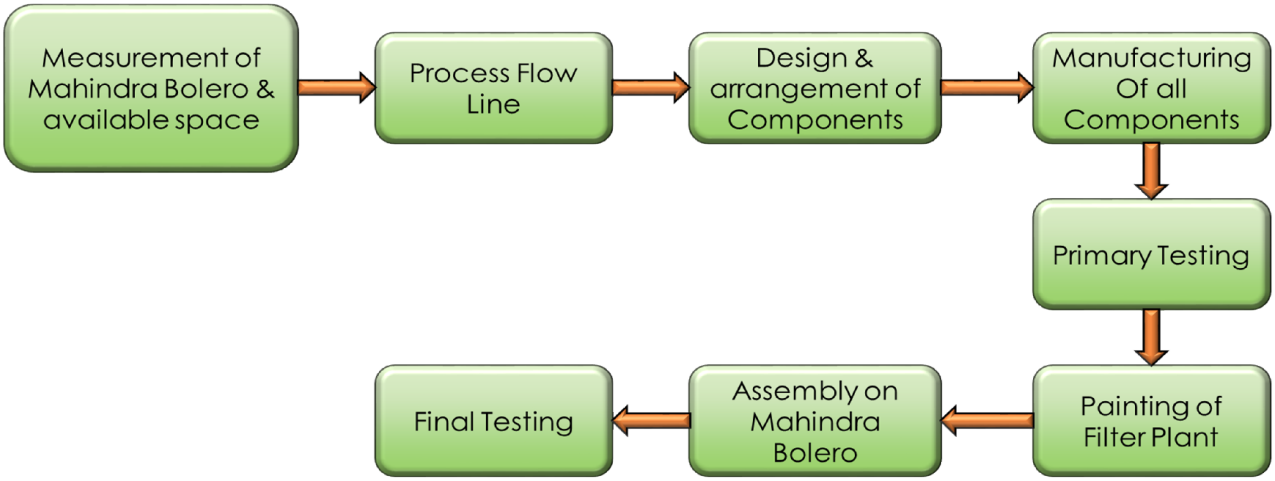
2 MANUFACTURING PROCEDURES

2.1 MACHINE DESIGN



Space available to use on Mahindra Bolero is measured and accordingly it is designed by using software of Auto CAD.

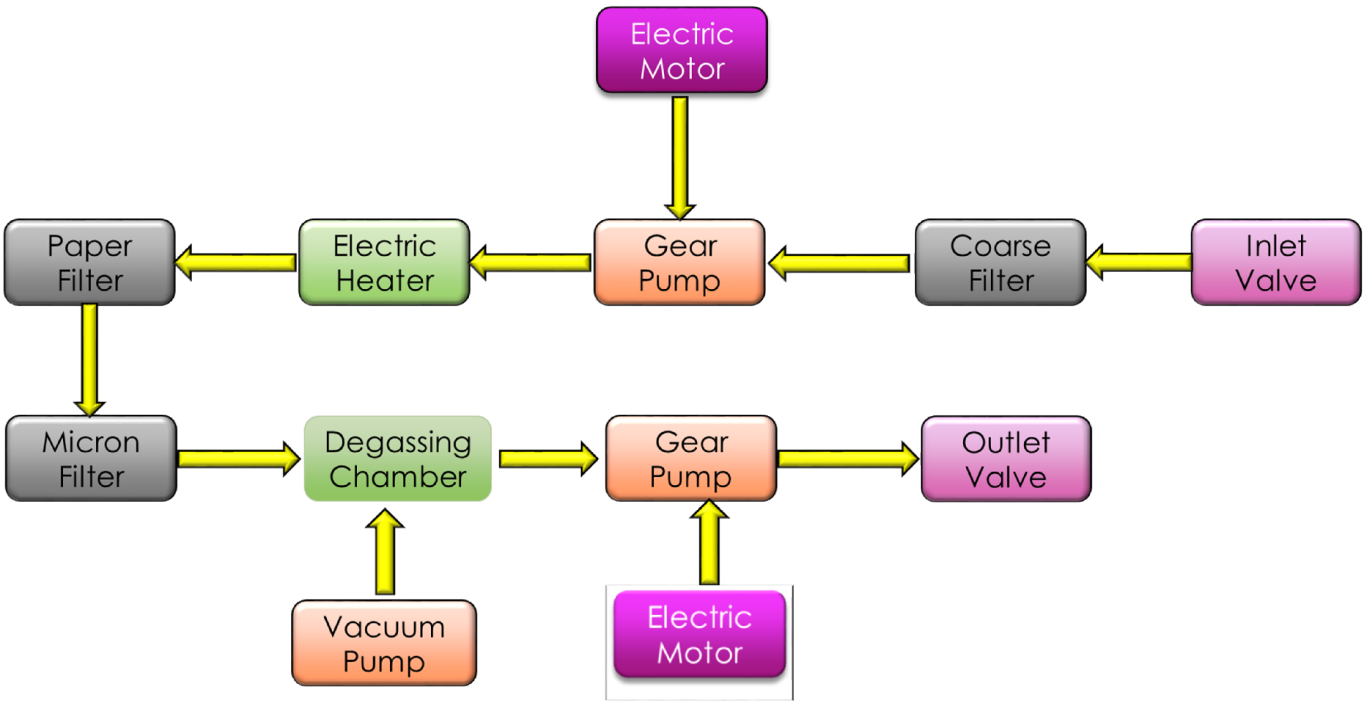
2.2 METHODOLOGY



2.3 SPECIFICATIONS

- Maximal oil flow rate 300 l/h
- Heating capacity 7.5 x 2 Kw
- Adjustable oil temperature range 40 °C – 100 °C
- Differential temperature (inlet/outlet) approx. 28 °C
- Minimal oil inlet temperature 5 °C
- Vacuum pump capacity 17 m3/h
- Filter fineness 2 microns
- Total power 16 kW
- Final oil qualities, after five passes:
- Water content - 2-4 ppm
- Gas content - 0.05 % Volume
- Operating pressure in degassing tank 2 - 9 mbar.
- Unit, size 1500 x 600 x 1200 mm.
- Unit, weight approx. 400 kg.

2.4 PROCESS FLOW LINE



3 TESTING AND RESULTS

3.1 BREAKDOWN VOLTAGE

The transformer oil characteristics before filtering:

- Dielectric strength of fresh oil before filtering - 50 kVA
- Oil amount taken for filtering - 500 l
- Capacity of the Unit - 300 l/h

The filtering process completed in four passes of oil through the Unit and the following results were obtained:-

	TOTAL AMOUNT OF OIL (Litres)	BREAKDOWN VOLTAGE ACROSS 2.5 mm GAP (KV)	MOISTURE CONTENT (PPM)
INITIAL CONDITIONS	500	10	50
FIRST PASS	500	30	35
SECOND PASS	500	52	24
THIRD PASS	500	64	10
FORTH PASS	500	78	3

3.2 COMPARISON

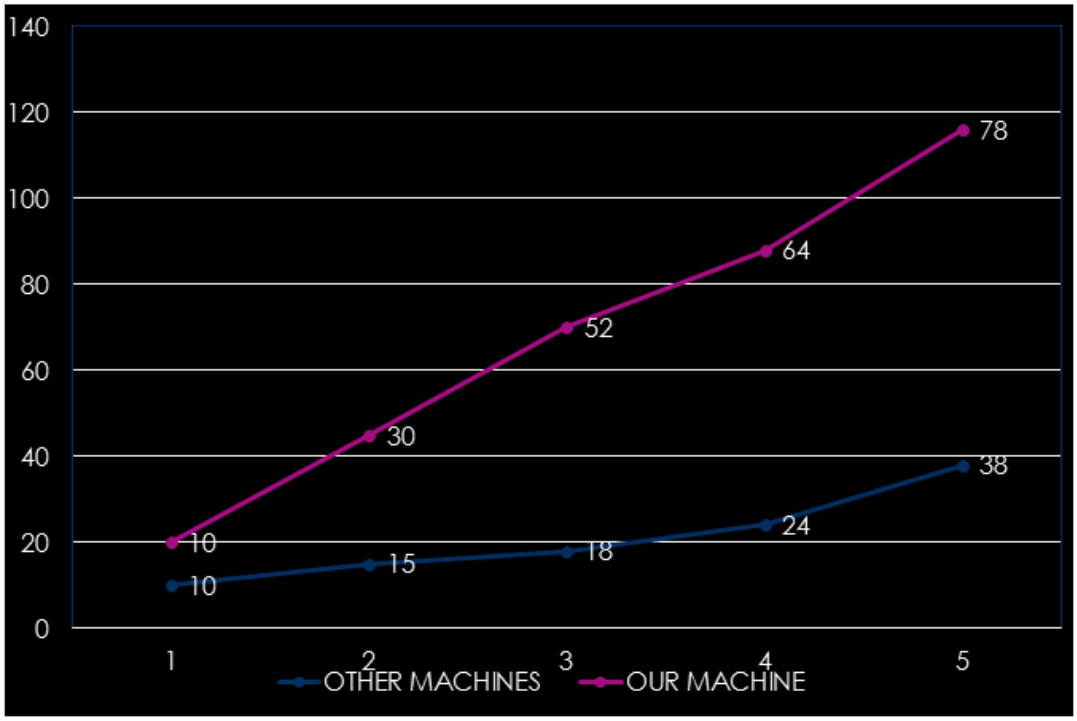
With other machine:

	BREAKDOWN VOLTAGE ACROSS 2.5 mm GAP (KV)	MOISTURE CONTENT (PPM)
INITIAL CONDITIONS	10	50
FIRST PASS	15	50
SECOND PASS	18	50
THIRD PASS	24	50
FORTH PASS	38	50

With other machine:

	BREAKDOWN VOLTAGE ACROSS 2.5 mm GAP (KV)	MOISTURE CONTENT (PPM)
INITIAL CONDITIONS	10	50
FIRST PASS	30	35
SECOND PASS	52	24
THIRD PASS	64	10
FORTH PASS	78	3

3.3 GRAPH OF COMPARISION



4 CONCLUSIONS

The cost effective and mobile transformer oil filter plant is manufactured. With degassing of oil.

The main conclusions of this study are as follows:

1) Degassing of transformer oil is easily possible with the help of vacuum pump.
2) The Moisture contents are reduced by 94%.

REFERENCES

[1] D.K. Systems Pvt. Ltd. Bhosari, MIDC, pune.

International Journal of Innovation and Scientific Research
ISSN 2351-8014 Vol. 17 No. 2 Aug. 2015, pp. 236-240
© 2015 Innovative Space of Scientific Research Journals
http://www.ijisr.issr-journals.org/

MOTHER'S WARMTH AND SOCIAL SUPPORT: A RELATIONAL ANALYSIS

Farhan Kamrani and Dr. Anila Amber Malik

Department of Psychology,
University of Karachi, Pakistan

Copyright © 2015 ISSR Journals. This is an open access article distributed under the ***Creative Commons Attribution License***, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT: This study was an attempt to see the relationship between perceived mother's warmth (an important ingredient of maternal acceptance) and social support (an ingredient of quality of relationship). After literature review it was hypothesized that perceived mother's acceptance would be positively correlated with social support from mother. A sample of 200 students (100 male, 100 female), of ages 20-25 years was randomly sampled from educational institutions. The participants provided their consent and demographic information and filled following questionaries; (1) Perceived Maternal Warmth Sub-scale of Adult PAQR/CONTROL: Mother (Short form) (Rohner, 2004), (2) Quality of relationship inventory (QRI, Pierce, Sarason, Sarason, Solky-Butzel & Nagle, 1994). Statistical analysis reveals that perceived mother's warmth is positively correlated to social support with mother. Avenues for future researches are also suggested.

KEYWORDS: Mother's Warmth and Social Support, Relational Analysis.

1 INTRODUCTION

Parenting has always been a topic of interest for modern Psychology. Early works in this regard date back to the works of great philosophers like the 18th century philosopher Rousseau, who stressed on parenting and did not consider any innate tendencies in child but according to him, everything in a child is taught to him (Delany, 2005).

The importance of parent-child relationship in later psychological life of the child is monumental in Freudian psychoanalysis (Freud, 1900). The initial psychosexual conflicts are related to parent child relationship. Freud and his paradigm contributed a great deal to the development of the scientific understanding of effects of parenting on what a person becomes. With the advent of behaviourism the notion that became very popular in the scientific circles of psychology is that, all children are born the same and can be trained for any particular profession and personality trait (Watson, 1913). So it can be said that this training is primarily gained from family environment so it's also a product of parenting.

The other important concept in this research is "Acceptance". The word acceptance is derived from the Latin verb *acquiescere* that means, to find rest in. In Psychology this word is used to express the recognition of the reality of something without changing it. Acceptance is a central concept of Abrahamic religions. One of the meanings of the word *Islam* is also acceptance (McDowell, Josh & Stewart, 1983). "Acceptance" became a subject of interest for Psychology after the advent of cognitive approach to Psychology. It brought new insight towards parenting. Some researchers explored perceptions (or cognitive representations) of childhood experiences and their emotional aspects to know how it contributed in current personality (Rohner, 2005). PAR-theory (Rohner, 2005) considers maternal acceptance as comprising of maternal warmth or affection that can be manifested in verbal, physical or symbolic forms. The word Warmth, if translated literally refers to a state of being warm in temperature (Merriam-Webster, 2013). The term is more often used for being warm in feeling. In current research the term is used in the context of feeling. The word feeling is also from the realm of Psychology of perception. It refers to the tactile sense of something. But the word is not just limited to the touch sensation but also refers to emotional reactions and states (Merriam-Webster, 2013).

The word "relationship" refers to the connection between two or more objects, concepts of people being connected. Human beings interact with each other throughout life spam for the fulfilment of their needs and for the sharing of

Corresponding Author: Farhan Kamrani

experiences. Every relationship is a discourse and has some value and roles attached to it. "Quantity" is the measurable dimension of something but quality refers to a criteria based judgement about the properties of something. When the word quality is combined with the term relationship it refers to the criteria based subjective evaluation of the value of any relationship. A study by Mallers, Charles, Neupert and Almeida (2010) that investigated the perception of childhood relationship with parents through retrospection suggests that the quality of mother and child is related to stressor exposure. This study also suggests that the quality father to son relationship is related to low level of emotional reactivity to stressors during adulthood.

The quality of relationship is a construct related to what a relationship means for a person in various domains of life i.e. emotional support, conflict avoidance, fulfilment etc. (Pierce et al, 1997). The perceptions of a person's role in another person's life in past has a significant impact on present relationship with the person. Pierce, Sarason, Sarason, Solky-Butzel and Nagle (1994) suggest 3 dimensions of quality of relationship i.e. social support, depth and conflict. According to House (1981) social support is the perception that one is cared for and has available assistance from others and that one has a fulfilling social system. Such a system could be related to emotions, financial, related to advice available in the dilemmas, and pertaining to belongingness. It indicates that how much a person in integrated in own system. This support can be gained through a number of sources. The prime source is family and friends. Institutions and groups also provide it.

This study is an attempt to know whether the people who received warmth as child receive more social support from mother as adult also or these two variables are unrelated. for current study it is assumed that perceived mother's warmth will be positively correlated with social support with mother.

2 METHODOLOGY

SAMPLING

For this study a sample of 200, (100 male and 100 females) between ages 20-25 (Mean age=19.81, SD=1.863) was randomly selected form educational institutions of Karachi-Pakistan. For this purpose 2 reputable educational institutions i.e. University of Karachi and Iqra University (*Gulshan-e-Iqbal* and *North Nazimabad* campuses) were approached. The entire sample was taken from student population. The sample belonged to middle and upper middle socio economic strata and was unemployed (fulltime students).

PROCEDURE

University of Karachi and Iqra University were selected for data collection. These universities were contacted for consent. The universities were visited and some departments were randomly selected. List of students were obtained for random sampling. The selected students were contacted and testing sessions were conducted for the selected students in classroom setting. Verbal and written consents were taken from students. The subjects were given the questionnaires and asked to answer the statements according to relevant scales. It was made sure that all the participants go through the same procedure of testing.

MEASURES

1) DEMOGRAPHIC DATA SHEET

That included items for getting information about participant's gender, age, date of birth, birth order, educational level, occupation, socio economic status, residential area and marital status. A special column will record if the parents of the respondent are alive or not.

2) QUALITY OF RELATIONSHIP INVENTORY (QRI, PIERCE, SARASON, SARASON, SOLKY-BUTZEL & NAGLE, 1994)

It's a self-report measure of conflict, depth and support in any peer or family relationship. It has 25 items that are rated on 5 point scale considering the relationship with any particular individual (in current research, with mother). Strong reliability and validity of the scale is reported by the authors (Pierce, Sarason, Sarason, Solky-Butzel & Nagle, 1994)

3) PERCEIVED MATERNAL WARMTH SUB-SCALE FROM ADULT PAQR/CONTROL: MOTHER (SHORT FORM) (ROHNER, 2004)

The scale is based on the recollection of the perception of parenting of age 7-12 years. Various domains of mother's acceptance/rejection and control are taped. The scale has 29 items and has a subscale of mother's warmth (physical, verbal and symbolic). Current research will only utilize the items maternal warmth subscale (8 items). Studies suggest strong theoretical background and reliability and validity for this scale.

DATA ANALYSIS

Predictive relationships were calculated for the given constructs (i.e. to test the hypothesis) through the Pearson product moment correlation. Descriptive statistics (i.e. measure of central tendencies, percentages etc) were also calculated. For these calculations statistical package for social sciences SPSS (12.0) was used.

ETHICAL CONSIDERATIONS

Participants were approached through proper channel i.e. concerned department were approached and after their consent students were approached. Students were asked for consent for the participation in this research. Those who agreed to participate marked their agreement through their signature in the consent form. Participants were made aware that they can leave the test at any point if they feel discomfort. They were assured that their name or identifying information will not appear in any part of research and will be used only for the research.

3 RESULTS

Table 1. Correlation between Perceived Mother's Warmth and Social Support with Mother

N=200

	Perceived Mother's Warmth	Sig.
Social Support With Mother	.356*	.00

* Correlation is significant at the 0.01 level.

Table 1 indicates that the Pearson Product Moment Correlation of Perceived Mother's Warmth and Social Support with Mother for the given sample is 0.356. The value is significant at 0.01 level i.e. there is a strong predictive relationship between these two variables.

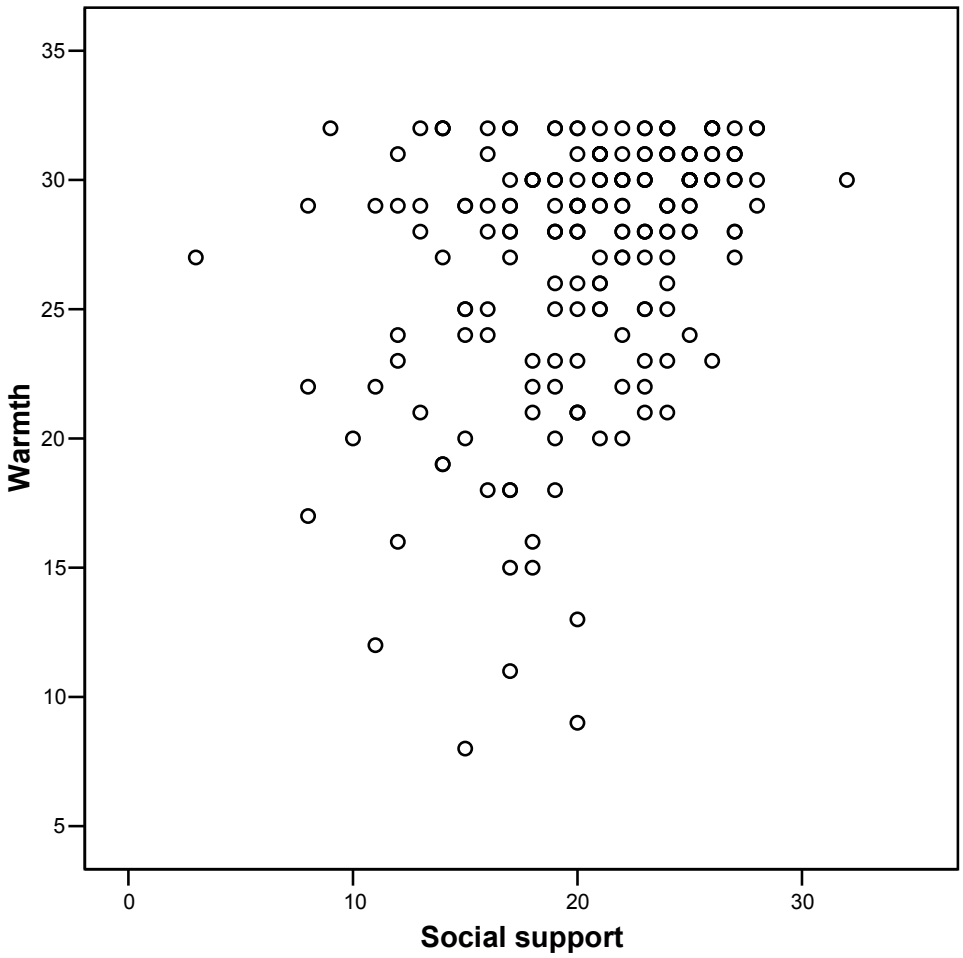


Fig. 1. Scatter plot between Perceived Mother's Warmth and Social Support with Mother

4 DISCUSSION

Results indicate that the hypothesis of current study i.e. perceived mother's warmth would be positively correlated with the social support with mother is proved. There was a strong relationship found between these two variables ($r= 0.356$, $p<0.05$). From these results it can be inferred that the experience of mother's warmth is a positive indicator of social support from mother. This is another finding that is in line with the notion that parenting has long lasting implications for the individual. Mother's warmth is the first experience that a child gains after birth. The perception of other caregiver(s) and members of family develops with time. It is the first social experience for the child and the quality inherent in this interaction shapes the upcoming interactions in life. This result indicates that those people who receive the warmth from mother as children are more able to receive social support from the mother also. This is a straightforward finding and suggests a consistency in quality human relationships.

Social support is essential to the Psychological wellness also and people who lack it are more venerable to psychological problems. Malik (2002) suggests that lower level of social support is related to symptoms of depression. Many psychological disorders are caused and exasperated due to lack of social support. . A study on quality of mother child relationship by Patterson, Cohn, and Kao (1989) suggests that the children who receive low level of warmth by their mothers and are rejected by their peers have more behavioural problems and are less competent then other children. Imam (2004) also report similar findings. A study by Kim (2008) on Korean American adolescents suggest that perceived lower maternal warmth is positively related to poor psychological adjustment of adolescents. A study (Cox, 2003) suggests that warmth in the relationship between the parent and child is related to fewer psychological problems. In accordance with the finding of this study another study (McIntyre & Dusek, 1995) suggests that parental warmth is found related to children's use of social support. I.e. warmth is not only the predictor of social support form mother in the later life but also it is related to using other available social support also. Current study has implications for the primary prevention of the psychological disorders

that have relation to the lack of social support. I.e. by increasing the amount of mother's warmth the quality of later life and psychological wellbeing can be safeguarded.

REFERENCES

[1] Cox, M. (2003). Parent-child relationships. In M. Bornstein, L. Davidson, C. Keyes, and K. Moore (Eds.), Wellbeing: positive development across the lifespan. USA: Lawrence Erlbaum.

[2] Delany, J. J. (2005). Jean-Jacques Rousseau (1712—1778). Internet Encyclopaedia of philosophy (IEP): A peer reviewed academic resource. Retrieved 30/09/12 from http://www.iep.utm.edu/rousseau/

[3] Freud,S. (1900). The Interpretation of Dreams. New York: Avon Books.

[4] House, J.S.(1981) *Work stress and social support*. Reading, Mass: Addison-Wesley.

[5] Imam , F. (2004). Perceived maternal warmth and personality dispositions of high and low achieving girls in Karachi. Pakistan Journal of Psychological Research. 19(1-2)51-60.

[6] Kim, E. (2008). Psychological adjustment in young Korean American adolescents and parental warmth. Journal of child and adolescent psychiatric nursing. 21(4)195-201.

[7] Mallers, H. M., Charles, S. T., Neupert, S. D. & Almeida, D. M. (2010). Perceptions of childhood relationships with mother and father: Daily emotional and stressor experiences in adulthood. Developmental Psychology. 46(6)1651-1661

[8] Malik, A. A. (2002) The study of social support as a determining factor in depressed and non-depressed as measure by an indigenously developed social support scale. Unpublished PhD dissertation, University of Karachi, Karachi, Pakistan.

[9] McDowell, Josh & Stewart (1983). Handbook of Today's Religions. Nashville: Thomas Nelson

[10] McIntyre, J. G., & Dusek, J. B. (1995). Perceived parental rearing practices and styles of coping. Journal of Youth and Adolescence, 24 (4), 499-509.

[11] Merriam-Webster (2013). Retrieved on 29/05/13 from http://www.merriam-webster.com

[12] Patterson, C. J., Cohn, D. A. & Kao, B. T. (1989). Maternal warmth as a protective factor against risks associated with peer rejection among children. Development and Psychopathology. 1(01)21-38

[13] Pierce, G.R., Sarason, I. G., Sarason, B. R., Solky-Butzel, J.A., Nagle, L.C. (1994). Quality of relationship inventory (QRI). In B. Burleson , T. Albrecht , I.G. Sarason, (1994). The Communication of Social Support: Messages, Interactions, Relationships, and Community. Sage Publication: London

[14] Pierce, G., Sarason, I.G., Sarason, B.R., Solky-Butzel, J.A., and Nagle, L.C. (1997). Assessing the quality of personal relationships. Journal of Social and Personal Relationships, 14, 339-356.

[15] Rohner, R. P. (2004). Adult PAQR/CONTROL: Mother (Short form). In R. P. Rohner (2005). *Handbook for the study of parental acceptance and rejection* (4th ed.).Storrs, CT: Rohner Research Publications.

[16] Rohner, R. P. (2005). Glossary of significant concepts in parental acceptance-rejection theory (PAR theory). Retrieved 10/09/2013 from http://www.ucc.uconn.edu/~rohner/glossary.html

[17] Watson, J. B. (1913). Psychology as behaviourist views it. Psychology review, 20, 158-177

International Journal of Innovation and Scientific Research
ISSN 2351-8014 Vol. 17 No. 2 Aug. 2015, pp. 241-245
© 2015 Innovative Space of Scientific Research Journals
http://www.ijisr.issr-journals.org/

ON THE USE OF DISCRIMINANT ANALYSIS IN CLASSIFICATION OF THE MODE OF DELIVERY OF AN EXPECTANT MOTHER

U.I. Usman[1] and O.S. Balogun[2]

[1]Monitoring and Compliance Unit, Abuja Enterprise Agency, Entrepreneurial Complex, Plot 74 Sector Centre A, Cadastral Zone B15, Jahi, Abuja, Nigeria

[2]Department of Statistics and Operations Research, Modibbo Adama University of Technology, P.M.B. 2076, Yola, Adamawa State, Nigeria

Copyright © 2015 ISSR Journals. This is an open access article distributed under the ***Creative Commons Attribution License***, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT: The aim of the study was to obtain a discriminant function that can be used to classify the mode of delivery of pregnant women using some variables. Data from Health Records of 184 Pregnant women who delivered at the General Hospital, Wuse were used. The data consist of Mother's Weight, Height, Age and Baby's Weight, Baby's Gender and mode of delivery (Natural birth and Caesarian Section). This indicates that the Mother's Age and Mother's weight significantly affects the discrimination between the two groups. The Discriminant function D(X), which can be used in classifying the mode of delivery of women was obtained and used. The discriminant analysis gave a correct classification rate of 64.7% and misclassification rate of 35.3%.

KEYWORDS: Natural birth, Caesarian section, Discriminant function, Classification.

1 INTRODUCTION

Child birth poses considerable risk to the lives of both mother and child particularly in situations where complication arises. Child birth is defined as the complete expulsion or extraction of a fetus from its mother.

Child birth is preceded by a period known as the Gestation period. It has been of interest to researchers to know the mode of delivery a mother is likely to use. Under normal conditions, a mother is expected to give birth by natural birth otherwise known as safe delivery, but in certain cases complications may arise leading to the use of Caesarian section. Caesarian section poses considerable risk.

West/Central Africa accounts for more than 30% of global maternal deaths, and 162, 000 women died of pregnancy or childbirth related causes in 2005. The maternal mortality ration is substantially higher here than in any other region, at 1100 maternal deaths per 100, 000 live births. Furthermore, no discernible progress has been made in reducing the ratio since 1990. Of the 23 countries in the region with comparable estimates every country but Cape Verde has an MMR of at least 500, and a third of these countries have an MMR of 1, 000 or greater. Almost two thirds of maternal deaths in the region occur in the Democratic Republic of Congo, Niger and Nigeria, which together account for approximately 20 per cent of all maternal deaths worldwide [1]. Several factors influence the high rate of maternal mortality in Nigeria, but the most common causes are lack of access to ante – natal care, inadequate access to skilled birth attendees, delays in the treatment of complications of pregnancy, poverty and harmful traditional practices.

Discriminant analysis has had its earliest and most widespread educational research applications in the areas of vocational and careers development. Because education prepares people for a variety of positions in the occupational structures prevalent in their societies, an important class of education research studies is concerned with testing of theories about the causes of occupational placements and/or the estimation of production equations for allocating positions or

Corresponding Author: U.I. Usman

anticipating such allocation. Discriminant analysis is a descriptive procedure of separation in which linear functions of the variables are used to describe or elucidate the differences between the two or more groups. That is, the aim of this analysis includes identifying the relative contribution of say, p variables to separation of groups and finding the optimal plane on which the points can be projected to best illustrate the configuration of the groups [2]. The classification of objects to groups is usually thought of as partition of the objects into subsets in which the members are more similar. Classifying individuals into groups such that there is a relative homogeneity between the groups and heterogeneity between the groups is a problem which has been considered for many years [3].

[4] used discriminant function in classifying drug offenders into groups (Drug Peddlers and Non-Drug Peddlers) using some variables (Type of Exhibit, Weight of Exhibit, Age and Gender) instead of the oral evidences used by National Drug Enforcement Agency to classify drug offenders into drug Peddlers and Non-Peddlers in Kwara State.

2 THE DISCRIMINANT MODEL

The elements of the discriminant models are given as

$$Z = a + W_1X_1 + W_2X_2 + \ldots + W_kX_k$$

where

Z = discriminant score

a = discrimanat constant

W_k = an independent variable or predictor variable

Discriminant analysis uses ordinary least squares to estimate the values of the parameters 'a' and W_k that minimize the within Group sum of Squares. Discriminant analysis involves deriving linear combination of the independent variables that will discriminate between the prior defined groups in such a way that the misclassification error rates are minimized [5]. The function is given as

$$D(X) = b'\underline{X}$$

$$where\, b' = S^{-1}\left(\underline{\bar{X}}_1 - \underline{\bar{X}}_2\right)'$$

$$X = \left(\underline{\bar{X}}_1 - \underline{\bar{X}}_2\right)$$

Where, $D(X)\, is\ a\ 1\times n$ vector of discriminant scores, $b'\ is\ a\ 1\times p$ vector of discriminant weights, and $X\ is\ a\ p\times n$ matrix containing the values of the n individuals on the p independent variables. S^{-1} the inverse of the pooled sample variance-covariance matrix of the independent variable. The Mahalanobis generalized distance D^2 Statistic is used to determine whether the between group differences in mean score profiles are statistically significant. Large value of D^2 would lead us to believe that the groups are sufficiently spread in terms of mean separation [5]. It is given as:

$$D^2 = \left(\underline{\bar{X}}_1 - \underline{\bar{X}}_2\right)' S^{-1}\left(\underline{\bar{X}}_1 - \underline{\bar{X}}_2\right)$$

$$The\ test\ can\ be\ constructed\ by\ for \min g:$$

$$Z = \frac{n_1n_2\left(n_1 + n_2 - p - 1\right)D^2}{n_1 + n_2\left(n_1 + n_2 - 2\right)p}$$

3 DATA ANALYSIS AND RESULT

The analysis is done to compute the discriminant weights, to examine the associated significance and assumption tests based on linear combination of the predictor variables and also to classify each case into one of the two groups it closely resembles. The variables used in this analysis are Dependent variable: group 1 (Natural birth), group 2 (Caesarian section)and Independent variables: Mothers Height (X_1), Mothers Weight (X_2), Mothers Age (X_3), Baby's Weight (X_4) and Baby's Gender (X_5).

3.1 TEST FOR EQUALITY OF MEANS

Test of function(s)	Wilks' lamda	Sig
1	0.936	0.037

Table 1. Wilks' Lamda

$$Hypothesis: H_0: \underline{\mu}_1 = \underline{\mu}_2 \; vs \; H_1: Not \; H_0$$

$$Test \; Statistic: \lambda = \frac{|BSS|}{|BSS + WSS|}$$

$$\alpha = 0.05$$

$$Decision: \sin ce \; p - value(0.037) < 0.05, \; \text{Re} \; ject \; H_0.$$

Under the hypothesis $H_0: \underline{\mu}_1 = \underline{\mu}_2$ and common variance covariance matrix the test statistic F is distributed as a F-distribution with $n_1 + n_2 - p - 1 df$ $i.e.$

$$F: F_\alpha: \left(p, n_1 + n_2 - p - 1\right)$$

Using the above relation H_0 is rejected at the significant level α, if $F: F_\alpha: \left(p, n_1 + n_2 - p - 1\right)$

CLASSFICATION RULE

Assign an individual with realized score $\underline{X}$ on the p independent variables to $G_1 \; if \; D\left(X\right) \geq C$ otherwise,

To $G_2 \; if \; D\left(X\right) < C$ where

$C = \left(\underline{\bar{X}} - \underline{\bar{X}}\right)' S^{-1} \left(\underline{\bar{X}} - \underline{\bar{X}}\right)$ we assume that in each group observed scores on the p independent variables as multivariate normal with mean $\mu_i, i = 1, 2$ and variance-covariance matrix S^{-1}, and if we can further assume that the prior probabilities of group membership and costs of misclassification of an individual that actually belongs to group 1(2) into 2(1) are equal.

Conclusion: The vector of the 2 group means are not the same.

3.2 TEST FOR EQUALITY OF GROUP MEANS INDIVIDUAL VARIABLE

$$Hypothesis: H_0: t_1 = t_2 \; vs \; H_1: Not \; H_0$$

$$Test \; Statistic: t = \frac{\bar{X}_1 - \bar{X}_2}{S_p \sqrt{\frac{1}{N_1} + \frac{1}{N_2}}}$$

$$Where \; S_p = \sqrt{\frac{N_1 S_1^2 + N_2 S_2^2}{N_1 + N_2 - 2}}$$

Variable	t	Df	Sig
Mothers Height	1.345	182	0.180
Mothers Weight	2.208	182	0.028
Mothers Age	2.053	182	0.042
Baby's Weight	0.077	182	0.940

Table 2. t-test for equality of mean

(i) Mothers Height

Decision: since p-value (0.180) > 0.05. Accept H_0.

Conclusion: There is no difference in the mean Mother's Height for group 1 and group 2.

(ii) Mothers Weight

Decision: since p-value (0.028) < 0.05. Reject H_0.

Conclusion: There is a difference in the mean Mother's Weight for group 1 and group 2.

(iii) Mothers Age

Decision: since p-value (0.042) < 0.05. Reject H_0.

Conclusion: There is a difference in the mean Mother's Ages for group 1 and group 2.

(iv) Baby's Weight

Decision: since p-value (0.942) > 0.05. Accept H_0.

Conclusion: There is a difference in the mean Baby's Ages for group 1 and group 2.

3.3 CANONICAL DISCRIMINANT FUNCTION COEFFICIENT

Variable	Function
	1
Mothers Height	-0.074
Mothers Weight	0.047
Mothers Age	0.083
Baby's Weight	-0.199
Baby's Gender	-0.783
Constant	8.089

Table 3. Canonical Discriminant Function Coefficient

Hence,

$$8.089 - 0.074X_1 + 0.047X_2 + 0.083X_3 - 0.199X_4 - 0.783X_5$$

3.4 CLASSIFICATION OF RESULTS

		Predicted group Membership		Total
		Natural birth	Caesarian section	
Original Count	Natural birth	64	35	99
	Caesarian section	30	55	85
%	Natural birth	64.6	35.4	100
	Caesarian section	35.3	64.7	100

Table 4. Classification of Results

From the table 64.7% of the group cases were correctly classified while 35.3% were wrongly classified.

4 CONCLUSION

In general, we were able to construct a Discriminant score: for detecting the variables (Mothers Height, Mothers Weight, Mothers Age, Baby's Weight and Baby's Gender) that allow the researcher to discriminate between Natural birth and

Caesarian section and we have shown that the group differs with regards to the mean of variables, and the variables to predict group membership.

REFERENCES

[1] UNICEF, (2008)**:** Progress for Children Report.
[2] Rencher, A.C. (2002), Method of Multivariate Analysis, Second Edition, John Wiley and Sons Inc.
[3] Ganesalingam, S. (1989), "Classification and Mixture Approaches to Clustering via Maximum Likelihood". Applied Statistics, 38, No. 3, Page 445-466.
[4] Balogun, O.S., Oyejola, B.A. and Akingbade, T.J. (2012), Use of Discriminant analysis in Classification of Drug Peddlers and Non-Drug Peddlers in Kwara State. International Journal of Engineering Research and Application, Vol. 2, Issue 5, Page 936-938.
[5] Dillion, W.R. and Goldstein, S. (1984), "Multivariate Analysis Method and Applications. John Wiley Sons, Inc. Canda.

International Journal of Innovation and Scientific Research
ISSN 2351-8014 Vol. 17 No. 2 Aug. 2015, pp. 246-250
© 2015 Innovative Space of Scientific Research Journals
http://www.ijisr.issr-journals.org/

E-Learning system by using cloud computing

Jyoti Chaudhary[1] and Anvita Saxena[2]

[1]PG Scholar, Department of Computer Science and Engineering,
Shobhit University, Meerut, Uttarpradesh, India

[2]Assistant Professor, Department of Computer Science and Engineering,
Miet kumaon Engineering College,
Haldwani, Uttarakhand, India

Copyright © 2015 ISSR Journals. This is an open access article distributed under the ***Creative Commons Attribution License***, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT: The increasing research in the areas of information technology has a positive impact in the world of education.The implementation of e-learning is one of contribution from information technology to the world of education. The implementation of e-learning has been implemented by several educational institutions. E-learning provides many benefits such as flexibility, diversity, measurement, and so on. The current e-learning applications required large investments in infrastructure systems regardless of commercial or open source e-learning application It can be challenging to implement e-learning in educational institutions. Another problem that can arise in the use of e-learning trend today is more likely to institution building their own e-learning system itself. If two or more institutions are willing to build and use an e-learning so they can minimize the expenditure to develop the system and share learning materials more likely happened. This paper presents the benefits of using cloud computing for e-learning. there are many educational institutions that cannot afford such investments, and cloud computing is the best solution, especially in the universities where the use of computers are more intensive and what can be done to increase the benefits of common applications for students and teachers .In addition to this paper we also illustrated the shift paradigm from conventional e-learning to cloud-based e-learning and described the expected benefits by using cloud-based e-learning.

KEYWORDS: Models of cloud, E-learning using cloud computing, Security in cloud computing E- learning.

1 INTRODUCTION

The cloud computing is a collection of server delivering resources that can be accessed remotely via the Internet in real-time. It is also a place for the users to create, store and access personal information by much more efficient way of computing technology [2]. The development of these technologies is directly related to the increasing access to the communication technology, as well as its decreasing cost provided by the mobile service providers. The learners choose to learn over distance or in person at a traditional campus; the power of e-learning and virtual collaboration is growing fast in education and in the worldwide economy. This power is best realized with a well-planned cloud computing and e-learning strategy. Learners can use the enormous interactivity of innovative media and develop their skills, knowledge, and awareness of the future domain. The benefits of these computing can support education institutions to resolve common challenges such as cost reduction, rapid and effective communication, security, privacy, flexibility and accessibility. The Educational institutes, businesses and many other industries are adopting the services of cloud computing because of the following reasons:

Cloud computing refers to applications and services that run on a distributed network using virtualized resources and accessed by common Internet protocols and networking standards. It is distinguished by the notion that resources are virtual and limitless and that details of the physical systems on which software runs are abstracted from the user.[1][2][3] Cloud computing takes the technology, services, and applications that are similar to those on the Internet and turns them into a self-service utility. The use of the word “cloud” makes reference to the two essential concepts.

Corresponding Author: Jyoti Chaudhary

- **Abstraction:** Cloud computing abstracts the details of system implementation from users and developers. Applications run on physical systems that aren't specified, data is stored in locations that are unknown, administration of systems is outsourced to others, and access by users is ubiquitous.
- **Virtualization:** Cloud computing virtualizes systems by pooling and sharing resources. Systems and storage can be provisioned as needed from a centralized infrastructure, costs are assessed on a metered basis, multi-tenancy is enabled, and resources are scalable with agility.[1]

The Educational institutes, businesses and many other industries are adopting the services of cloud computing because of the following reasons:

1. **Cost Saving:** One of the most appealing reasons to switch to the cloud is the cost savings feature. With the cloud, the user will pay for applications only when needed and many applications are included free of charge.
2. **Scalability:** One of the major reasons for using cloud computing is its scalability. Cloud computing allows universities, colleges and IT industries to easily upscale or downscale IT requirements as and when required.
3. **Ease of Use:** Quite simply, cloud computing is easy to get up and running. Instead of having to download and/or install software yourself, in the cloud it is all done for you.
4. **Time Shifting:** This allows for on-demand analysis of study material instantly.
5. **Adore More Fault Tolerance:** Cloud providers can afford to have multiple data centers and multiple Internet connections at each data center to adore fault tolerance. As they offer levels of data protection for the e- learner users simple nightly backups, such as continuous data protection, generators to handle power outages, and high-end servers that can keep running even one component fails.

Apart from the above mentioned reasons, the Learners, Consumers and businesses utilize the cloud on a daily basis even if they're not aware of it. For instance, when we are using e-mail, or go to a social network and post photos, access online document software, or use company's hardware/software we probably use the cloud services.

2 MODELS OF CLOUD COMPUTING

Deploying cloud computing can differ depending on requirements, and the following four deployment models have been identified, each with specific characteristics that support the needs of the services and users of the clouds in particular ways (see Figure 1).

- **Private Cloud** — The cloud infrastructure has been deployed, and is maintained and operated for a specific organization. The operation may be in-house or with a third party on the premises.
- **Public Cloud** — The cloud infrastructure is available to the public on a commercial basis by a cloud service provider. This enables a consumer to develop and deploy a service in the cloud with very little financial outlay compared to the capital expenditure requirements normally associated with other deployment options.
- **Hybrid Cloud** — The cloud infrastructure consists of a number of clouds of any type, but the clouds have the ability through their interfaces to allow data and/or applications to be moved from one cloud to another. This can be a combination of private and public clouds that support the requirement to retain some data in an organization, and also the need to offer services in the cloud.

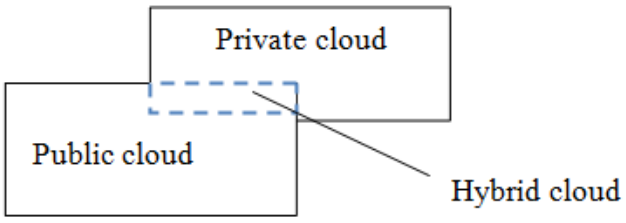


Fig-1 Service models of cloud

3 E-LEARNING USING CLOUD COMPUTING

A new Paradigm Out-of-classroom and in-classroom educational experiences E-learning is the computer and with the aid of network enabled transfer of skills and knowledge. E-learning applications and processes offer Web-based learning, computer-based learning, virtual education prospects and digital collaboration to their e-users. Popular e-learning technologies include: Content is delivered via the Internet, audio, satellite TV .Voice-centered technology, such as CD/DVD or Webcasts .Video technology, such as instructional videos, DVDs and interactive videoconferencing. Computer-centered technology delivered over the Internet or corporate intranet [3].

One of the most interesting applications of cloud computing is educational cloud. The educational cloud computing can focus the power of thousands of computers on one problem, allowing researchers search and find models and make discoveries faster than ever. The universities can also open their technology infrastructures to private, public sectors for research advancements. The efficiencies of cloud computing can help universities keep pace with ever-growing resource requirements and energy costs. Students expect their personal mobile devices to connect to campus services for education. Faculty members are asking for efficient access and flexibility when integrating technology into their classes. Researchers want instant access to high performance computing services, without them responsibility of managing a large server and storage farm. The role of cloud computing at university education should not be underestimated as it can provide important gains in offering direct access to a wide range of different academic resources, research applications and educational tools. Usually, E-learning systems are developed as distributed applications, but not limited to. The architecture of an e-learning system, developed as a distributed application, includes a client application, an application server and a database server (see Figure 2), beside the hardware to support it (client computer, communication infrastructure and servers).

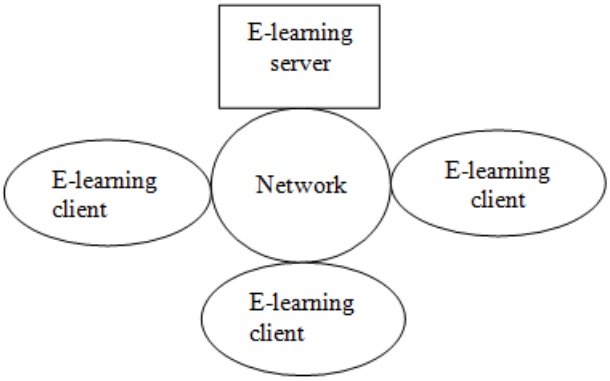


Figure 2—E-learning systems [4]

BENEFITS OF E-LEARNING SYATEM USING CLOUD COMPUTING:-

A. Infrastructure: use an e-learning solution on the provider's infrastructure

B. Platform: use and develop an e-learning solution based on the provider's development interface

C. Services: use the e-learning solution given by the provider.[5][6]

ADVANTAGES:-

There are numerous advantages when the e-learning is implemented with the cloud computing technology, they are:

A. Low cost*:* E-Learning users need not have high end configured computers to run the e-learning applications. They can run the applications from cloud through their PC, mobile phones, tablet PC having minimum configuration with internet connectivity. Since the data is created and accessed in the cloud, the user need not spend more money for large memory for data storage in local machines. Organizations also need to pay per use, so it's cheaper and need to pay only for the space they need.[7]

B. Improved performance: Since the cloud based e-learning applications have most of the applications and processes in cloud, client machines do not create problems on performance when they are working.

C. ***Instant software updates:*** Since the cloud based application for e-learning runs with the cloud power, the software's are automatically updated in cloud source. So, always e-learners get updates instantly.

D. ***Improved document format compatibility:*** Since some file formats and fonts do not open properly in some PCs/mobile phones, the cloud powered e-learning applications do not have to worry about those kinds of problems. As the cloud based e-learning applications open the file from cloud.

E. ***Benefits for students:*** Students get more advantages through cloud based e-learning. They can take online courses, attend the online exams, get feedback about the courses from instructors, and send their projects and assignments through online to their teachers.[8]

F. ***Benefits for teachers:*** Teachers also get numerous benefits over cloud based e-learning. Teachers are able to prepare online tests for students, deal and create better content resources for students through content management, assess the tests, homework, projects taken by students, send the feedback and communicate with students through online forums.[9]

G. ***Data security:*** A very big concern is related to the data security because both the software and the data are located on remote servers that can crash or disappear without any additional warnings. Even if it seems not very reasonable, the cloud computing provides some major security benefits for individuals and companies that are using/developing e-learning solutions [10]

4 SECURITY IN CLOUD BASED E-LEARNING

Security is one of the primary concern in the greater context of cloud computing as it relates to cloud based e-learning. From 2005-2011,security has been in the top four IT issues as published by Educause, a "non profit association whose mission is to advance higher education by promoting the intelligent use of information technology". When shifting elearning in the cloud, main security concerns are about confidentiality, integrity and availability.Security remains as an integral component of the top ten IT issues in 2012[11]. A. Seven Threats to security in cloud computing[11][12] There are several significant threats that should be considered before adopting the paradigm of cloud computing in elearning. These threats are described as follows:

1) **Abuse and Nefarious use of cloud**:Cloud services providers often targeted for their weak registration system and limited fraud detection capabilities. This paves way to the spammers, malicious code authors and other cybercriminals can misuse the various types of services including unlimited bandwidth and storage facilities offered by the cloud providers. Misuse includes creating spam, decoding and cracking of passwords, executing malicious codesto access rich information such as question papers, learning materials, assessments etc.

2) **Insecure Software Access**:Various software interfaces and APIs are used by the cloud users in e-learning to access and manage the cloud services. These APIs play an integral part during provisioning, management, orchestration and monitoring of the processes running in a cloud environment.Hence these APIs needs to be secured and should include features of authentication, access control, encryption and activity monitoring. Many security issues will be raised if cloud service providers believe on weak set of APIs.

3) **Malicious Insider**:Malicious employees who are working in the provider‟s or user site can be able to perform insider attacks. This insider can steal the confidential data of cloud users in e-learning. Malicious insider can easily get the cloud users in e-learningconfidential data such as password, cryptographic keys and files. It will affect the standards and trust of cloud users in e-learning. As a result, it can cause damage on both financial grounds as well as organisation reputation.

4) **Data Separation**:Virtual Machine (VMs) are virtualized based on the physical hardware of cloud providers and stores the e-learning user‟s applications supplied by the cloud providers due to the cloud virtualization. These VMs are isolated from each other by cloud providers in order to maintain the security of users. These VMs are managed by hypervisor who are the main source of managing the virtualized cloud platform so as to provide virtual memory as well as CPU.scheduling policies to VMs. Hypervisors are mainly targeted by the hackers since they are residing between VMs and hardware. Strong isolation is needed to ensure that VMs are not able to access the activities of other VMs under the same cloud computing providers. Even though several vendors offers strong security mechanism to protect the cloud supervisors, however sometimes security of VMs is compromised.

5) **Data Loss or Leakage**: Operational failures, unreliable data storage and inconsistent use of encryption keys will lead to a data loss. Operational failure includes deletion, incomplete deletion or alteration without any backup of the source elearning content. It may be either intentionally or unintentionally. Unreliable data storage means storing a data on

unreliable media which cannot be recoverable if the data is lost. Inconsistent use of encryption keys will lead to unauthorized access and data loss such as destruction of sensitive and confidential information. It will definitely affect the reputation of the company.

6) **Hijacking**:Controlling the users account through the unauthorised access by the hackers is referred as account or service hijacking. It includes phishing, fraud and exploitation of software vulnerabilities.It is not enough to secure the sensitive and confidential information through the common way of authentication and authorization process e-learning.

7) **Unknown Risk**:It is essential for the every e-learning user to know the software versions, security practices, software code updates and intrusion attempts. Cloud service providers usually advertised these futures and functionality with the necessary details such as internal security procedure, configuration hardening, patching, auditing and logging. E-learning users must be aware and clarified how their data and related files are stored. On the other hand, e-learning user may unaware of the unknown risk profile which may include serious threat.[12]

5 CONCLUSION

Cloud computing as an exciting development is a significant alternative today's educational perspective. Students and administrative personnel have the opportunity to quickly and economically access various application platforms and resources through the web pages on-demand. This automatically reduces the cost of organizational expenses and offers more powerful functional capabilities. There will be an online survey to collect the required data for the use of cloud computing in the universities and other governmental or private institutions in the region. This will help us review the current status and probable considerations to adopt the cloud technology. Beginning with the outsourcing of email service seems attractive. The gradually removal of software license costs, hardware costs and maintenance costs respectively provides great flexibility to the university/corporate management. In this paper we discuss a cloud computing based e-learning. Describe its definition and some benefits. Cloud based education will help the students, staff, Trainers, Institutions and also the learners to a very high extent and mainly students from rural parts of the world will get an opportunity to get the knowledge shared by the professor on other part of the world. Even governments can take initiatives to implement this system in schools and colleges in future and we believe that this will happen soon.

REFERENCES

[1] "A NEW TREND FOR E-LEARNING IN KSA USING EDUCATIONAL CLOUDS", Abdullah Alshwaier, Ahmed Youssef and Ahmed Emam, Advanced Computing: An International Journal (ACIJ), Vol.3, No.1, January 2012

[2] "THE UTILITY OF CLOUD COMPUTING AS A NEW PRICING – AND CONSUMPTION - MODEL FOR INFORMATION TECHNOLOGY", David C. Wyld, Department of Management, Southeastern Louisiana University, Hammond, LA USA, International Journal of Database Management Systems (IJDMS), Vol.1, No.1, November 2009

[3] "Cloud Computing-Future Framework for e-management of NGO's", 1. Harjit Singh Lamba, 2.Gurdev Singh, International Journal of Advancements in Technology http://ijict.org/ ISSN 0976-4860, Vol 2, No 3 (July 2011)

[4] "E-learning based on Cloud Computing", Deepanshu Madan, *Scholar's; Computer science & Engg. Deptt. Dehradun institute of technology Dehradun,* Ashish Pant, *Assistant Professor; Computer Sc. & Engg dept. Dehradun Institute of Technology Dehradun* Suneet Kumar, *Assistant Professor; Computer Sc. & Engg dept. Dehradun Institute of technology Dehradun, India,* Arjun Arora, *Assistant Professor; Computer Sc. & Engg dept. Dehradun Institute of Technology, Dehradun, India. ,* International Journal of Advanced Research in Computer Science and Software Engineering

[5] "Using Cloud Computing for E-learning Systems", PAUL POCATILU, FELICIAN ALECU, MARIUS VETRICI, Economic Informatics Department, Academy of Economic Studies Piata Romana, Secot 1, Bucharest, ROMANIA

[6] "E-Learning on the Cloud ", Mohammed Al-Zoube, Princess Sumaya University for Technology, Jordan.

[7] "APPLIANCE OF CLOUD COMPUTING ON E-LEARNING", Bhruthari G. Pund, Prajakta P. Deshmukh, *Prof. Ram Meghe Institute Of Technology, Badnera, Amravati, Maharashtra.*

[8] "Cloud Computing Benefits for E-learning Solutions", Paul POCATILU, PhD, Associate Professor, Department of Economic Informatics, Academy of Economic Studies, Bucharest.

[9] "An E-learning System Architecture based on Cloud Computing", Md. Anwar Hossain Masud, Xiaodi Huang, World Academy of Science, Engineering and Technology 62 2012

[10] Cloud Computing Issues and Benefits Modern Education, By D.Kasi Viswanath, S.Kusuma & Saroj Kumar Gupta, *Madanapalle Institute of Technology and Science Madanapalle, Chittoor*

[11] http://hiberniacollege.com/study-with-hibernia/benefits-of-e-learning/

[12] http://www.wikinvest.com/concept/Cloud_Computing.

International Journal of Innovation and Scientific Research
ISSN 2351-8014 Vol. 17 No. 2 Aug. 2015, pp. 251-263
© 2015 Innovative Space of Scientific Research Journals
http://www.ijisr.issr-journals.org/

Effet des eaux usées de la ville de Settat sur la charge métallique des sols agricoles

[Settat Sewage Sludge Effects on Metal Load In Agriculture Soils]

Doha BARRANI and Abdelhamid BOUZIDI

Laboratoire de Sciences de l'Environnement et du Développement (SED),
Faculté des Sciences et Techniques, Université Hassan 1er, BP 577 – Settat, Maroc

Copyright © 2015 ISSR Journals. This is an open access article distributed under the ***Creative Commons Attribution License***, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT: The present work contribute to the study of the impact of the use of wastewater in irrigation of agricultural soils. The main objective is to diagnose the state of metal pollution of soils. The obtained results from the physic-chemical analysis on samples selected along the wadi Boumoussa (natural drain wastewater from the city of Settat) emphasize that these soils are sandy loam with a slightly basic pH, the electrical conductivity parameter expressing the ionic charge, varies between 1100µS/cm 1500µS/cm which refer these soils in class 0 (unsalted ground) and the organics values are between 2% and 3.5%. These values classify our soil as organic matter moyennent provided. While their cation exchange capacity (CEC) is very high. The studied soils are rich in phosphorus (P_2O_5> 5) and nitrate (NO^{3-}> 30ppm). Assessed values of exchangeable cations is; calcium (CaO <2991.1 ppm), magnesium (MgO <2995.1 ppm), and potassium (K_2O> 500 ppm). The analysis of heavy metals showed remarkable concentrations of Pb (26.37 ppm) and Zn (22.37 ppm) with a high pollution index (PLI> 2).

KEYWORDS: Morocco, Chaouia Ourdigha, Settat, sewage sludge, soil, heavy metals.

RÉSUMÉ: Ce travail porte sur une étude de l'impact de l'utilisation des eaux usées dans l'irrigation des sols agricoles. L'objectif principal est de diagnostiquer l'état de pollution métallique de ces sols. Les résultats obtenus sur les échantillons sélectionnés le long de l'oued Boumoussa, (drain naturel des eaux usées de la ville de Settat) se rapportant aux éléments physico-chimiques suivis font ressortir que ces sols sont sablo limoneux avec un pH légèrement basique. La conductivité électrique, paramètre exprimant la charge ionique, varie entre 1100µS/cm à 1500µS/cm ce qui classe ces sols dans la classe 0 (sol non salé). Les valeurs des matières organiques se situent entre 2% et 3,5%. Ces valeurs classent nos sols dans comme étant moyennent pourvus en matière organique. Tandis que leur capacité d'échange cationique (CEC) est très élevée. Les sols étudiés sont riches en phosphore (P_2O_5> 5) et en nitrates (NO^{3-} > 30ppm). Les valeurs évaluées des cations échangeables est ; le calcium (CaO< 2991,1 ppm), le magnésium (MgO<2995,1 ppm), et le potassium (K_2O> 500 ppm). L'analyse des métaux lourds a révélé des concentrations remarquables en Pb (26,37ppm) et en Zn (22,37ppm) avec un indice de pollution élevée (PLI> 2).

MOTS-CLEFS: Maroc, Chaouia Ouardigha, eaux usées, Settat, sols agricoles, éléments traces métalliques.

1 INTRODUCTION

Le sol est un compartiment complexe, un carrefour multifonctionnel, en relation avec la lithosphère, l'hydrosphère, l'atmosphère et la biosphère. Il est le résultat de l'altération, du remaniement et de l'organisation des couches supérieures de la croûte terrestre sous des actions intrinsèques et/ou extrinsèques [1], [2].

Corresponding Author: Abdelhamid BOUZIDI

Les sols agricoles constituent une source de denrées alimentaires, de biomasse et de matières premières, sont besoin plus d'eaux, et à des éléments minéraux pour le développement des plantes afin d'obtenir le meilleur rendement. En fait, l'agriculture consomme plus 70 % des ressources en eaux notamment dans les pays arabes [3].

Au Maroc, dans la région de Settat ou prédomine le climat aride, la pluviométrie demeurent faible et ne suffisent plus les besoins en eau donc, il est normal de se tourner vers des ressources d'eau non conventionnelles pour satisfaire l'accroissement de la demande telles que les eaux usées.

Les eaux usées générées par l'activité industrielles sont utilisées dans l'irrigation des terrains agricoles, continent des éléments nutritifs, notamment en azote, potassium et phosphore, permet de diminuer les frais de fertilisation des sols. Cependant, cette ressource constitue une valeur hydrique et un potentiel d'apport de matières fertilisantes, malheureusement elle peut être également une source de pollution [4], [5], [6]. Son contenu en éléments traces métalliques peuvent présenter un risque sur les cultures et finalement sur les consommateurs [7], [8].

Le problème des sols contaminés est aujourd'hui très préoccupant dans notre pays. Les métaux lourds tels que le plomb, et le zinc, ne peuvent pas être biodégradés et donc persistent dans l'environnement pendant de longues durées. Ainsi, le degré de pollution d'un sol en ETM dépend de sa capacité de rétention principalement liée à ses propriétés physico-chimiques (minéralogie, texture, taux de matière organique, pH…) [9], [10].

De nombreuses études ont montré que le pH est un facteur particulièrement important dans l'adsorption et l'immobilisation des métaux lourds par les sols [11], [12], [13], [14], [15]. La matière organique a des fonctions nutritives d'approvisionnement du sol en N, et en P, et joue un grand rôle dans la rétention des cations et les contaminants organiques. De nombreuses études ont trouvé que les ETM s'accumulent au niveau de la surface organique des sols agricoles [16], [17], [18], [19], [20].

Dans le présent travail nous avons déterminé la fraction disponible en ETM ; le Pb, et le Zn, au niveau des sols des sols agricoles de la région de Settat, en relation avec des paramètres physico-chimiques du sol.

Dans un travail précédent qui s'intéresse à étudier le transfert des éventuels polluants métalliques des eaux usées aux différents organes de mais [21]. Notre étude est en total complémentarité avec cette étude, nous nous envisagé d'étudier le transfert des polluants métalliques des eaux usées vers les lombrics.

2 MATERIEL ET METHODES

2.1 ZONE D'ETUDE

L'expérimentation a été menée dans une exploitation agricole située dans la région de Settat (Figure 1). C'est une région à vocation agricole, appartenant à la plaine de la Chaouia.

Dans son cadre géologique, le site d'étude appartient à une grande unité géologique, dans une cuvette d'âge cénomanien. Il est caractérisé par une dominance des formations marno-calcaire d'âge crétacé moyen et supérieur et des formations quaternaires constituées de limon dont la richesse en galets diminuent en s'éloignant de Settat.

De point de vue pédologique, l'ensemble de la région est pratiquement recouverte de sols iso-humiques. La structure du sol est caractérisée par une dominance du sol Tirs qui représente 84%, tandis que les terres « le Biad » (calcaires) constituent 5.1 %, les Harch représentent 5.3 % et les Rmel (sablonneuses) occupent 5.6 %. Les terres agricoles (SAU) dans la zone est de 14 615 hectares (79% de la superficie totale de la commune, RGA 1996) dont 12,1% sont occupés par des cultures irriguées.

Le climat est semi-aride à hiver tempéré la température maximale moyenne est de 35°C. Dans la région, le total annuel des précipitations est variable d'une année à l'autre mais il tombe en moyenne aux alentours de 350 mm. Le cumul pluviométrique moyen annuel sur la période de 1997 à 2004 est de 346,7mm.

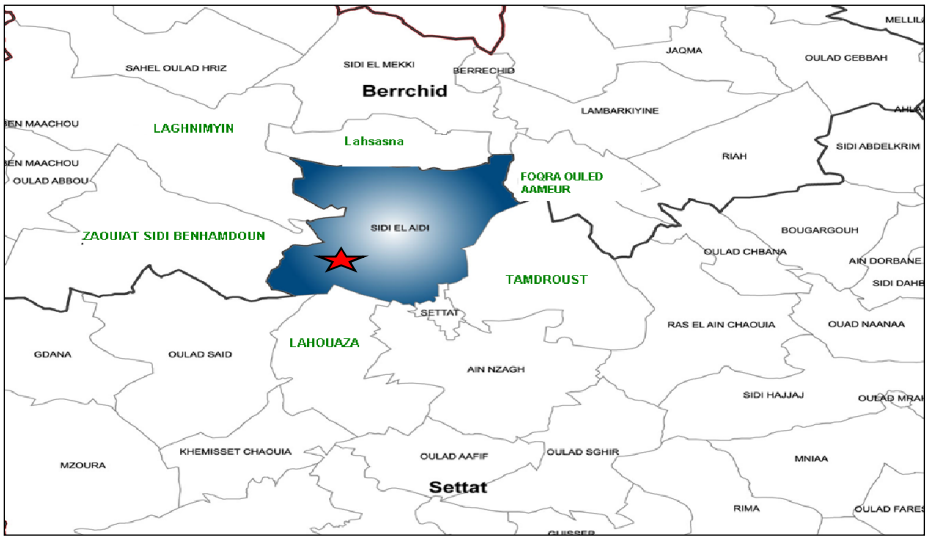


Fig.1. Situation géographique de zone d'étude

★ *Site de l'étude*

2.2 ECHANTILLONNAGE

Pour ce travail, l'échantillonnage a été réalisé en printemps 2013, à partir de deux terrains ; i) un terrain agricole (1) tout près de l'oued Boumoussa, situé dans la région de Sidi El Aïdi, à 7 km de la ville de Settat, ii) un terrain témoin (2) proche de la ville de Berrechid, à 29.85 km de la ville de Settat.

Deux types de prélèvement de sols ont été effectués dans les différentes parcelles sélectionnées (témoins et irriguées) à l'aide d'une tarière hélicoïdale, à quatre niveaux de profondeurs : 0 – 20 cm, 20 – 40 cm, 40-60cm, et 60-80cm. Les échantillons ont été transportés dans des sachets de plastique fermé au laboratoire. Ces échantillons ont été séchés à 40°C pendant trois jours, écrasés au mortier en porcelaine, tamisés en deux étapes à 2 mm et dans une colonne de tamisage entre de 2mm et inférieur à 40 µm, afin de déterminer la texture des sols étudiés, et en dernière étape ces échantillons ont été ensachés pour des déférentes analyses (Figure 2).

Fig. 2. Les différentes étapes de préparation des échantillons

2.3 METHODE D'ANALYSE PHYSICO-CHIMIQUE

Méthode d'analyses	référence
pH	La méthode de MCKEAGUE [22] et La méthode de MCLEAN [23] la norme AFNOR [24]
La conductivité électrique (CE)	La méthode de RICHARDS [25]
La matière organique (MO)	La méthode de WALKLET et BLACK [26] FAO [27]
La capacité d'échange cationique (CEC)	La méthode de RHOADES et POLEMIO [28] FAO [29]
Les Nitrates (NO^{3-})	La méthode de HADJIDEMETRIOU [30] La méthode de SIMS et JACKSON [31]
Le Phosphore	La méthode d'OSLEN [32]
Le calcaire actif	La méthode de DROUINEAU [33]
Les cations échangeables	La méthode de RICHARDS [25]
La texture	Appareil de tamisage Retsch AS200

2.4 METHODE D'ANALYSE DES METAUX LOURDS

La détermination des métaux lourds est réalisée par la méthode L'ICP-AES au Centre National de la Recherche Scientifique et Technique (Rabat), division des Unités d'Appui Technique à la Recherche Scientifique (UATRS). Le laboratoire d'analyses utilise des standards (précis de 1000 ppm de Jobin Yvon) certifiés ISO 9001.

La concentration d'un métal dans le sol représente l'ensemble de ces composés chimique. Le degré de la pollution des métaux lourds dans les sols irrigué par les eaux usées est évalué et comparé à travers l'indice de la charge de pollution (Pollution Load Index (PLI) [34], [35]. Cet indice est basé sur les valeurs des facteurs de concentration des différents polluants dans le sol. Le facteur de concentration (CFi) est le ratio obtenu en divisant la concentration de chaque métal dans le sol par la valeur du fond géochimique (concentration naturelle du métal dans le sol). Cette dernière a été assimilée dans notre étude à la concentration moyenne du métal lourd dans les sols témoins. Pour chaque site échantillonné, l'indice de la charge de pollution (PLI) peut être calculé comme la racine niéme du produit de n facteurs de concentrations. L'indice de charge de pollution (PLI) supérieur à 1 symbolise une pollution.

$$PLI = n\sqrt{CFi \times CFj \times \ldots\ldots . xCFn}$$

Avec

$$CFi = \frac{\text{Fond géochimique du métal i}}{\text{Concentration du métal i}}$$

3 RESULTATS ET DISSCUSSIONS

3.1 PARAMETRE PHYSICO-CHIMIQUE

3.1.1 PH (EAU)

Le pH (eau) : solution préparé à partir du sol dilué dans l'eau distillé est un paramètre physico-chimique du sol très important. Les pH (eau) des sols étudiés enregistre des valeurs comprises entre 8< pH (eau) < 8,75 caractéristiques des sols fortement basiques (calcaires). Ce paramètre augmente significativement vers les profondeurs du sol (60-80cm) (Figure3). Ces résultats obtenus corroborent l'ensemble des données rapportés par d'autre étude [21], qui a enregistré des faibles valeurs de pH en surface par rapport à des niveaux plus profonds au-delà de (60-80cm).

De nombreuses études ont montré que le pH est un facteur de première importance dans l'adsorption et l'immobilisation des métaux lourds par les sols [11], [12], [13], [14], [15]. L'abaissement du pH favorise la mobilité des ETM. Inversement, l'augmentation du pH provoque l'immobilisation par formation de composés insolubles ou accroissement de la capacité d'échange cationique.

L'analyse statistique montre une élévation significative du pH (eau) suite à l'irrigation par les eaux usées. Cette élévation du pH dans les sols irrigués par les eaux usées, peut réduire la disponibilité des cations métalliques dans ces sols.

3.1.2 pH (KCl)

Le pH (KCl) : solution préparé à partir du sol dilué dans l'eau distillé on ajoutant la poudre de KCl symbolise le pH potentiel du sol, il est plus faible que le pH (eau) à cause de la libération dans l'eau des ions H^+ et Al^{3+} préalablement adsorbé sur le complexe adsorbant du sol. Les valeurs du pH (KCl) sont élevées dans les sols irrigués par les eaux usées que dans les sols témoins. Les sols irrigués par les eaux usées sont donc potentiellement moins alcalins que les sols témoins (Figure 4).

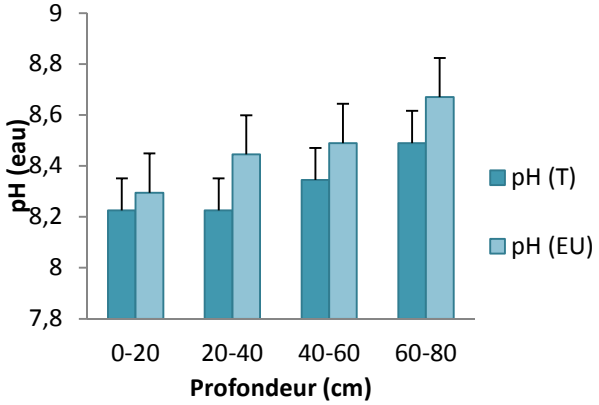


Fig.3. le pH (eau) dans les sols étudiés en fonction de la profondeur
T: Témoin, EU: Eaux usées

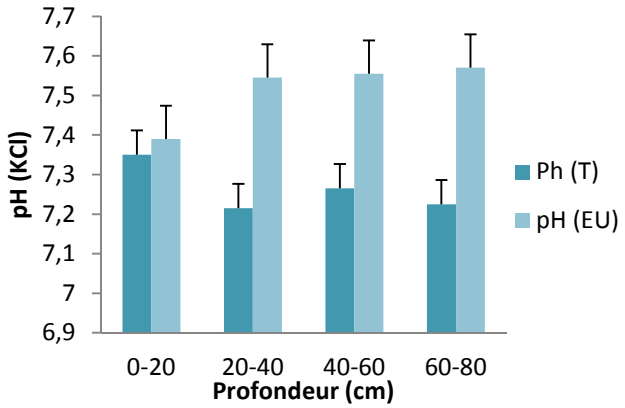


Fig.4. le pH (Kcl) dans les sols étudiés en fonction de la profondeur
T: Témoin, EU: Eaux usées

3.1.3 La conductivité électrique

La salinité des sols est représentée par la concentration des sels minéraux dans le sol, une mesure importante qui affecte la capacité des sols à supporter certaine culture et leur potentiel de production. Les valeurs de la conductivité électrique (CE) sont comprises entre 1,1 < CE< 1,5 mmhos/cm indicateur de la fertilité des sols. Les terrains témoins possèdent une CE plus supérieure à celle des terrains irrigués par les eaux usées. Ces résultats peuvent être expliqués par les pratiques de fertilisation et l'apport des composés minéraux (Figure 5).

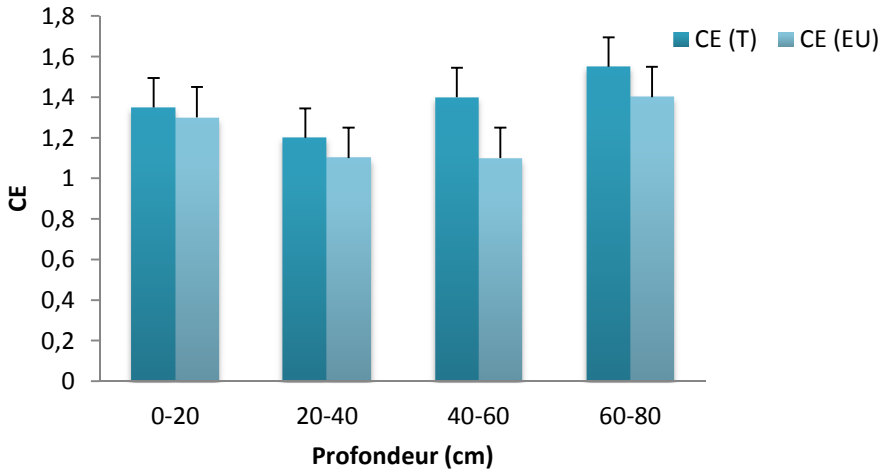


Fig.5. La teneur en CE dans les sols étudiés en fonction de la profondeur
T: Témoin, EU: Eaux usées

3.1.4 LA MATIÈRE ORGANIQUE

La matière organique (MO) a un effet majeur sur les agrégats du sol, la transformation des éléments nutritifs et leurs disponibilités, et la rétention de l'eau.

Nos résultats obtenus ont montré que les sols irrigués par les eaux usées présentent une teneur en MO

(2< MO< 3,5 %) comparable à celle trouvée dans les sols témoins. Cette présence de la MO pourrait être expliquée par l'usage déchets d'élevage par les agriculteurs (Figure 6).

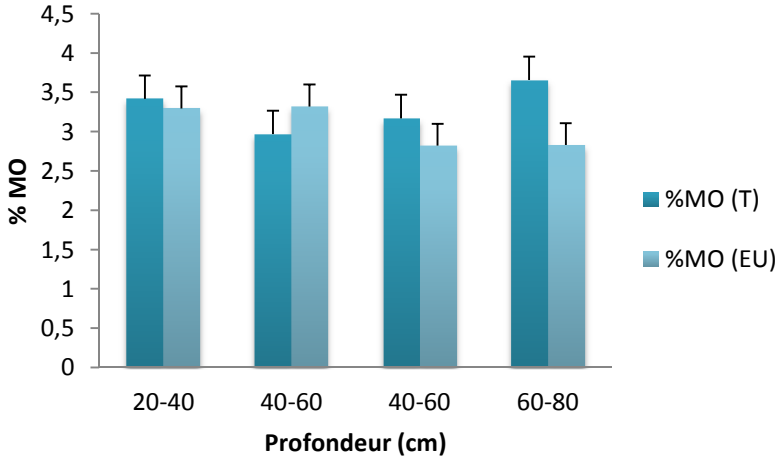


Fig.6. La teneur en matière organique dans les sols étudiés en fonction de la profondeur
T: Témoin, EU: Eaux usées

3.1.5 LA CAPACITÉ D'ÉCHANGE CATIONIQUE

Les valeurs de la capacité d'échange cationique (CEC) des terrains témoins sont élevées par rapport aux terrains irrigués par les eaux usées. Donc les terrains témoins possèdent un meilleur pouvoir adsorbant des cations métalliques. Les valeurs de la CEC sont supérieures à 25 donc les CEC sont très élevés (Figure 7).

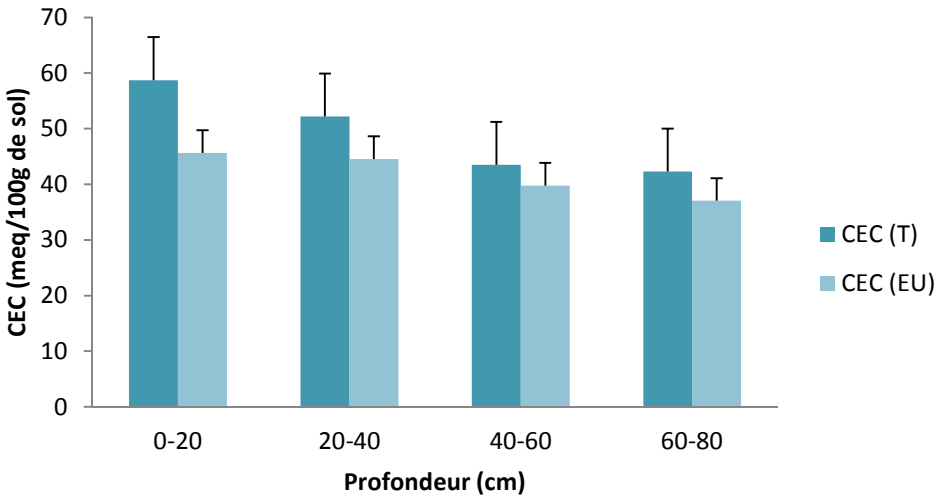


Fig.7. la capacité d'échange cationique dans les sols étudiés selon les profondeurs.
T : Témoin, EU : Eaux usées

3.1.6 CALCAIRE ACTIF ET CATIONS ECHANGEABLE

Le carbonate soit sous forme calcium ou magnésium ou les deux à la fois, se trouvent dans le sol suite aux transformations ou à la décomposition de la roche mère. La plupart des sols des régions semi-arides et arides sont de nature calcaire.

L'analyse statistique montre que les terrains témoins présentent des teneurs en calcaire actif plus importantes par rapport les terrains irriguées par les eaux usées (Figure 8). L'importance des teneurs du calcium et magnésium est la résultante de la nature calcaire des sols étudiés.

La concentration du potassium dans les échantillons extraits des terrains irrigués par les eaux usées est supérieure à celle évalué dans le sol témoin. La référence [36] présente une étude effectuée sur les eaux usées de la ville de Settat a démontré que ces concentrations diminuent graduellement en fonction des profondeurs (Figure 9), et qui a mis en évidence également la présence de forte concentration en potassium variant de 289,9mg/l à 356,06mg/l. Les teneurs en calcium, et magnésium dosés dans la parcelle irriguée par les eaux usées, s'est révélé moins importantes par rapport à la parcelle témoin (Figures 10 et 11).

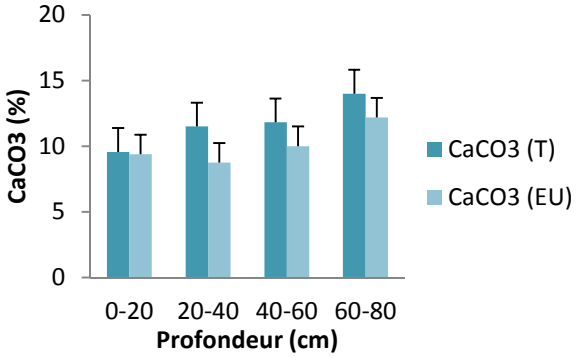


Fig.8. La teneur en calcaire actif dans les sols étudiés
T : Témoin, EU : Eaux usées

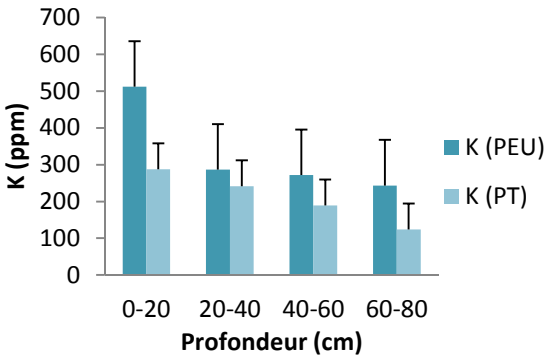


Fig.9. La teneur en Potassium dans les sols étudiés
T : Témoin, EU : Eaux uses

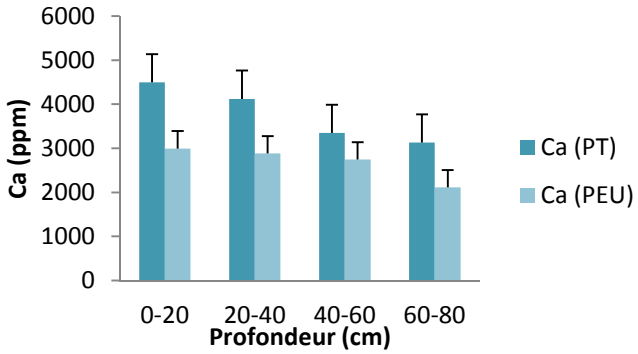


Fig.10. La teneur en calcium dans les sols étudiés en fonction de la profondeur
T : Témoin, EU : Eaux usées

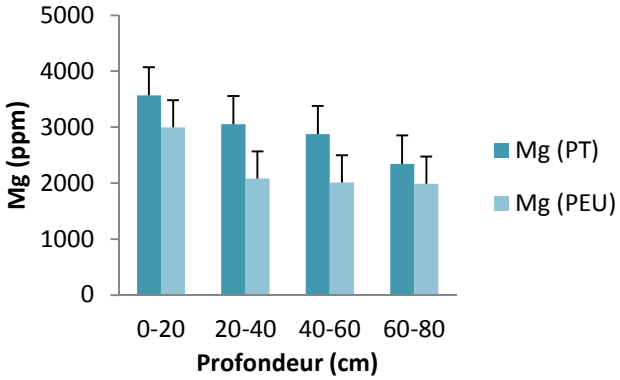


Fig.11. La teneur en magnésium dans les sols étudiés en fonction de la profondeur
T : Témoin, EU : Eaux usées

3.1.7 LA TEXTURE DU SOL

La granulométrie est présentée par une courbe granulométrique qui exprime la répartition de la dimension moyenne des grains sous forme de pourcentage du poids total des matériaux.

Les résultats obtenus à partir du tamisage du sol échantillonné dans les deux types de parcelles : témoin et celle irriguée par les eaux usées, sont présentés sous forme d'un graphe de répartition des différentes fractions granulométriques du sol (Figures 12 et 13).

La répartition granulométrique en fonction des classes texturales présentées, montre que les sols étudiés ont des profils semblables. Ils sont majoritairement composés de fraction comprise entre 63µm- 500µm, alors une texture caractéristique des sables limoneux.

De nombreuses études ont été intéressées à la problématique de la relation texture du sol et sa teneur en éléments traces ([37], [38], [39], 40]). Ces études ont mis en évidence une relation étroite, en démontrant que forte association des éléments traces métalliques à la fraction la plus fine du sol (< 40um).

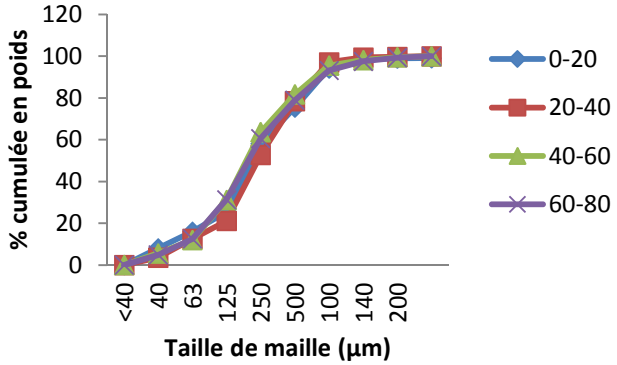


Fig.12. Répartition des différentes fractions granulométriques du sol dans la parcelle irriguée par les eaux usées

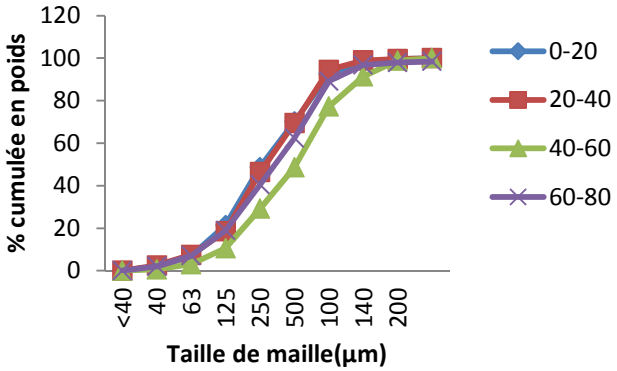


Fig.13. Répartition des différentes fractions granulométriques du sol dans la parcelle témoin

3.1.8 PHOSPHORE ET NITRATES

Le phosphore est élément majeur essentiel à la croissance des plantes. L'analyse de sol pour le phosphore est généralement un indicateur équitablement fiable du besoin des cultures en engrais phosphaté.

Les sols étudiés sont riches d'une manière générale en phosphore assimilable (P_2O_5 > 5ppm). Les valeurs du phosphore sont élevées dans les sols irrigués par les eaux usées par rapport les sols témoins. Cela met en évidence la valeur fertilisante des eaux usées et explique leur utilisation dans l'agriculture (Figure14).

Les sols sont riches en nitrates. Les valeurs des nitrates sont élevées dans les sols irrigués par les eaux usées en comparaison avec les sols témoins (Figure15). L'irrigation par les eaux usées enrichit les sols en éléments nutritifs, en particulier les nitrates et le phosphore. La référence [21] et la référence [41] présentent des résultats similaires pour les nitrates et le phosphore.

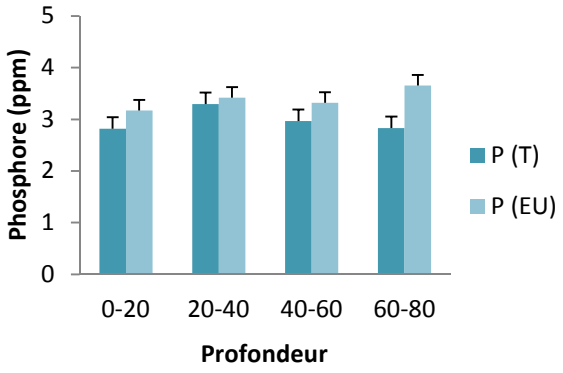


Fig.14. Teneur en Phosphore dans les sols étudiés
T : Témoin, EU : Eaux usées

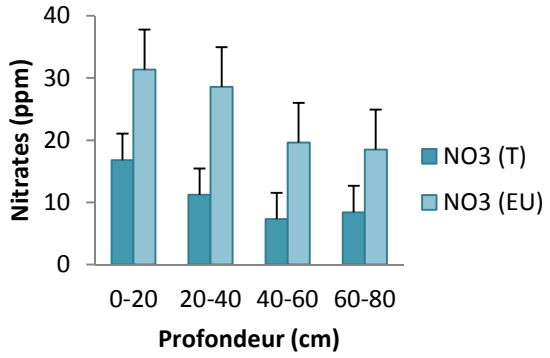


Fig.15. Teneur en nitrate dans les sols étudiés
T : Témoin, EU : Eaux usées

3.2 POLLUTION METALLIQUE DANS LES SOLS

Les résultats des analyses des éléments traces métalliques (Zn et Pb) dans les deux sols (témoins et irrigués) sont présentées dans les deux graphes (Figures 16 et 17). Les concentrations moyennes des métaux lourds dans les couches (0-20 cm), (20-40 cm) et (40-60 cm) des sols irrigués par les eaux usées sont supérieures à celle obtenues dans les mêmes couches des sols témoins (Tableau 1).

Tableau 1: Concentrations (mg/kg) de métaux lourds et les valeurs du PLI (Indice de pollution) à différentes profondeurs des sols irriguées par les eaux usées et les sols témoins

Profondeur (cm)	Pb	Zn	PLI
T. témoins			
0-20	8,09	16,66	-
20-40	9,06	12,22	-
40-60	10,2	12,22	-
T. irriguée par les eaux usées			
0-20	26,37	22,37	2,08
20-40	22,81	19,54	1,99
40-60	20,43	15,5	1,58

Les résultats des analyses ont montré des teneurs relativement élevées en éléments traces métalliques dans les terrains irrigués par les eaux par rapport aux sols témoins (Figures 16 et 17). Cependant ces concentrations dans ces sols irrigués par les eaux usées restent inférieurs aux celles des normes fixées par l'OMS (100ppm pour le Pb et 300ppm pour le Zinc). Ces éléments s'accumulent principalement dans la couche superficielle (0-20 cm).

Ces éléments sont générés par l'activité industrielle de la ville de Settat. Donc, les sols de la région sont riches par les ETM issus des eaux usées [25].

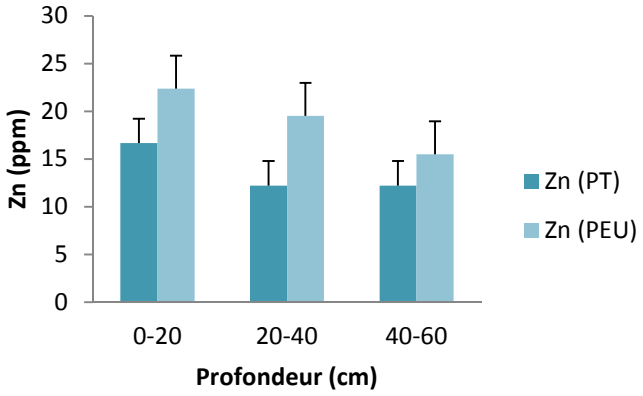


Fig.16. Les teneurs moyennes en Zinc dans les sols étudiés en fonction de la profondeur
PT : Parcelle Témoin, PEU : Parcelle Eaux usées

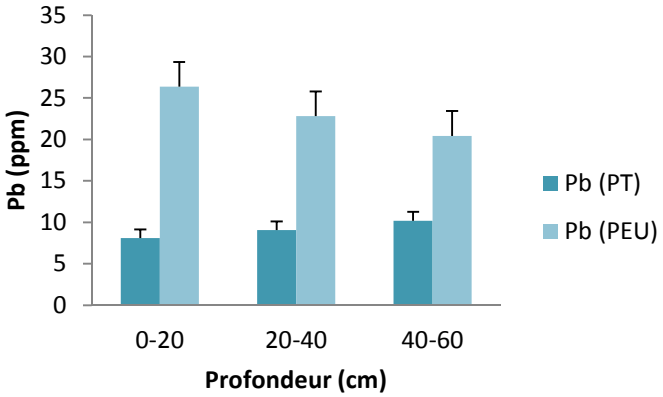


Fig.17. Les teneurs moyennes en Plomb dans les sols étudiés en fonction de la profondeur
PT : Parcelle Témoin, PEU : Parcelle Eaux usées

L'indice de pollution révèle que les terrains irrigués par les eaux usées sont en moyenne deux fois plus pollués que les terrains témoins, et baisse dans les couches inférieurs du sol (Tableau 1). Cela s'explique par la répartition verticale des ETM, plusieurs paramètres interviennent pour expliquer ce résultat notamment la MO, CEC, la texture des sols étudiés. Les teneurs élevée en MO aboutit à la fixation des ETM sous forme de complexe organométallique, ensuite les sols étudiés est de nature calcaire présente des teneurs élevées en Ca ce qui participe à la formation des complexes carbonates-métaux lourds [16].

4 CONCLUSION

Les résultats de cette étude montrent que les eaux usées utilisées sont très riches en matière organique et en éléments fertilisants (N, P). Le pH de ces eaux est légèrement basique. La charge ionique du sol est caractérisée par une conductivité électrique moyenne de l'ordre de 1500µS/cm ce qui classe ces sols dans la classe 0 c'est-à-dire sols non salé.

Les résultats des éléments métalliques montrent que les sols étudiées présentent des teneurs élevés en EMT par rapport aux sols témoins et restent en dessous des normes fixées par l'OMS (100ppm pour le Pb et 300ppm pour le Zinc), et se concentrent dans la couche en surface (0-20 cm).

L'indice de pollution calculé dans les trois niveaux manifeste des valeurs élevé dans les sols irriguées par les eaux usées.

REMERCIEMENTS

Je remercie très sincèrement Monsieur A.BOUZIDI, directeur de ma thèse qui m'a cessé de me guider et de prodiguer ses conseils judicieux, et aussi je remercie les évaluateurs pour leurs remarques qui vont permis d'améliorer la première version du manuscrit.

REFERENCES

[1] GOBAT J., ARAGNO M., & MATTHEY W, Le sol vivant, bases de pédologie, biologie des sols, (1998).
[2] LOZET J., MATHIEU C., Dictionnaire de Science du Sol. Lavoisier, 269p, (1997).
[3] HAMODA M.F., Water strategies and potential of water reuse in the south Mediterranean countries. Desalination 165, 31-41, (2004).
[4] MORIYAMA K., MORI T., ARAYASHIKI H., SAITO H. & CHINO M., The amount of heavy metals derived from domestic wastewater. *Wat. Sci. Tech.*, 21, 1913-1916, (1989).
[5] THEISSEN G., Eaux usées et maraîchage. Attention aux métaux lourds et aux exigences sanitaires. *Nouvelles économiques, Afrique Agriculture*, 232, p. 12, (1995).
[6] T.S.M., La réutilisation des eaux usées après épuration. Février, 2, 81-118, (1996).
[7] Kabata-Pendias A., Pendias H. Trace Elements in Soils and Plants. CRS Press, Boca Rator, pp. 1-87, 131-141, (2001).
[8] GONZALO M.A., L'évaluation de la terre végétale oligo-élément pollution à proximité d'une usine de ciment et d'une ancienne mine d'uranium à ciel ouvert dans le centre de l'Argentine journal home (2010).
[9] MORAL R., GILKES R.J., JORDAN M.M, Distribution of heavy metals in calcareous andnon-calcareous soils in Spain. Water, Air and Soil Pollution. 162, 127–142, (2005).
[10] SORIANO A., PALLARES S., PARDO F., VICENTE A.B., SANFELIU T., BECH J., Deposition of heavy metals from particulate settle able matter in soils of an industrialized area. Journal of Geochemical Exploration, (2011).
[11] ELLIOT H.A., LIBERATY M.R. & HUANG C.C., Competitive adsorption of heavy metals by soils. J. Environ. Qual. 15 : 214-219, (1986).
[12] HARTER, R.D., Congenital Minamata disease: intrauterine methylmercury poisoning. *Teratology*, 18, 285- 288, (1983).
[13] GUADALIX M.E.& PARDO M.T., Zinc sorption by acid tropical soils as affected by cultivation. European J. soil SCI. 46:317-322, (1995).
[14] STAHL R.S.& JAMES B.R., Zinc sorption by B horizon soils as function of pH. Soil.Sci.Sco.Am.J. 55 : 1592-1597, (1991).
[15] VAN BLADEL R., GODFRIN J.M. & CLOSS P., Influence des propriétés physico-chimiques des sols sur l'adsorption des métaux lourds cuivre et zinc. Revue de l'agriculture, 41(3): 729-744, (1988).
[16] BERMUDEZ et al., Heavy metal pollution in top soils near a cement plant: The role of organic matter and distance to the source to predict total and HCl-extracted heav metal concentrations, (2010).
[17] DRAGOVIC S., MIHAILOVIC N., GAJIC B. Heavy metals in soils: distribution, relationship with soil characteristics and radionucleids and multivariate assessment of contamination sources. Chemosphere. 72, 491–495, (2008).
[18] FORSTNER U., Chemicals forms ans reactivities Of metals in sediments. In chemical methods for assessing bio-available metals in sludges ans soil, Leschber R., Davis R.D., L'Hermite P. CEC. Elsevier Applied Science publishers. 1-30, (1985).
[19] HERNANDEZ L., PROBST A., PROBST J.L., Ulrich E. Heavy metal distribution in some French forest soils: evidence for atmospheric contamination. Sci. Total Environ. 312, 195–219, (2003).
[20] MICO C., RECATALA L., PERIS M., SANCHEZ J., ASSESSING heavy metal sources in agricultural soils of an European Mediterranean area by multivariate analysis.Chemosphere 65, 863–872, (2006).
[21] TOMGOUANI. KAO., Evaluation de la pollution métallique dans les sols agricoles irrigués par les eaux usées de la ville de Settat- Etude du transfert de polluants métallique SOL-MAIS. Thèse de Doctorat. Univ. Settat. Maroc, 73p, (2009).
[22] MCKEAGUE, J.A., (ed.), In manual on soil sampling and methods of analysis. Canadian Society of soil Science: 66-68, (1978).
[23] MC LEAD E.O., pH and lime requirements. In: Page, A.L. et al. (Eds.), Methods of Soil Analysis, Part 2, second ed., Agronomy, vol. 9 Soil Society of America, Madison, WIpp. 199–244. (1982).
[24] AFNOR. Qualité des Sols. Recuil de Normes Françaises, (1994).
[25] RICHARDS, L.A., Diagnosis and improvement of saline and alkali soils. USDA Agrie. Handbook 60. Washington D.C., (1954).
[26] WALKLEY A., and BLACK I.A., An examination of the Degtjareff method for determining organic carbon in soils: Effect of variations in digestion conditions and of inorganic soil constituents. Soil Sci. 63:251-263, (1934).
[27] FAO, The Euphrates Pilot Irrigation Project. Methods of soil analysis, Gadeb Soil laboratory (A laboratory manual), (1974).

[28] RHOADES, J.D. and POLEMIO, M., Determining cation exchange capacity; a new procedure for calcareous ans gypsiferous soils. Soil Sci. Soc. Am. J.41:524-300, (1977).
[29] FAO, Management of gypsiferous soils. Soils Bull. 62, Food and agriculture Organisation, Rome, (1990).
[30] HADJIDEMETRIOU, D.G., Comparative study of the determination of nitrate in calcareous soils bay the ion-selective electrode, chromotropic acid and phenodisulphonic acid methods analyst 107: 25-29, (1982).
[31] SIMS, J.R. and JACKSON, G.D., Rapid analysis of soil nitrate with chromotropic acid. Soil Sci. Soc.Am. Proc. 35 : 603-606, 1971.
[32] OLSEN, S.R., COLE, C.V., WATANEB, F.S. et DEAN, L.A., Estimation of available phosphorus in soils by extration with soduim bicarbonate. U.S. Dep.Agric.Circ. USA.939, (1954).
[33] DROUINEAU, G., Dosage rapide du calcaire actif du sol. Nouvelle données sur la reportation de la nature des fractions calcaires. Ann. Agron. 12 :411-450, (1942).
[34] TOMGOUANI KAO, EL MEJAHED, K., BOUZIDI, A., Evaluation de la pollution métallique dans les sols agricoles irrigués par les eaux usées de la ville de Settat (Maroc). *Bulletin de l'Institut Scientifique,* Rabat, section Sciences de la Vie, n°29, 89-92, (2007).
[35] LEE C.G., CHON H.T. & JUNG M.C., Heavy metal contamination in the vincinity of the daduk Au-Ag-Pb-Zn mine in Korea. Applied Geochemistry, 16: 1377-1386, (2001).
[36] KHOLTEI S., *Plaine de Berrechid :* caractérisation des eaux usée de Settat ; évaluation de leur impact sur la qualité des eaux souterraines et risque toxicologique. Thèse Univ. Casablanca, 162 p., (2002).
[37] CORNELIS C. & GEUZENS P., Achtergrondgehalten vaneen aantal anorganische enorganische Veron- treinigingen in vlaamse bodems- voorstel voorre ferentiewaarden. Rapport MIE/DI/9327. VITO. Afdeling Leefmilieu. 42p, (1993).
[38] COTTENIE A., VERLOO M., KIEKENS L, La situation des sols belges en éléments traces. In compte rendu de la semaine d'étude sol et fertilisation, 3-7 sept. 1973. Bull. Rech. Agron. Gembloux, p. 180-190, (1974).
[39] DE TEMMERMAN LO., ISTAS JR., HOENIG M., DUPIRE S., LEDENT G., VAN ELSEN Y., bAETEN H., MEYER A., Définition des teneurs « normales » des éléments en trace de certains sols belges en tant que critère de base pour la détection et l'interprétation de la pollution des sols en général. Rev ; Agric. 35 (2), p. 1915-1944, (1982).
[40] PETIT J.P. & DEFOUX J., Inventaire de la qualité des sols en Région wallonne. Rapport de l'office Wallon des déchets-Direction de la protection des sols-DGRNE –MRW. 16p, (2001).
[41] FAIZ M, Etude de l'impact de l'utilisation des eaux usées dans l'agriculture des sols de la province de Settat : diagnostic d'une contamination par les métaux lourds. Mémoire de DESA. UFR. APA. Univ. Hassan 1er. Settat. Maroc. 77p, (2005).

International Journal of Innovation and Scientific Research
ISSN 2351-8014 Vol. 17 No. 2 Aug. 2015, pp. 264-270
© 2015 Innovative Space of Scientific Research Journals
http://www.ijisr.issr-journals.org/

SOLID WASTE HERE AND THERE: THE EFFECTS ON PUBLIC HEALTH AND THE ENVIRONMENT

Forson Bekoe-Nketia

Department of Geography and Rural Development,
Kwame Nkrumah University of Science and Technology, Kumasi, Ghana

Copyright © 2015 ISSR Journals. This is an open access article distributed under the ***Creative Commons Attribution License***, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT: In African countries including Ghana, where there is increasing urbanization, solid waste management constitutes one of the most crucial health and environmental problem in most towns and cities. The situation is similar in the Tain District, where the rapid pace of urbanization has come with a rapid increase in the volume of solid waste generated from production and consumption activities. In addition, the recent proliferation of polythene bags for packaging food, water and other packageable goods has seriously aggravated the situation in the district. This study examined the effects of improper solid waste management on public health and the environment in the Tain District. Interview schedule and field observation were the main tool and method respectively for gathering data from 152 households and 4 key informants which were selected through the convenient and purposive sampling techniques. Data gathered from the households was analyzed using Statistical Product for Service Solution and Excel software. In addition, content analysis was employed to analyze data gathered from the key informants. The findings indicate that air pollution, outbreak of diseases, flooding and river contamination are the major effects of improper solid waste management in the study communities. Based on these findings, the study recommends that the Waste Management Department and the Environmental Health and Sanitation Units should enforce the waste management legislations in the Tain District. In addition, an introduction of waste management into the school curriculum will enable the country have a generation with a new mindset towards the huge volumes of solid waste we generate in our neighborhoods.

KEYWORDS: Solid waste, Environment, Health, Urbanization, Effect, Threat.

1 INTRODUCTION

Events of the 20th and early into the 21st century show that waste in whatever classification whether solid, liquid or toxic has become a major consequence of urbanization and economic development [1]. Whilst in the past, solid, liquid and toxic waste disposal was perceived as problems of over development; [2] today the question of urban waste management poses a daunting task to developing countries. Correspondingly, when the governments of African countries were required by the World Health Organization (WHO) to prioritize their environmental health concerns, the results revealed that solid waste was identified as the second most important problem after water quality [3]. According to Ole Lyse, nine out of every 10 African cities are facing serious waste management problems [4]. Ghana is no exception [5] where solid waste management is a particularly critical issue that seems to overwhelm the authorities. In fact, the problem appears stubborn and can be likened to a 'monster' staring the authorities in the face while they look on helplessly [5]. Similarly, [6] has referred to it as "a nightmare" and it would seem that many of the Millennium Development Goals (MDGs) are far from achievable by the target year of 2015 in the waste-laden city environments. This is because the effects of improper solid waste management somewhat affects the MDGs, particularly including improving child health and mortality (Goal 4), maternal health (Goal 5), the incidence of malaria and other diseases (Goal 6) and environmental sustainability (Goal 7). Irrespective of the copious awareness creation exercises by the Environmental Protection Agency, the Waste Management Department, the Zoomlion Ghana Limited and Assembly Members all the districts in the Brong Ahafo Region of Ghana with the inclusion of the Tain District, the solid waste management situation in the district continue to worsen thereby posing serious threat to public

Corresponding Author: Forson Bekoe-Nketia

health and the environment. Besides, the environmental burdens including air pollution, bad odour from rotten organic materials and contamination of water bodies associated with the worsening solid waste management situation appears to fall more heavily on the poor even though waste removal and disposal are public funded and regulated. Despite the immensity of the problem, no in-depth research on solid waste management has been carried out in the Tain District. This situation creates a knowledge gap and makes it difficult to find answers to the worsening solid waste situation in the district. As such, the paper aims at filling the research gap on the effects of improper solid waste management and provides a baseline data that will stimulates further research on the subject matter.

1.1 METHODS

The study gathered data from both primary and secondary sources. The secondary source of data was obtained from both published and unpublished materials especially from thesis, articles, journals, internet sources, periodicals, and textbooks. Primary data was also collected through the use of interview schedule and field observation (photographic evidence). Non-probability methods of sampling were used in selecting the respondents for the study. The specific non-probability sampling methods used in this study included the convenient and the purposive sampling methods. The convenient sampling technique was used in selecting the 152 households for the survey. The criteria for selection of households were based on readiness and willingness to be interviewed. The interviewer visited and interviewed heads of households in the three selected localities who were readily available and willing to be interviewed. This procedure was followed until the required number of households for the study was reached. Also, in selecting the key informants for the study, the purposive sampling technique was used. The key informants identified and interviewed included the heads of the Environmental Health and Sanitation units, Waste Management Department of the Tain District Assembly, Zoomlion Ghana Limited and Assembly members. In this case, the above mentioned stakeholders had the necessary information, adequate knowledge and experience on solid waste management in the study area. Data analysis was done using both qualitative and quantitative methods. Quantitatively, descriptive statistical tools such as frequencies and percentages of the Statistical Product for Service Solution (SPSS) and Excel software were used. The results were presented in the form of tables and charts (bar charts). Qualitatively, content analysis was used, that is, aggregate responses from respondents were also analyzed manually by making summaries of the respondents' views and supported them with relevant quotations and my own field observations of the solid waste situations in the three selected communities.

1.2 SAMPLING PROCEDURE

The research was conducted in three communities in the Tain District namely: Seikwa, Badu and Nsawkaw. Purposive sampling was used to select the communities because of proximity and the fact that they are the major urban centers in the district. A formula given by [7] was used to determine the sample size for the study.

$$n = \frac{\mathrm{N}}{1 + N(a)^2}$$

Where 'n' is the sample size, 'N' is the sample frame (5,627) and 'α' represented the margin of error which is 0.08, with confidence level of 92 percent. A sample size of one hundred and fifty-two (152) was arrived as follows:

$$n = \frac{5627}{1 + 5627(0.08)^2} \quad = 152$$

The household heads in each study locality were selected proportionally based on the population of each community. The household heads were covered using the convenient sampling technique. Also, to ensure that the number of households interviewed in each of the study community is proportionate, the simple proportion method was used. First, percentages were calculated by dividing the number of households in each of the study communities by the sample frame (the total number of households) which is 5,627 and then the figures obtained were multiplied by 100 percent. The percentages were calculated as follows:

$$\text{Seikwa} = \frac{1840}{5627} * \ 100 = 32.7$$

The same procedure was used to calculate for the remaining study communities. Furthermore, the percentages obtained for each study community was then multiplied by the sample size to attain the actual number of households which were interviewed in each of the study communities. The sample size for each study community was computed as follows:

$$\text{Seikwa} = \frac{32.7}{100} * \ 152 = 50$$

Table 1.1 captures the details of the calculations. Moreso the key informants such as the heads of the Environmental Health and Sanitation units, Waste Management Department of the Tain District Assembly, Zoomlion Ghana Limited were also chosen by means of purposive sampling whilst both the convenient sampling technique was use to select the Assembly members in the study localities.

Table 1.1: Proportionate sampling of households for each of the study communities

Community	Number of Households	Percent (%)	Sample size
Seikwa	1,840	$\frac{1840}{5627} * 100 = \mathbf{32.7}$	$\frac{32.7}{100} * 152 = \mathbf{50}$
Badu	2,859	$\frac{2859}{5627} * 100 = \mathbf{50.8}$	$\frac{50.8}{100} * 152 = \mathbf{77}$
Nsawkaw	928	$\frac{928}{5627} * 100 = \mathbf{16.5}$	$\frac{16.5}{100} * 152 = \mathbf{25}$
Total	5,627	100	152

Source: Fieldwork, March, 2012

2 FINDINGS AND DISCUSSION

2.1 EFFECTS OF IMPROPER SOLID WASTE MANAGEMENT

According to [8], improper solid waste management creates severe environmental problems that affect human health and cause serious economic and other welfare losses. Therefore in order to address the objective of identifying the effects of solid waste management in the study communities, respondents were interviewed and the following responses in table 2.1 were obtained.

Table 2.1: Respondents perceptions on the effects of improper solid waste management

Consequences	Frequency	Percent
Air pollution	52	34.2
Bad impression that the people who live in that area are dirty	34	22.4
Contamination of water bodies	17	11.2
Outbreak of diseases	41	26.9
Flooding	8	5.3
Total	152	100

Source: Fieldwork, March, 2012

From table 2.1, 34.2 percent (majority) of the respondents said the principal effect of improper solid waste management in the study communities is air pollution or the bad odour they inhale from rotten organic materials and smoke during the burning of solid waste at the dumpsites. This confirms [8] findings that fires on disposal sites can cause major air pollution, causing illness and reducing visibility, making disposal sites dangerously unstable, causing explosions of cans and possibly spreading to adjacent property. Again, it confirms finding of [9], [10] that solid waste is considered to be one of the dangerous causes of pollution; therefore this problem has to be treated in a wise manner to protect our environment. Plate 2.1 shows smoke emanating from a dump site in Nsawkaw, thus causing air pollution.

Plate 2.1: Burning of solid waste at a dumpsite in Nsawkaw

Source: Fieldwork, March, 2012

Also, 26.9 percent of the respondents claimed poor solid waste management in the study communities leads to the outbreak of diseases. According to the respondents, improper handling of solid waste provides habitat for flies and rodents (mice) who intern collects germs and deposit them on bowls, cups and tables in their homes, and create disease. The responses given however were not from individuals with technical understanding about diseases, but informal information. Furthermore, 34 respondents representing 22.4 percent of the sample size (152) stated that improper handling of solid waste creates bad impression that they are filthy. This is because in Ghanaian societal settings, cleanliness is generally embraced as a virtue and so if a particular household or community goes contrary to this norm, that particular household or community is regarded as dirty or filthy. Again, some respondents said plastic and paper blowing over fields or trapped by trees has an unwanted visual impression on the study communities. Moreso, 11.2 percent of the respondents pointed out that improper solid waste management leads to the contamination of water bodies in their communities. According to the respondents, when it rains, the run-off conveys solid waste into rivers and streams in the study communities making the water unhealthy to use. Finally, 5.3 percent of the respondents said the main effect of improper solid waste management is flooding. This could mean that improper solid waste management contributes to the clogging of gutters and leads to floods when there is torrential rainfall. Plate 2.2 shows a clogged gutter at the entrance of the Seikwa Health Centre which always leads to flooding whenever it rains.

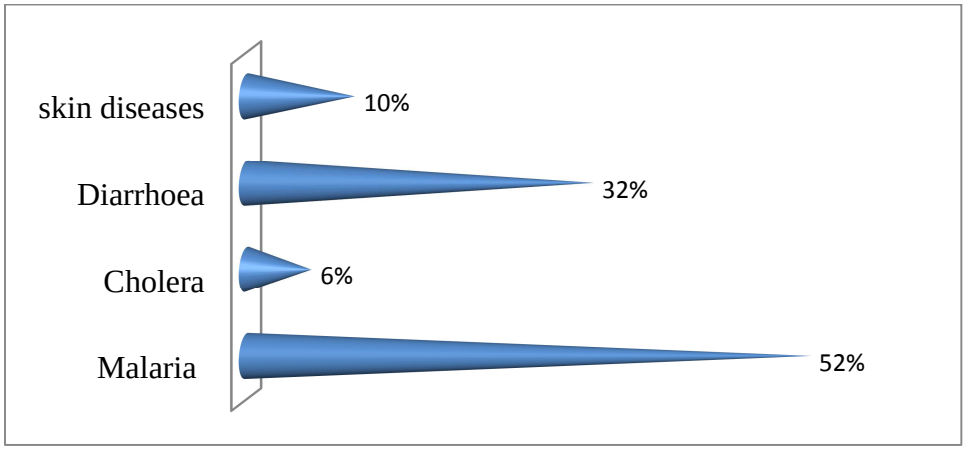
Plate 2.2: A clogged gutter at the entrance of the Seikwa Health Centre

Source: Fieldwork, March, 2012

2.2 COMMON ENVIRONMENTAL DISEASES IN THE STUDY COMMUNITIES

Reference [11] stressed that improper handling of solid waste does not only ruins an area's appearance but also provide comfortable breeding grounds for organisms that spread diseases. According to the environmental health and sanitation inspectors in the study communities' malaria, diarrhoea, cholera and skin diseases are the common diseases resulting from the improper handling of solid waste. Therefore in an attempt to ascertain the frequent diseases that affect the residents in the study communities a subsequent question was posed. The responses are displayed in figure 2.1.

Figure 2.3: Perceived environmental diseases in the study communities



Source: Author's fieldwork, March, 2012

From figure 2.1, majority of the households (52 percent) said the common environmental disease resulting from the improper management of solid waste in the study communities is malaria. It was revealed during the study that in the beginning of wet season when all the solid waste and faeces are soaked with water, it becomes ideal for insect breeding. The population of mosquitoes and flies increases tremendously resulting in diseases such as malaria, diarrhoea, cholera and other skin diseases. This also confirms finding of the data obtained from the Tain District Database which indicated that 76.8 percent of the people in the district suffer from malaria representing 50.8 percent of total out-patient departmental cases [12]. Thirty-two (32%) percent of the households said diarrhoea. Six (6%) percent claimed it is cholera while the remaining 10 percent said skin diseases. This could mean that if effective measures are not put in place to manage waste collection and disposal, there will be an increase in diseases like malaria, diarrhoea among others in future.

3 SUMMARY OF MAJOR FINDINGS

- The paper reveals that the taxonomy of the effects of improper solid waste management in the study communities are air pollution or the bad odour they inhale from rotten organic materials and smoke during the burning of solid waste at the dumpsites, outbreak of diseases, creates bad impression that they are filthy, contamination of water bodies and flooding.
- The common environmental disease resulting from the improper management of solid waste in the study communities as disclosed in this paper are malaria, diarrhoea, cholera and other skin diseases.

4 CONCLUSION

The study concludes that improper solid waste management has devastating adverse effects on the physical environment which consequently affects public health.

5 RECOMMENDATIONS

Based on the findings of the study, the following measures are recommended to minimize the devastating adverse effects of improper solid waste management on the environment and public health in the study localities (Seikwa, Badu and Nsawkaw).

- The Integrated Solid Waste Management (ISWM) should be adopted to ensure effective solid waste management in the study localities. Households should be encouraged by the Waste Management Department (WMD) and the Zoomlion Ghana Limited to segregate the solid waste generated into their various types before disposal. In this case metals, bottles and rubber cans can be reused while plastic wastes like polythene bags and pure water sachets can also be recycled. The rest like organic waste such as remnants of cassava, yam, plantain and cocoyam can be used to feed livestock and the rest composted. Finally, those (solid waste) that are combustible can be incinerated and landfilled those (solid waste) that cannot be subjected to any of the above mentioned methods.
- The research has shown that the people in the study communities have an unsatisfactory solid waste handling background which aggravates the solid waste management problem in the study areas. However, to avert this unsatisfactory attitude of the people, the stakeholders must firmly enforce existing regulations on solid waste disposal such as street littering and other crude methods adopted by the residents in the study areas. This can also be done by restraining under-aged children between the ages of 12-5 years who do not know the effects of indiscriminate solid waste disposal, from handling household waste in the study areas. Moreover, once dust or litter bins are placed at all vantage points within the communities, there will be no excuse for persons who engage in indiscriminate solid waste disposal practices. Appropriate punishment for waste disposal offences should include court fines, orders to clean up the streets and imprisonment depending on the severity of the offence committed. Also, nepotism should be disregarded when punishing offenders. Such measures could change the bad ways people in the study areas dispose of the solid waste they generate.
- Public education on solid waste management should be taken as a national assignment. The introduction of the Solid Waste Management into the School curriculum will enable the country have a generation with a new mindset towards the large quantities of solid waste we generate in our neighborhoods. Also, more sanitation clubs should be formed by all the companies or institutions who are into waste management and in the food and beverage industry to help clear the large quantities of solid waste they generate. The fact that all Ghanaians belong to the various religious groups (Christians, Muslims and traditional) means that religious organizations should be made important avenues for environmental education. Stakeholders must, therefore, build partnerships with religious leaders and encourage them to

educate their members on environmental sanitation and proper solid waste management practices such as solid waste separation, reuse, and recycling, composting and proper waste disposal. Besides, the Tain FM located in Nsawkaw, should be used to raise awareness among the general public on the importance of maintaining a clean and healthy environment.

REFERENCES

[1]. Tsiboe, I. A. and Marbell, E. (2004). *A Look at Urban Waste Disposal Problems in Accra.* Roskilde University, Denmark.

[2]. United Nations Environmental Programme (UNEP) (2009). Developing Integrated Solid Waste Management Plan Training Manual, Volume 2: Assessment of Current Waste Management Systems and Gaps Therein. Osaka/Shiga, Japan.

[3]. Senkoro, H. (2003). Solid Waste Management in Africa: A WHO/AFRO Perspective, Paper 1, presented at the CWG Workshop in Dar es Salaam March 2003. (http://www.skat.ch/sfweb/activities/ws/cwg/pdf/cwg-01.pdf). Accessed on 18/02/2011.

[4]. Lyse, O. (2003): Waste disposal haunts cities. *The Times of Zambia* (Ndola). Retrieved from, Allafrica.com/stories

[5]. Kironde, J. M. L. (1999). Dar es Salaam, Tanzania. *Onibokun, A. G. (Ed).* Managing the monster: urban waste and governance in Africa. Pp. 101-172. Ottawa, IDRC.

[6]. Baabereyir, A. (2009). Urban Environmental Problems in Ghana. A case study of social and environmental injustice in solid waste management in Accra and Sekondi-Takoradi. NTNU, Norway. Pp.5&6.

[7]. Gomez, B. and J. P. Jones III (2010). Research Methods in Geography: A Critical Introduction. A John Wiley & Sons, Ltd., Publication, the Atrium, Southern Gate, Chichester, West Sussex, PO19 8SQ, United Kingdom.

[8]. Kolsch, F., and Ziehmann, G. (2004). Landfill stability risk and challenges. URL:http://www. Jxj.com/wmw/index.html

[9]. Al-Yaqout, A. E, Kouski, P. A and Hamoda, M. F. (2002). Public opinion and sitting solid waste landfills in Kuwait. Resources Conservation and Recycling 35:215-227

[10]. Vidanaarachchi, C. K., Yuen, S. T. S. and Pilapitiya, S. (2005). *Municipal solid waste management in Southern Province of Sri Lanka: Problems, issues and challenges.* Waste Management.

[11]. Goldsmith, B. (1988). Newsweek Magazine, June 2 issue, pp. 89 and 161.

[12]. Ghana Districts Database (2011), *the repository of all districts of the republic of Ghana.* [Online] http://www.ghanadistricts.com (accessed: September 27, 2011)

International Journal of Innovation and Scientific Research
ISSN 2351-8014 Vol. 17 No. 2 Aug. 2015, pp. 271-277
© 2015 Innovative Space of Scientific Research Journals
http://www.ijisr.issr-journals.org/

Speech to Text Conversion in Real-time

Nuzhat Atiqua Nafis[1] and Md. Safaet Hossain[2]

[1]Department of Electronic and Telecommunication Engineering,
University of Development Alternative,
Dhaka, Bangladesh

[2]Department of Computer Science and Engineering,
University of Development Alternative,
Dhaka, Bangladesh

Copyright © 2015 ISSR Journals. This is an open access article distributed under the ***Creative Commons Attribution License***, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT: "Real time speech to text" can be defined as accurate conversion of words that represents uttered word instantly after speaking. Speech-to-text-conversion is a useful tool for integrating people with hearing impairments in oral communication settings, e. g. counseling interviews or conferences. However, the transfer of speech into written language in real time requires special techniques as it must be very fast and correct to be understandable. Our aim is to develop software that enhances the user's way of speech through correctness of pronunciation following the English phonetics. This software allows one to learn, judge and recognize their potential in English language. It also facilitates an extra add-on feature which nourishes the user's communication skills by an option of text to speech conversion also. The paper introduces and discusses different techniques for speech to text conversion and its process that described in complement with the options that are already in use. This paper presents a method to design a Text to Speech con version module by the use of Matlab. This method is simple to implement and involves much lesser use of memory spaces.

KEYWORDS: speech to text, properties of speech, Speech to text system, another way of data entry, makes communication easier for handicapped users, natural language processing.

1 INTRODUCTION

For past several decades, designers have used or processed speech for different applications. Speech recognition reduces the difficulties and problems caused by other communication methods. In the past speech has not been used much in the field of electronics and computers. However, with modern processes, algorithms, and methods we can process speech signals easily and use it in our desirable fields. Our speech-to-text engine directly converts speech to text. It can complement the idea giving users a different choice for data entry. Our speech-to-text engine can also provide data entry options for blind, deaf, or physically handicapped users. Text-to-speech convention transforms linguistic information stored as data or text into speech. It is widely used in audio reading devices for blind people now a days [1].In the last few years however; the use of text-to-speech conversion technology has grown far beyond the disabled community to become a major adjunct to the rapidly growing use of digital voice storage for voice mail and voice response systems. Also developments in Speech synthesis technology for various languages have already taken place [2] [3]. Many speech synthesizers using complex neural networks have also been designed [4]. In the bigger picture, the module can open up a window of opportunities for the less privileged paving the way for a plethora of employment opportunities for them in the job sector. It can also play a defining role in establishing communication of the blind if it is incorporated into mobile phones (so that text messages could be converted into speech). [5] [6]. The existing system deals with various dictionaries, which implements dictation of words with correct pronunciation. It supports the operation, only for a set of words, which are available in the dictionary. The availability of such software doesn't eradicate the problem, which is being discussed in the picture. The system speaks out the selected

Corresponding Author: Md. Safaet Hossain

word, which the user wishes to listen to. The current system is focused more on polishing the pronunciation from better to best and not focused to bringing up someone from nothing to best.

2 PROPERTIES OF SPEECH

The most natural way to communicate for human beings is through words. Human respiratory and articulator systems which consist of different organs and muscles generate speech [8][9]. Coordinated action of these speech production organs creates speech. The speech or voice can be categorized in many ways. In general, the following ways are mainly analyzed: acoustic, phonetic, phonological, morphological, syntactic, semantic and pragmatic. These levels are used or being processed in the way of converting text to speech. Furthermore, communication in spoken language can be divided as linguistic and paralinguistic. Paralinguistic information is considered as information about the speaker, way how words are spoken, and the factors during speech like breathing, speed, intonation, hesitation etc. And linguistic is considered as the actual meaning of word. Mainly Paralinguistic is the way of communication and linguistic is the information conveyed during communication.

3 THEORETICAL APPROACH

Over the past 20 years several developers and designers has improved the way of converting speech to text in real time [15]. It is their hard work that we are able to convert speech to text. The developments are done by improving technologies, computer systems and communication ways. These parallel developments led the way to the applications we use today for converting speech into text.

Currently, two major options are available for providing real-time speech-to-text services:

1. Computer assisted note taking (CAN).
2. Communication access (or computer aided) real-time translation

3.1 DIFFERENCE BETWEEN METHODS

There is a lot of difference between these two methods:

1. In their process of generating speech to text [11] in real time [12].
2. With respect to the circumstances under which the methods can be properly used and
3. With respect to the amount of training which is will help to convert speech to text successfully.

3.2 SPEECH PREPROCESSING

We used MATLAB software's sound recorder tools for speech processing and also use those steps:-

i. The system must identify useful or significant samples from the speech signal. To accomplish this goal, the system divides the speech samples into overlapped frames

ii. The system checks the frames for voice activity using endpoint detection and energy threshold calculations.

iii. The speech samples are passed through a pre-emphasis filter.

iv. The system performs autocorrelation analysis on each frame.

We implemented these steps with C# programming, which was executed based on the algorithms. Although we used the same C# programming for training and recognition, the C# code executes on a PC during training. Then we downloaded the Nios II software. This is embedded software. It will supply the Hidden Markov Model (HMM). It will also supply the dedicated tools for Quartus II software. With the help of the journal paper we found the names of these programs and their work.

We could have performed software design and simulation using the Quartus II software and use SOPC [6] Builder to create the system from readily available, easy-to-use components. With the Nios II IDE, we can easily create application software for the Nios II processor with the intuitive click-to-run IDE interface. SOPC Builder's built-in support for interfaces and the easy programming interface provided by the Nios II software application layer make the Nios II processor for implementing our on-line speech-to-text system.

We started doing the work in order to build our project with the journal, but the Quartus II software needs to be programmed in .qsf language. It was a problem. So we started digging our way up.

4 SPEECH TO TEXT SYSTEM

Our speech-to text system converts speech to text from instantly given voice. This system does not synthesize the quality of recorded human speech. There are different technologies suitable for different applications.

Basically, there is no simple metric that could be applied to any STT [Speech to Text] system and which would give a clear concept of the overall quality of any system. The main reason is that the STT system should not be assessed in isolated place, but it should be evaluated for their respective uses. There are many uses for STT systems, so they should be given to their exact destinations.

4.1 BUILDING PROCESS

In the process of completing our project, we have to go through certain processes. Those processes are described below:

i. Recording audio & converting it into .wav format

ii. Processing that .wav file

iii. Storing it in a file

iv. Making software to compare the audio with other audio files with inserted voice and recognize it

v. Making a program to show the voice files in text format.

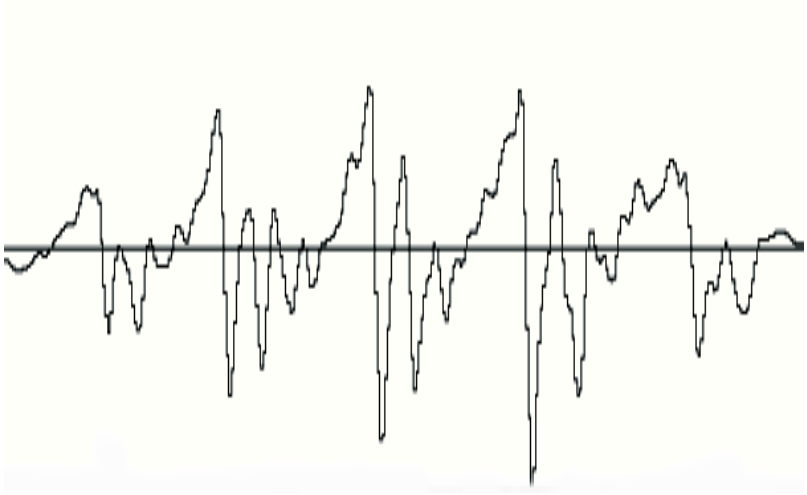


Fig. 1. Part of the waveform sound done with Matlab software

4.1.1 REQUIREMENTS

- Personal Computer (Desktop/laptop)
- Matlab Version 11
- Visual Studio 2010
- Audio Recorder Toolbox
- Microphone & Headset

4.2 WORK PROCESS

Our speech-to-text system directly acquires and converts speech to text. We built the project using Microsoft Visual Studio. But to use the direct conversion we have to add Speech SDK 5.0. We downloaded this software from MSDN Library. Then we installed that program. We added this software with Visual studio. Then we started building the program. We took a simple windows form application.

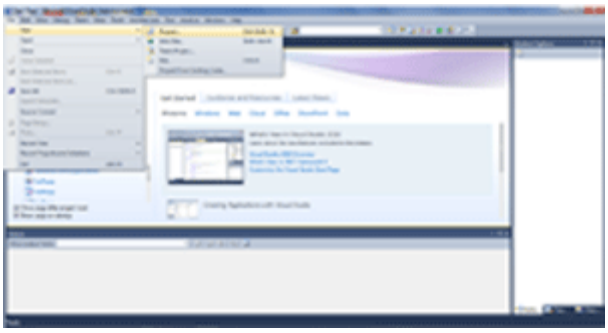


Fig. 2. Starting a new project with visual studio 10

Then we had to add reference. We added .speechlib as a reference. We also added system. sound for building the project correctly.

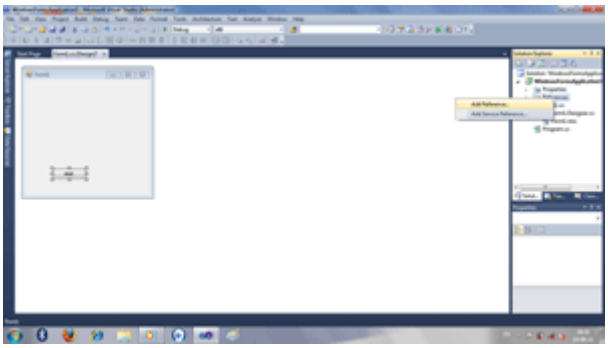


Fig. 3. adding a reference

After that we have added a button to the form. The button is called 'Start dictation'.

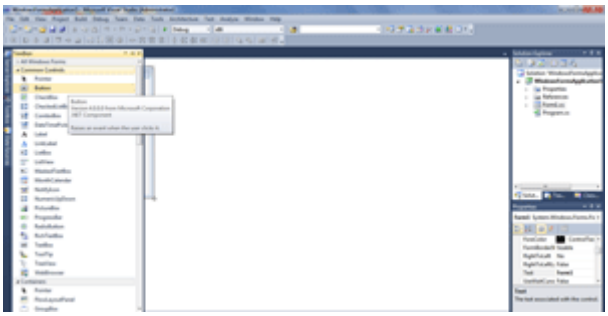


Fig. 4. adding a button

We did the code for the project in C#. The entire project is based on C# on Microsoft Visual Studio 10. We have added the Dictation format from Speech SDK 5.1. The project is based on a voice database of Microsoft.

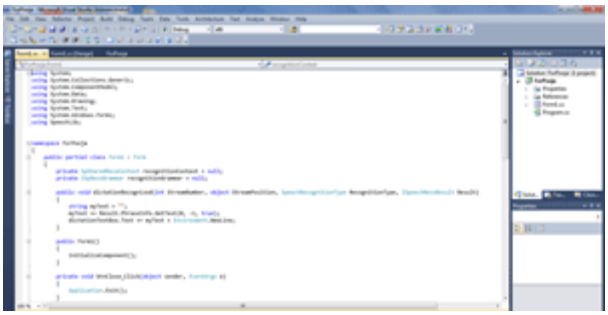


Fig. 5. coding of the project

4.3 IMPLEMENTATION

The project implements a speech-to-text system using isolated word recognition with a vocabulary of limited words (recognized with SDK 5.1) and statistical modeling (HMM) for machine speech recognition. In the training phase, the uttered digits are recorded using 16-bit pulse code modulation (PCM) with a sampling rate of 8 KHz and saved as a wave file using sound recorder software. We use the MATLAB software's wavread command to convert the .wav files to speech samples.

Generally, a speech signal consists of noise-speech-noise. The detection of actual speech in the given samples is important. We divided the speech signal into frames of 450 samples each with an overlap of 300 samples, i.e., two-thirds of a frame length. The speech is separated from the pauses using voice activity detection (VAD) techniques.

The system performs speech analysis using the linear predictive coding (LPC) method. From the LPC coefficients we get the weighted cepstral coefficients and cepstral time derivatives, which form the feature vector for a frame. Then, the system performs vector quantization using a vector codebook. The resulting vectors form the observation sequence. For each word in the vocabulary, the system builds an HMM model and trains the model during the training phase is performed using PC-based C programs.

5 RESULT

We took samples from various users by making them pronounce the same word. The following table shows the result:

Table 1. Table of Words

Words	User 1	User 2	User 3	User 4
Hello	Hello	Haul	Hello	Hello
Excuse me	Seem	Yes me	Excuse me	Excuse me
Thank you	Thank you	Thank you	Thank to	Thank you
One	One	One	One	One
Accuracy	**75%**	**50%**	**75%**	**100%**

5.1 PERFORMANCE MEASUREMENT

The performance of the project is very good. It recognizes the words with its added database. If the words match then it shows the output. Its accuracy is 75%

5.1.1 ADVANTAGE

We do have a few advantages comparing to the previous method described in the journal. They are:

i. Timing: Our timing is better. [Because we are converting speech to text instantly, within 2-3 sec]

ii. Costing: Our costing is much less. [Because we are doing it in our personal computers and using only 2 softwares]

iii. Hassle of using lot things: We have only used two softwares- Matlab & Visual Studio 10

5.1.2 DISADVANTAGE

i. The disadvantage is that our project will only run in those computers's which has visual studio in it.

ii. Another disadvantage is with our accent. The SDK only recognizes American accent. So it sometimes miswrites our voice messages.

5.2 TARGET USERS

The design can be used for various applications. The basic system can be used in applications such as:

- Interactive voice response system (IVRS) [7]
- Voice-dialing in mobile phones and telephones [10]
- Hands-free dialing in wireless Bluetooth headsets

- PIN and numeric password entry modules
- Automated teller machines (ATMs)
- Data entry work
- In classroom works for disabled students

6 DISCUSSION

A low cost, fully functional speech to text converter meets the need of converting voice into text. It is very good and useful. As Bangladesh [16] is a developing country, here needs to develop in software side. For developing the sector you need to be eager and research minded. If you can promote this, it will be very helpful and inspired. Neither this project is costly nor critical, so it is available.

7 FUTURE WORK

Our project is a fully functional complete project. Our project can be used as various School/College/University labs. It can be also used for various research projects. We can improve the performance of the project by training our computers with our voice. By this method the computer will come to know our voice, the way we speak, our accent. This will help to make this project's performance better. Another scope of changing is that this project can be built for mobile [9]. So it will be easier for people to use this project.

REFERENCES

[1] Leija, L.Santiago, S.Alvarado, C., "A System of text reading and translation to voice for blind persons," Engineering in Medicine and Biology Society, 1996.

[2] R. Sproat, J. Hu, H. Chen, "Emu: An e-mail preprocessor for text-to-speech,"" Proc. IEEE Workshop on Multimedia Signal Proc., pp. 239–244, Dec. 1998.

[3] C.H. Wu and J.H. Chen, "Speech activated telephony e-mail reader (SATER) based on speaker verification and text-to-speech conversion,"" IEEE Trans. Consumer Electronics, vol. 43, no. 3, pp. 707-716, Aug. 1997.

[4] Ainsworth, W.,"A System for converting English text into speech, "Audio and Electroacoustics, IEEE Transactions, vol.21, no.3, pp. 288-290, Jun 1973.

[5] Nipon Chinathimatmongkhon, Atiwong Suchato,Proadpran Punyabukkana, "Implementing Thai text-to-speech synthesis for hand held devices", Proc Of ECTI-CON 2008.

[6] M.T. Bala Murugan and M. Balaji , "SOPC-Based Speech-to-Text Conversion" National Institute of Technology, Trichy.

[7] Ki-Yeol Seo, Se-Woong Oh, Sang-Hyun Suh, and Gyei-Kark Park, "Intelligent Steering Control System Based on Voice Instructions" vol. 5, no. 5, pp. 539-546, October 2007.

[8] Sangam P. Borkar, "Text to speech system for Konkani (GOAN) language" Rajarambapu Institute of Technology Sakharale, Islampur, Maharashtra, India.

[9] Kimmu Parssinen, "Multilingual Text to Speech system for Mobile Device" University of technology April 2007

[10] Julie Ngan, Joseph Picone, "Issues in generating pronouncing pronunciation dictionaries for voice interfaces to spatial databases" Institute for Signal and Information Processing, Mississippi State University.

[11] Susanne Wagner (Halle), "Intralingua speech-to-text-conversion in real-time: Challenges and Opportunities" Muttra 2005 – Challenges of Multidimensional Translation

[12] Yee-Ling Lu; Mak, Man-Wai; Wan-Chi Siu,, "Application of a fast real time recurrent learning algorithm to text-to-phoneme conversion," Neural Networks, 1995. Proceedings., IEEE International Conference on , vol.5, no., pp.2853,2857 vol.5, Nov/Dec 1995.

[13] Decadt, Bart; Duchateau, Jacques; Daelemans, Walter; Wambacq, P., "Phoneme-to-grapheme conversion for out-of-vocabulary words in large vocabulary speech recognition," Automatic Speech Recognition and Understanding, 2001. ASRU '01. IEEE Workshop on , vol., no., pp.413,416, 2001.

[14] Penagarikano, M.; Bordel, G., "Speech-to-text translation by a non-word lexical unit based system, "Signal Processing and Its Applications, 1999. ISSPA '99. Proceedings of the Fifth International Symposium on , vol.1, no., pp.111,114 vol.1, 1999.

[15] Olabe, J. C.; Santos, A.; Martinez, R.; Munoz, E.; Martinez, M.; Quilis, A.; Bernstein, J., "Real time text-to-speech conversion system for spanish," Acoustics, Speech, and Signal Processing, IEEE International Conference on ICASSP '84. , vol.9, no., pp.85,87, Mar 1984.

[16] Sultana, S.; Akhand, M. A H; Das, P.K.; Hafizur Rahman, M.M., "Bangla Speech-to-Text conversion using SAPI," Computer and Communication Engineering (ICCCE), 2012 International Conference on , vol., no., pp.385,390, 3-5 July 2012.
[17] F.; Moulines, E., "Text-to-speech algorithms based on FFT synthesis," Acoustics, Speech, and Signal Processing, 1988. ICASSP-88., 1988 International Conference on , vol., no., pp.667,670 vol.1, 11-14 Apr
[18] Stuckless, Ross (1999): "Recognition Means More Than Just Getting the Words Right". Speech Technology Oct/Nov 1999, 30.
[19] Wagner, Susanne & Kämpf de Salazar, Christiane (2004): "Einfache Texte – Grundlage für barrierefreie Kommunikation". In Schlenker-Schulte, Christa (ed.): Barrierefreie Information und Kommuniaktion: Hören - Sehen – Verstehen in Arbeit und Alltag. WBL. Villingen-Schwenningen: Neckar-Verlag.
[20] Wagner, Susanne & Prinz, Ronald & Bierstedt, Christoph & Brodowsky, Walter & Schlenker-Schulte, Christa (2004): "Accessible Multimedia: status-quo, trends and visions". IT - Information Technology 6. 346-352.

International Journal of Innovation and Scientific Research
ISSN 2351-8014 Vol. 17 No. 2 Aug. 2015, pp. 278-289
© 2015 Innovative Space of Scientific Research Journals
http://www.ijisr.issr-journals.org/

Efficiency of Health Systems in Countries of the North and South Shores of the Mediterranean

Majdi Mekdem

University of Sousse,
Faculty of Economic Sciences and Management of Sousse, Tunisia

Copyright © 2015 ISSR Journals. This is an open access article distributed under the ***Creative Commons Attribution License***, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT: This paper aims to study the degree of efficiency of health systems in the countries of the two shores of the Mediterranean. We analyze the classification of these countries to identify particularly efficient and inefficient groups of countries. From the point of view of method, we use the estimation method (DEA). We also use a combination of inputs and outputs. In our model, we use as outputs, life expectancy at birth, survival of children under five years and adult survival rates as inputs, we chose health spending $ current, Adult literacy rates. We rely on the input orientation approach to variable returns to scale. The efficiency scores were calculated using the DEAP software (Coelli, 1996). The average efficiencies of scores (NRP) in 2010 is equal to 0.934.

KEYWORDS: health, efficiency, DEA, life expectancy, health expenditure, input orientation, variable returns to scale.

JEL CLASSIFICATION: C23; I15; O14; O52; O55

1 INTRODUCTION

The notion of efficiency has been analyzed by several authors who have attempted to construct an indicator that empirically measures the performance of public expenditure in the field of providing public education, health, infrastructure and legal regulations.

In this paper we focus on the efficiency of health spending problem. In this framework include multiple jobs. Alexander et al. (2003) and AfonsoAubyn (2005) are based on a parametric and non-parametric approach, considered a measure of efficiency of health systems by constructing an efficient frontier from the amount of input used and of output generated.

The quality of health spending can be measured by the technical efficiency of health services due to these expenses. Hence, the obligation is to construct indicators that measure the efficiency of health spending.

This article is organized as follows: the first part aims to study the efficiency of health systems "literature review". The second is devoted to building health efficiency indicators in the countries of the southern and northern Mediterranean.

Several countries wanted to measure the degree of efficiency of their health systems. They used the parametric and nonparametric methods.

2 ESTIMATION OF THE EFFICIENCY WITH NONPARAMETRIC APPROACH

Work developed by Gupta and Verhoeven (2001) measured the efficiency of public spending (health + education) by using the input orientation in a sample of 38 African countries between 1984 and 1995; Health outputs are used life expectancy at birth, infant mortality and child immunization rates against communicable diseases (measles and DPT). The results confirmed that

1. Health systems in these countries are inefficient especially in the provision of education and health services compared to countries in Asia and Latin America;

2. The productivity of public education and health spending in Africa have evolved but less rapidly in comparison with countries in Asia and Latin America;

3. The performance of health systems differs from one country to another. Some African countries are more successful than others and spending on health and education are associated with higher health outcomes such as Gambia, Guinea, Ethiopia and Lesotho as they are associated with particular outcomes low in Botswana, Cameroon, Ivory Coast and Kenya.

4. The relationship between the efficiency scores and levels of public spending is negative, which justifies the argument that the increase in health spending is not an optimal solution, hence the need for improvement allowances budget in these countries.

Alexander et al. (2003) analyzed the efficiency of health systems in 51 developing countries in 1999. They used the method of (DEA output orientation). They divided the sample into two groups to solve the problem of heterogeneity: a group of countries with a per capita income of less than $ 1,500 and another group with a per capita income between $ 1,500 and $ 4,500[1]. The outputs are used life expectancy at birth disability adjusted for men; life expectancy at birth corrected the inability for women and infant mortality. An input is considered: per capita health expenditures (in international $).

Their results show that efficient countries are either countries that have benefited from relatively high levels of output, given their level of spending (Bhutan, Bangladesh and Jamaica) or countries with relatively low levels of health expenditure (Tanzania , Madagascar, Indonesia, China and Sri Lanka). The most inefficient countries are mainly in Africa.

Afonso and Aubyn (2005) wereinterested in the efficiency of health and education spending for a sample of 24 OECD countries in 2002. They used the method (DEA and FDH input orientation).

The outputs are used infant mortality and life expectancy at birth. Inputs are physical; the number of doctors, the number of nurses and the number of hospital beds (per 1000 inhabitants). The results show that the average efficiency of the health sector in the sample varies between 0.83 and 0.95 depending on the method used. Eleven countries twenty-four are considered efficient with FDH while eight countries are with DEA but the results obtained with both methods are broadly comparable.

3 ESTIMATION OF THE EFFICIENCY WITH THE PARAMETRIC APPROACH

Evans et al. (2000) measured the efficiency of health systems using a fixed-effects panel of 191 countries between 1993 and 1997. The output is measured by life expectancy disability adjusted (DALE) and inputs by health spending (public and private) and the average number of years of education of the adult population. The output oriented efficiency scores are defined as the ratio between current performance and maximum potential. The results show that the most efficient health systems are those of Oman, Malta, Italy, France, San Marino, Spain, Andorra, Jamaica, Japan[2] while the more inefficient are mostly African: Zimbabwe, Zambia, Namibia, Botswana, Malawi. An interesting contribution paper resides in the construction of a confidence interval for the efficiency estimate using a Monte Carlo procedure. Tandon et al. (2000) followed the same approach and the same data that Evans et al. (2000) to estimate the performance of health systems, but by building a composite indicator results (outputs).

Thus, the efficiency of country health systems will be judged on the results achieved over five objectives: the level of health and its distribution[3]. The responsiveness of health systems and distribution and fairness of financial contribution. The

[1] *This is expressed in dollars of purchasing power parity, but the authors do not justify the choice of thresholds.*

[2] *If the high-income countries are excluded, the most efficient countries are Oman, Jamaica, Morocco, Chile, Costa Rica, Venezuela, Turkey, Cuba, El Salvador or the Dominican Republic.*

[3] *According to the WHO (WHO 2000), responsiveness is not measured in how the system responds to health needs, which appears in the results in terms of health, but system performance in areas other than health and responsiveness to public expectations as to how it should be treated with preventative care providers, care or non. The reactivity was measured through a key informant survey that involved 1,791 interviews in 35 countries and allowed to rate (0 to 10) to each of the components of responsiveness, and a general note. A second internet survey of 1006 participants (half part of the WHO) generated opinions about the relative importance of the components, for which WHO has used to transform scores into general notes Instead of simply calculating a mean or using global responses of key informants*

authors constructed a composite index is a weighted average of the five dimensions[4] (Murray et al., 2000) to use as a measure of the output. The inputs are considered health expenditure per capita (public and private) in purchasing power parity and the average number of years of education among the population over fifteen years. The results show slightly different rankings from those of Evans et al. (2000).

The most efficient countries are France, Italy, San Marino, Andorra, Malta, Singapore, Spain, Oman, Austria and Japan,[5] while the more inefficient are Sierra Leone, Myanmar, Central African Republic, the Democratic Republic of Congo, Nigeria, Liberia, Malawi, Mozambique, Lesotho, or Zambia.

Jayasuriya and Wodon (2003) estimate the efficiency of the provision of education and health services for a sample of 76 developing countries between 1990 and 1998. They used as output, life expectancy at birth and inputs are total expenditure per capita health (in 1995 constant dollars) and the adult literacy rate. The authors also added a time trend to capture technological progress over time and regional dummies to allow the production frontier vary by region. Found the results confirmed that the increase in health spending is not a solution to improve health outcomes. The authors noted that the adult literacy rate has a strong impact on life expectancy; an increase of 10% literacy rate would increase the life expectancy of about 1.2 years. The calculation of average efficiency in the sample amounted to 0.85, which implies that countries could increase average life expectancy by 15% with the same levels of resources.

4 CONSTRUCTION OF HEALTH EFFICIENCY INDICATORS IN THE COUNTRIES OF NORTH SHORE & SOUTH MEDITERRANEAN

Economic efficiency, or productive efficiency has two components: allocative efficiency and technical efficiency.

4.1 ALLOCATIVE EFFICIENCIES OR PRICES

The allocative efficiency (or price) is the ability to combine the inputs and outputs in optimal proportions, given the prices quoted on the market. In this type of model the efficiency measurement is done in two ways:

- ✓ Definition of efficiency in absolute terms (search for the optimum, Pareto[6]).
- ✓ Definition of efficiency in relative terms (benchmarking and comparison to an average or a set of institutions).

4.2 TECHNICAL EFFICIENCY (OR PHYSICAL)

It is the ability to prevent waste. The company declared technically efficient if, for the levels used inputs and outputs products, it is impossible to increase the amount of output without increasing the amount of one or more inputs or to reduce the amount another output.

Technical efficiency is divided in turn into scale efficiency and pure technical efficiency.

4.3 THE EFFICIENCY OF SCALE

It helps to bring the measure of technical efficiency of scale yields obtained for the optimal activity levels. It characterizes the gap between actual performance and those that would be obtained in a competitive equilibrium situation where long-term profit is zero, that is to say, compared to a situation where the returns to scale constant. Thus, a company is inefficient scale if its initial situation is one of increasing or decreasing returns to scale.

---

[4]The weights used are: 25% for the standard of health (measured by life expectancy disability adjusted), 25% for the distribution of health status (measured by the health equality in terms of child survival), 12.5% for the degree of reactivity (measured from surveys), 12.5% for the distribution of responsiveness, and 25% for the equity of health financing (measured by inversely proportional index of inequality repartition).

[5] If the high-income countries are excluded, the most efficient countries are Oman, Colombia, Morocco, Chile, the Dominican Republic, Costa Rica, Cuba, Croatia, Thailand, and the Czech Republic.

[6]The concept of Pareto optimum can divide into two all possible states of society. Can be distinguished: those that are uniformly improvable: it is possible to increase the well-being of individuals without reducing the other and which are not uniformly improvable: increasing the well-being of individuals involves reducing the welfare of at least one other individual.

4.4 THE PURE TECHNICAL EFFICIENCY (TE)

The pure technical efficiency shows the ability of firms to optimize their production for a fixed level of inputs and or minimize their consumption of resources for a given level of output. It reflects the organization of work within the production unit, the ability to organize, motivate and effectively monitor their employees and supervisors, or the ability to make good decisions and sink errors. These forms of efficiency are often classified under "X-efficiency." Therefore, the measurement of pure technical efficiency does not depend on product prices, inputs and availability. As suggested by the above definitions, the measure of efficiency will be input or output orientation in one is interested in minimizing inputs or maximizing output.

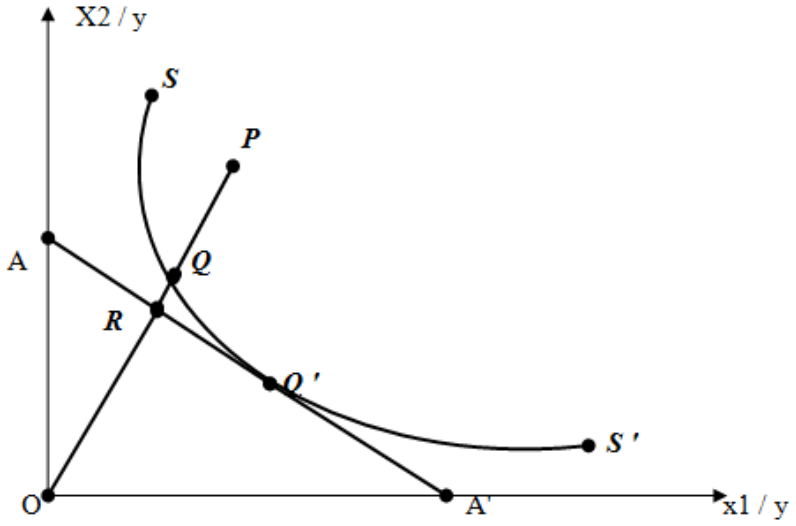
4.5 EFFICIENCY IN INPUT DIRECTION

It has a production function with two factors (X1, X2). We assume that the returns to scale are constant. Either the isoquant SS representing a production function, otherwise it represents a minimum combination of inputs per unit of output. Let U be a decision unit that requires amounts of inputs defined at a point P to produce a unit of output. The technical inefficiency of a company is represented by a QP distance. This distance reflects the proportional reduction of the amount of possible inputs under the constraint that the quantity of output remains fixed. Therefore a technical efficiency ratio input orientation (ET_I) is written as follows:$\boldsymbol{ET_i = \frac{OQ}{OP}}$

Inefficiency and therefore results in resource use surplus. Once the input prices are known, then we can represent the right isorevenue $AA'$and provide a measure of allocative efficiency: $\boldsymbol{EA_i = \frac{OR}{OQ^*}}$ where RQ is the decreased amount possible production costs tends to the pointQ'representing the allocative and technical efficiency threshold. The point Q represents the place of technical efficiency but allocativement inefficient. The allocative inefficiency thus manifests itself in the combination of inputs in optimal proportions as compared to relative prices. The economic inefficiency E Ei is represented by the ratio $EE_i = \frac{OR}{OP^*}$where the distance RP is interpreted as a cost reduction run. Thus we see that economic efficiency is the product of technical efficiency and allocative efficiency.

$$\boldsymbol{ET_i \times EA_i = (OQ/OP) \times (OR/OQ) = (OR/OP) = EE_i}$$

Technical and allocative efficiency - input orientation: See Figure 3.3



Source: Coelli et al. (1998).

To explain the fact that a decision unit fails to minimize the quantities of inputs used and the costs of these inputs should two reasons advanced beings. First the decisional unit aims to minimize costs but it cannot, this could be explained by

institutional constraints, or by a lack of information that would allow it to identify efficient combinations of inputs or by the objective of the decision unit is not to seek to minimize costs.

4.6 OUTPUT DIRECTION EFFICIENCY

When speaking of output orientation, it is to ask the question: how can we increase the amount of output without changing the amount of inputs used?

We consider the case of a production providing two outputs (X1) and one input (x1). We assume that the returns to scale are constant, the production technology can be represented by the curve of production possibilities in two dimensions ZZ 'of a unit where the point A represents an inefficient firm. The distance AB is the technical inefficiency; it is the amount of potentially increased outputs without additional inputs. Thus a ratio of technical efficiency in output orientation is written in the following way:x_2

$$\boldsymbol{ET_O = \frac{OA}{OB}}$$

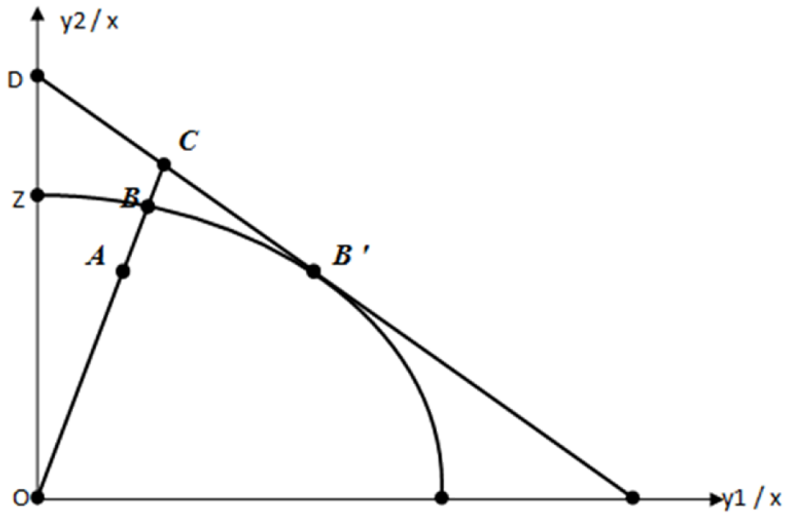
If the information on the price of inputs is perfect, then we can represent the right isorevenue DD' and define a measure of allocative efficiency as:EA_0

$$\boldsymbol{EA_0 = \frac{OB}{OC}}$$

The Economic efficiency (EE_0) Corresponds to the product of these two measures:

$$\boldsymbol{EE_0 = (OA/OC) = (OA/OB) \times (OB/OC) = ET_0 \times EA_0}$$

Technical efficiency and output allocative- orientation: see Figure 3.4



Source: Coelli et al. (1998).

4.7 ESTIMATION METHODS

Quantitative measures of economic efficiency are interesting for at least three reasons (Kalirajan and Shand, 1999). They would allow a comparison of similar productive units and can therefore give us an indication of the relative efficiency of firms. When these measures show changes in the relative efficiency of different production units studied, further analysis can identify the factors that lead to these variations. These analyzes have policy implications for improving efficiency.

Efficiency measures used are rooted in the work of Farrell (1957) and make use of techniques called extreme points. Before the work of Farrell, estimates of production functions were average, implying that some firms produce more or less

than average. This approach has been widely criticized. Instead of measuring the separate indices productivity of each input, Farrell proposes to measure the productive efficiency of the activity in general.

The concept of productive efficiency is different from the concept of social or collective efficiency. The social or collective efficacy is relative to the overall economy including producers and consumers. She suffers when it is impossible to increase the utility (or satisfaction) of a consumer without diminishing that of another. Optimum is called Pareto or first-best. In his 1957 article (applied to inter-State of the US agricultural data) he argues that the measure of efficiency allows giving a theoretical and empirical importance so that a satisfactory measure of efficiency used to evaluate the Industrial productivity (see Ali and Seinford 1993).

To estimate the efficiency score, two approaches have been developed: one is developed by parametric (Aigner and Chu, 1968 Aigner et al 1977 and Meeusen et al 1977..) Is the second non-parametric (Charnes, Cooper and Rhodes, 1978 Banker et al. 1984), which give rise to particular interpretations of the deviation from the border of a firm?

The parametric approach the border based on a specification of the technology we need to estimate the parameters. Technical efficiency is measured from the error term of the production function. We distinguish the boundaries of deterministic output, probabilistic, and stochastic.

The nonparametric approach is unusual not to impose any functional form for production frontiers. These are constructed by solving problems and primal dual linear programming. Once defined, the inputs and outputs of the production units, a production unit (UP) is considered efficient in a sample if no other UP no longer outputs produced with the same amount of inputs. One of the most used methods is the Data Envelopment Analysis (DEA in French and Data Envelopment Analysis, DEA English).

4.8 GENERAL PARAMETRIC APPROACH

4.8.1 PRODUCTION FRONTIER - GENERAL

According to neoclassical theory, firms within their production frontier producing the maximum output level with the chosen level of inputs. This is the "function of primal production." Thus, all firms are technically efficient by definition, the only source of economic inefficiency lies in allocative inefficiency. We can write the production function of firm i (which produce a single output and uses several inputs) as follows:

$$\boldsymbol{y_i^* = f(x_{i1}, x_{i2}, \ldots., x_{1m})/T} \textbf{(1)}$$

Where,y_i^*x and T represent output, inputs and technology firm i.

In practice, the firm produces below the production possibility frontier (PPF) being technically inefficient because it can have an incomplete knowledge of the best methods to use the inputs, or be influenced by factors that prevent it from being on the border. To model the influence of various factors that make office is located below the PPF, we can rewrite the production function of firm i as follows:

$$\boldsymbol{y_i = f(f(x_{i2}, \ldots., x_{1m})exp(u_i)/T} \quad \textbf{(2)}$$

Where$\boldsymbol{u_i}$ indicates the combination of factors that prevent the firm to be on the production and achieve bordery$_i^*$.

On the other hand, $\mathbf{exp}(\boldsymbol{u_i})$ represents the firm's ability to be at the observed level of productiony_i, which represents the level of technical efficiency achieved. The values taken by$\boldsymbol{u_i}$depend on the situation in which firm i located. When nothing affects the ability of the firm to achieve y_i^*, u_itakes the value zero. Otherwise, the value of depends on the constraints of the firm. $\boldsymbol{u_i}$

Thus, measurement of technical efficiency of the firm can be defined as the ratio of the observed product and the maximum possible product:

$$\mathbf{exp}(\boldsymbol{u_i}) = \frac{y_i}{y_i^*} \textbf{(3)}$$

Equation (3) is the base model for measuring technical efficiency.

The estimate of FPP by the parametric approach involves a number of choices including: The type of FPP, the choice of the functional form of the FPP, the choice of estimation technique and FPP the choice of method for modeling inefficiency.

4.8.2 CHOICE OF PRODUCTION TYPE OF BORDER

In the literature there are three parametric approaches to estimate the production possibility frontier and therefore technical efficiency: deterministic, probabilistic and stochastic. The literature on the border of the deterministic production possibilities provided the basis for studies and probabilistic stochastic production frontiers, and the disruption of the type of distribution that reflects inefficiency. Probabilistic and stochastic approaches include (by definition) to reduce the sensitivity of the frontier (PPF) Estimated error (truly) random.

The deterministic approach was developed by Afriat (1972) and Richmond (1974) and is using all the observations supposed be on or under the PPF and assumes that the entire error term results from technical efficiency. This technique most closely matches the theoretical concept of "border" considered the highest limit of output. But empirically this technique is very sensitive to measurement errors. Deterministic frontier models have several limitations which include the following:

(1) They do not differentiate the effects due to statistical noise, external shocks or outside the control of the company, the effects due to technical inefficiency;

(2) Construction, the border is sensitive to measurement error in the dependent variable.

The probabilistic approach aims to reduce this sensitivity. Given the fact that the border is sensitive to extreme observations that may bias the estimate for a given sample of companies, Timmer (1971) reduces this sensitivity by allowing a predetermined percentage of the most effective observations to be below of the border. Many frontier models have been developed (see the literature review of these studies in Kaliragan and Shan, 1999). Afriat (1972) and Richmond (1974) were the first to specify such models using Beta and Gamma distributions, respectively.

The stochastic approach simultaneously proposed by Aigner, Lovell and Schmidt (1977), by Battese and Corra (197) and Meeusen and van den Broeck (1977) with the aim to specify in the error term of two components:

(1) one captures the effects of inefficiency with respect to the border

(2) the other allows a random variation of the border through all the sample companies and captures the effects of measurement errors and other statistical noise outside the control of producers. Thus, we can rewrite equation

$$\boldsymbol{y_i = f(x_i)\exp(\varepsilon_i)} \quad \textbf{(4)}$$

In equation (4) the error term is decomposed as follows:

$$\boldsymbol{\varepsilon_i = v_i - u_i} \quad \textbf{(5)}$$

The estimate of the border (4) requires the following hypotheses:

- First, $\boldsymbol{v_i}$ and $\boldsymbol{u_i}$follow independent distributions.
- Second, the term $\boldsymbol{v_i}$is a vector of random errors assumed to follow a normal density.
- Third, The term $\boldsymbol{u_i}$is a non-negative random variable for which a particular distribution is chosen: it is supposed to represent the technical inefficiency score of the ith firm.

4.9 NONPARAMETRIC APPROACH - GENERAL

Methods of data envelopment (DEA)[7] are considered an important tool to assess and improve the performance of manufacturing operations and service. They have been extensively applied in assessing the performance of schools, hospitals, bank branches, factories, etc.

[7] *DEA (data envelopment analysis) is a method of analyzing efficiency.*

4.9.1 ANALYTICAL FRAMEWORK

Suppose there are k inputs and outputs m to n (DMUs). For a (DMU)i there is a column vector of outputs and xi is a column vector of inputs. X (k × n) is the matrix of the inputs Y and (m × n) is the matrix of the outputs

The purpose of the DEA is to create a non-parametric boundary so that all observations are below or exactly on the shape of this curve. Hence, the need is to integrate the ratios outputs / inputs in the specification. That is to say that for every (DMU), we seem to find a measure of all inputs to outputs by reports as U'Yi / V'xi where u is a (m × 1) vector of weights of output and V is a (K × 1) vector of the weights of the inputs.

In order to achieve optimal weights, we solve the following mathematical program:

Maximize u, v **()**$\frac{u' y_i}{v' x_i}$

S / c$\frac{u' y_i}{v' x_i}$ **≤1, J = 1, ..., N (1)**

And u, v≥ 0

Where u and v are coefficients associated with each (DMU) such that efficiency is maximized when it does not exceed a unit value. However, the resolution of this program can provide a multiplicity of solutions (eg, if (u *, v *) is a solution, then (α u *, v * α) is too). So, we need an additional constraint is necessary to avoid this problem.

The program can be rewritten as follows:

Maximize u, v ()$u' y_i$

S / C = 1$v' x_i$

0, j = 1, ..., N, (2)$u' y_i - v' x_i \leq$

And u, v≥ 0.

Duality[8] linear programming leads us to derive an "envelopment" form of this problem in the context of variable returns to scale:

Minimize $\theta, \lambda\theta$,

S / c (3)$-y_i + Y\lambda \geq 0$

$0\theta x_i - x\lambda \geq$

n1'λ= 1

$\lambda \geq 0$

Where θ is a scalar and λ is a (n × 1) vector of constants.

n1 'λ = 1 implies the convexity of the efficiency curve.

This programming configuration implies fewer constraints than the previous form

(K + m <n + 1) is generally preferred in solving this problem.

The calculated value of θ is the efficiency score for a (DMU) i. It must satisfy the condition θ ≤1. If θ = 1, then we are on the efficiency frontier and DMU is technically efficient.

(1- θ) represents the amount of input that must be reduced without changing the output for efficient production.

[8] *The advantage of this transformation is that it involves a lower number of constraints (Coelli et al. 2005).*

4.9.2 SELECTION OF INPUTS

The inputs correspond to the factors used in the production process. From the perspective of the health system and as part of the production of health inputs are numerous; they can be approached in physical terms (personnel, medical equipment, etc.) or cash (expenses) and the results are sensitive to this choice (Afonso and Aubyn 2005). Economists have selected the variable total health expenditure per capita in purchasing power as a better input used because it allows to some extent to approach all controllable inputs by health systems. But the choice of inputs in the context of a health production function raises unresolved discussion in the literature.

Some authors have claimed that the inclusion of health spending is not sufficient to measure the efficiency of health systems. According to Tandon et al. (2003), next to the inputs "direct" (approximated by health spending), other inputs broken "indirect" participate in health production as per capita income, level of education of the population, power quality, housing conditions or access to infrastructure (water, sanitation).

A population health can also be strongly influenced by other factors such as the presence of some disease vectors, the severity of the HIV / AIDS etc. But due to the unavailability of data, we adopt in our calculations the following inputs: we introduce a controllable input (health expenditure) and a non-controllable input (by the health system), an environment variable; the level of education of the population, as measured by the adult literacy rate. Even if this variable is not directly controllable by health systems, it is a crucial variable closely correlated to income, and thus serves to explain the health outcomes of a country (Caldwell 1985).

4.9.3 CHOICE OF OUTPUTS

The output of a health system should match the level of health services to the population.

Depending on the relevance of the indicators for the health services offered, we use three indicators of outputs to estimate the efficiency of health systems. Threecharacterizelevels of mortality:

- Survival of children under five.
- The survival rate of adults.
- Life expectancy at birth.

4.9.4 CHOICE OF METHOD OF STUDY OF THE EFFICIENCY

The calculation of efficiency scores, reasoning with an assumption of constant returns to scale, is based on the model of Charnes et al. (1978). The assumption of constant returns to scale is appropriate when all units of decision realize an optimal scale.

However, imperfect competition, government regulations or financial constraints can lead to a decision unit does not achieve its desired effect at an optimum level. Many authors have suggested then adjust the DEA model with constant returns to scale in order to take into account situations characterized by variable returns to scale. Banker et al. (1984) have extended the measure of the efficiency with variable returns to scale by introducing an additional convexity constraint in the program:

$$= 1\sum_{i=1}^{i} \lambda_i$$

The advantage of the specification to variable returns to scale calculates the net technical efficiency of efficiency of scale. The measures of scale efficiency can be obtained for each decision unit by performing both a DEA analysis with constant returns to scale and variable returns to scale. The technical efficiency scores obtained with constant returns to scale are then broken down into two components: one from the scale inefficiency and the other from a technical inefficiency "pure" (that is, ie technical efficiency with variable returns to scale). If the scores at constant returns to scale are different from those with variable returns to scale for a particular decision unit, then it means that it is characterized by scale inefficiency (Coelli et al. 2005).

Our analysis focuses on the model with the assumption of variable returns to scale and input orientation. We chose minimizing inputs that seems to admit because: first, it is considered that, as in the case of public services, the services provided by the state to citizens are assumed to be fixed; Second, the use of resources by the countries studied is usually done in a difficult budgetary situation; and third, that choice to follow the type of data that we have. The values of the inputs are more dispersed than those of outputs; they thus provide a better discriminate the efficiency scores. In the choice of returns to scale, we chose the assumption of variable returns to scale. This may be justified on the one hand, that this is a

very general approach and, secondly, for the consideration of multi-output character in the health sector. Similarly, another argument reinforces this choice. It's the same kind of data used: using aggregate data makes it difficult to identify inefficiencies of scale.

4.10 RESULTS

4.10.1 EFFICIENCY SCORES ANALYSIS

We use a combination of inputs and outputs. In our model, we use as outputs, life expectancy at birth, the survival of children under five years and the adult survival rate; and as inputs, we chose health spending and the adult literacy rate.

Efficiency scores are presented in Appendix A. We used the DEAP software (Coelli, 1996). The complementary to 1 of each coefficient and efficiency score measures the proportional decrease of inputs without reducing the levels of output.

Table 3.2. Average scores efficiencies in the Mediterranean countries

Years	Average efficiency scores in the (NRP)	Average efficiency scores in the (PRSM)
1992	0.9371	0953
2010	0934	0960

in_vrsdea oriented input variable returns to scale

4.10.2 ANALYSIS OF EFFICIENCY SCORES

The score of efficiency (NRP) in 2010 is equal to 0.934. So these countries can reduce their inputs 0.066% without reducing levels of output. Also,it is observed an average of the scores in the efficiencies (PRSM) which equals 0.96. Thus, these countries can also cut spending by 0.04% and retain the same results of their outputs.

4.10.3 EVALUATION OF HEALTH OUTCOMES IN THE MEDITERRANEAN COUNTRIES OVER TIME

A population health in both shores of the Mediterranean has increased dramatically in recent decades. Life expectancy, for example, has increased by about one year every four years since the early 90's premature and infant mortality also declined rapidly and it is the same for the mortality rate after diagnosis individuals such as cancer or acute myocardial infarction.

However, there remain significant differences in health status between countries, and those who spend the most are not necessarily the ones who get the best results (see table below).

Table 3.3- Relation between health spending and effectiveness score:

Country	$ Current health expenditure (2010)	Efficiency Score (2010)
PRT	2578	0.91
FRA	3851	0.97
ITA	2836	1
ESP	2941	1
RCMP	3010	0.97
Belg	4096	0.91
SLO	3622	0.95
DEN	4118	0.79
Horn	3922	0.82
SW	3622	1
March	231	1
AL	437	1
TUN	501	1
LYB	502	0.91
EGY	261	0.88

Source: Author's calculations

For example, Italy has health spending per capita lower than those of the majority of NRP but the Italians have a very high level of health. This suggests that there is a potential for improving the cost-effectiveness of spending. There are usually no contradiction between improving health equity and raise the average level of population health. In fact, countries that show less inequality generally enjoy a high average health status such as we see in Sweden and Italy.

5 CONCLUSION

In all countries of the world, the rise in health spending increases, in principle, the population's health. Sometimes the positive effects of these expenses are dimmed. On one hand, the expenditure improves the supply of medical care. Other factors are influencing the health status of the population. We cite as an example the training, lifestyle, health and income distribution. On the other hand, the increase in these expenses must be controlled and allocated in a beneficial way to have positive effects on labor productivity, the supply of labor and training. This could contribute positively to economic growth. However, these expenses can cause serious problems due to their development that exceeds GDP growth. Several factors are due to the increase in health spending (demand factors, factors for tenders, institutional factors).

Improve efficiency in the health sector is a key objective. So we reviewed the efficiency of the health system. It is obvious that the performance is associated with efficiency. Theoretical work estimates the efficiency of the health system using the non-parametric and parametric methods. Economists Gupta and Verhoeven (2001), Alexander et al. (2003) and Afonso Aubyn (2005), Evans et al. (2000) measured the efficiency of public spending (health + education) by using the input orientation, output orientation, variable and constant returns to scale. Health outputs are used life expectancy at birth, infant mortality and child immunization rates against communicable diseases (measles and DPT). Health inputs used are the current health expenditures in $ and literacy rates. The results found mention that the increase in health spending is not an effective solution. So we need to improve budgetary allocations in these countries.

We then move to an analytical application to build health efficiency indicators. Certainly, the measure of efficiency is a complex task and poses a number of conceptual and methodological challenges that leave plenty of room for measurement errors. We estimate the degree of efficiency of health systems in the countries of the two shores of the Mediterranean and analyze the classification of these countries to identify particularly efficient and inefficient groups of countries. From the point of view of method, we use the estimation method (DEA). We also use a combination of inputs and outputs. In our model, we use as outputs, life expectancy at birth, survival of children under five years and adult survival rates as inputs, we chose health spending $ current, Adult literacy rates. We rely on the input orientation approach to variable returns to scale. The efficiency scores were calculated using the DEAP software (Coelli, 1996). The average efficiencies of scores (NRP) in 2010 is equal to 0.934. So, these countries can reduce their inputs 0.066% without reducing levels of output. Also, it is observed an average of the scores in the efficiencies (PRSM) of about 0.96. Thus, these countries can also cut spending by 0.04% and retain the same results of their outputs. Our results confirm the theoretical approach that suggests that countries that spend the most are not necessarily the ones who get the best results.

REFERENCES

[1] Afonso, A., &Aubyn, M. S. (2005). Non parametric Approaches to education and health efficiency in OECD Countries. Journal of Applied Economics, 8 (2), 227-246.

[2] Afonso, A., &Aubyn, M. S. (2006). Cross-country efficiency of secondary education provision: A semi-parametric analysis with non-discretionary inputs. Economic Modeling, 23 (3), 476-491.

[3] Alexander, CA, Busch, G., & Stringer, K ..(2003). Implementing and Interpreting a data envelopment analysis model for Assessment to the efficiency of health systems in developing countries. IMA Journal of Management Mathematics, 14 (1), 49-63.

[4] Bai, J., and Ng, S. (2004). A PANIC Attack on Unit Roots and Cointegration.Econometrica, 72, 1127-1177.

[5] Banker, RD, Charnes, A., & Cooper, WW (1984). Some models for Estimating scales and technical inefficiencies in Data Envelopment Analysis. Management Science, 30 (9), 1078-1092.

[6] Banker, R. D., and Morey, R.C. (1986). Efficiency analysis for exogenously fixed inputs and outputs. Operations Research, 34 (4), 513-521.

[7] Charnes, A., Cooper, WW, & Rhodes, EL (1978). Measuring the efficiency of decision makingunits. European Journal of Operational Research, 108, 140-148.

[8] Coelli, T. J. (1996). A guide to DEAP Version 2.1: A data envelopment analysis (computer) program, CEPA Working Paper, 96/08, p. 49.

[9] Robert, F., Engle, C., & Granger, WJ (1987). Cointegration and Error-Correction: Representation, Estimation and Testing. Econometrica, 64, 813-836.
[10] Evans, D., Tandon, A., Murray, CJL, & Lauer, JA (2001). Comparative Efficiency of National Health Systems: Cross National Econometric Analysis. British Medical Journal, 323, 307-310.
[11] Evans, DB, Tandon, A., Murray, JL, & Lauer, JA (2000). The comparative efficiency of national health systems in Producing health: an analysis of 191 Countries. GPE Discussion Paper No. 29, World Health Organization, Geneva, Switzerland.
[12] Gupta, S., Verhoeven, M., &Tiongson, E. (2001). Public Spending on Health Care and the Poor. IMF Working Paper No. 01/127, International Monetary Fund, Washington DC.
[13] Kyung Im., Pesaran, S., Hashem, M., &Yongcheol, S. (2003).Testing for Unit Roots in Heterogeneous Panels. Journal of Econometrics, 115, 53-74.
[14] Jayasuriya, R., &Wodon, Q. (2003). Efficiency in reaching the Millennium Development goals. World Bank Working Paper No. 9, World Bank, Washington DC.
[15] OECD (2003) "Spending on health and long-term care: projections to 2050 revisited" ECO / CPE / WP1 (2003) 5.
[16] World Health Organization (WHO). International Health Regulations, Geneva, World Health Organization, 1969.

International Journal of Innovation and Scientific Research
ISSN 2351-8014 Vol. 17 No. 2 Aug. 2015, pp. 290-302
© 2015 Innovative Space of Scientific Research Journals
http://www.ijisr.issr-journals.org/

Regional Agricultural Development and Economic Growth: Case of the Monastir area

Houcine Bouhajeb and Mejdi Mekdem

Faculty of Economics and Management of Sousse, University of Sousse, Tunisia

Copyright © 2015 ISSR Journals. This is an open access article distributed under the ***Creative Commons Attribution License***, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT: In this research paper, the objective is to highlight the degree of contribution of the agricultural sector in the region of Monastir to Economic growth of our country: "Tunisia". We limit ourselves to the study of regional development of agriculture in this region. This is to see the impact of this sector stage of development on economic growth. The question that concerns us is this: Is agriculture as an economic activity is involved in a huge way in the growth of the country? Or there are other more important areas in the region that are the core of economic development. Several hypotheses resulting which we quote which states that agriculture in the region and because of the recorded fluctuations had a negative impact on the country's economic growth and participates in a less efficient way, its role is less important comparison with other operative sectors in the region (manufacturing and non-manufacturing industries, Tourism, Services,...etc.). Several theoretical and empirical studies have shown that agriculture contributes an effective way to growth. Empirically, based on the time series, we will determine the contribution of the agricultural sector development and fisheries beyond fifteen years on growth and the country's economic development. Econometric results we found, it was found that agriculture contributed less efficiently to economic growth compared with other countries more competitive sectors and have considerable share in GDP and contribute more effectively to the economic development of Tunisia.

KEYWORDS: Development, Regional Development, Region, Economic Growth, Agriculture, Monastir.

INTRODUCTION

We are interested in a study of agriculture and fisheries in the governorate of Monastir located in the country's eastern center and covers 0.7% of the total area of the country. The economy of the region is based on the greenhouse cultivation where the governorate ranks first nationally. A modern and advanced agriculture based on irrigated crops over an area of 5690 hectares, is based on the cultivation of early vegetables in greenhouses and including nearly 3 million olive trees and five fishing harbors have achieved to excellent results in the production. In the governorate of Monastir and adjacent public agencies, there are specialized administrations in the agriculture and fisheries,which we quote close administration of farmers and new agricultural investors formed by the promotion agency of Agricultural Investment (APIA), the Regional Commission for Agricultural Development (CRDA), and the Regional District Fisheries (ARP).

This work is just limited to the study of regional development of agriculture in the region of Monastir, the object is to see the impact of this sector development stage on the country's economic growth. In other words, it is to question the role of agriculture in economic growth and the degree of contribution to economic development. Our goal is to study the impact of agriculture in the region on the country's economic growth. In other words, in determining the contribution of the development of agriculture and fisheries in the region beyond fifteen years of growth and economic development.

Several hypotheses resulting which we quote which states that agriculture in the region and because of the recorded fluctuations had a negative impact on the country's economic growth and participates in a less efficient way, its role is less important in comparison with other operative sectors in the region (manufacturing and non-manufacturing industries, Textile, Tourism, Services, ... etc.).

Our work will be divided into two stages. In the first, and as part of the theoretical part, we will limit ourselves to the study of regional agriculture and fisheries in order to see its contribution, its degree of contribution to growth and economic

Corresponding Author: Mejdi Mekdem

development the country, the study area is the governorate of Monastir. We will do a descriptive study of agriculture and fisheries in the region of Monastir, in the second and final stage, and as part of the empirical part, we will study the impact of the development of the agricultural sector in the region of Monastir on the country's economic growth. In other words, the degree of contribution to growth and this through an empirical study by collecting data on the evolution of variables including: the value added, capital (investment), the number of irrigated areas with economic means irrigation water, rainfall average (in millimeters) of the governorate and the number of fishing units to fire. Changes exceed fifteen years starting from a Cobb-Douglas function to empirically validate the results that our research work will lead.

RELATIONSHIP BETWEEN AGRICULTURE AND ECONOMIC GROWTH: REVIEW OF THE LITERATURE

Several economists have frequently attached great importance to the role of agriculture in economic growth. Lewis (1954), agriculture contributes to the formation of capital, frees labor characterized by low productivity to feed other sectors including industry by creating a market for industrial products, supplier of services to and to finance imports. Gillis (1990) considers that agriculture attracts foreign direct investment (FDI) creates jobs and allows opening new opportunities for investment for local entrepreneurs to increase local production. According to the World Bank (2008), agriculture contributes to development as an economic activity, livelihood and environmental services provider, which makes it a unique instrument for development. This is confirmed by a study conducted by Guillaumont in 2003, based on the work of Barro and Sala-i-Martin (1996), which concluded that only environmental conditions and through the agricultural sector, have a significant impact on growth production in the Sahel of Africa.

However, like any economic sector, the agricultural sector requires funding for better contribution to growth. Indeed, financial condition and resources for a large part accessibility to inputs and equipment required for the adoption of an intensive production system. However, the literature shows a weakness financing in agriculture in the majority of developing countries (LDCs). FAO (1996) 'Food and Agriculture Organization, "for example indicates an under-investment in agriculture over the past decade in many developing countries. She sees a greater share of public spending on agriculture is for grants, so that there is little public resources for the creation of new infrastructure or other growth-enhancing expenditures. A study by the Centre Sector Policy Analysis (CAPES) in 2008 on vegetable crops shows that falling yields explain an incomplete and defective mastery of production techniques, a decrease in the quality of seeds or even both at a time. Thus, the study recommends a review of the production techniques, strengthening the training and the underbody of producers and agricultural technicians on technical routes of production. In addition, it should be noted that at the literature, education is the factor mentioned by several authors as an explanatory factor in the level of efficiency of producers (Zonon, 2003). However, there is no overall approval for the impact of investment in education on the productivity of farmers. Gurgand (1994.1997) finds that education has zero returns even negative in agriculture in Côte d'Ivoire.

As against Tilak (1993) and Coltear (1990) conducted a review of several studies in Asia and Europe showing that education significantly increases the productivity of farmers. Zonon in 2003 shows that literacy has a major impact on the efficiency level of the farmers. However, education alone does not increase in a systematic way the level of performance of the producers; education policies must be followed by those producers of equipment or new techniques transmission policies.

There is some agreement among economists about the importance of the agricultural sector in a developing economy. Thinking of the Physiocrats to the writings of contemporary authors, the agricultural sector remains an important pillar on which everything has to be based off of the economy. Historians have noted that in many so-called developed countries today, the agrarian revolution before the industrial revolution. This vision justifies the centrality of agriculture in development theory. Many authors of this current of thought such as Lewis (1955), Hirschman (1958), EIF and Ranis (1964), or Mellor (1966) devoted significant writings on it. And even in this period of the 21st century by FAO efficient agricultural policies implemented in the setting is a necessary condition for uprooting and eradication of hunger and the reduction of inequalities between many countries.

The study of the impact of agriculture on the growth and economic development is done according to several points of view in the economic literature. The first authors of the theory of development affected her a role "passive" in the economy. Lewis (1955), Hirschman (1958), EIF and Ranis (1964) put the upstream activities of other sectors of the economy that actually stimulate development. "Agriculture must provide the rest of the economy the resources it needs to function. The agricultural sector is thus doomed to decline gradually as the economy grows. But the notion of Agriculture for development of the rest of the economy, labor and capital tank to operate, fell more and more in front of the one to engage in the path of development farm for himself and that agriculture can sometimes be a sector of the economy in mind, especially in times of economic adjustment. “A development of the agricultural sector as a sector of economic activity is also a guarantee of achieving a level of economic development. The coexistence of urban and rural areas no longer appears as an aberration, an

absurdity in that a development of the agricultural sector would observe evolutionary improvements in living standards in rural areas.

The central element of development models explaining the role of agriculture in growth is the notion of surplus generated in the agricultural sector. To this end, the physiocrats recognize the importance of a surplus (value added) Agricultural necessary for the health of public finances and the level of economic activity. It should be noted that three major concerns arise from the literature on the role of agriculture in growth and economic development:

- Determinants of generating a surplus in the agricultural sector through productivity gains from investment and innovation;
- The various mechanisms for transfer of the surplus;
- The use of this surplus to achieve industrial development through public investment where this surplus is transferred by taxes.

In 1767, at the dawn of the industrial revolution, Mill stated that the farmer productivity defines the size of the industrial sector. Before 1950, many authors confirmed that growth in the agricultural sector may be preceded or spawned the industrial revolution. Historians of this revolution spotted recurrence and the reappearance of a certain logic by which the agricultural revolution before the industrial revolution by a shift from fifty to sixty years. But from 1950, economists viewed increasingly the agricultural sector as a delayed sector in the economy, generating a surplus of labor such as formalized Kevin (1955). Interest was focused on growth resulting in the non-agricultural sector. The agricultural sector should provide the latter with the elements necessary for its expansion. By participating in this logic, the economist Kuznets (1964) identifies four ways in which agriculture contributes to economic development:

- **Products**: Agriculture provides food to feed workers in other sectors. It also provides industry with raw materials useful to it. A productive agricultural sector provides cheap products, thereby improving the level of real wages and thus a possibility of accumulation for the other sectors. In addition, the increase in agricultural production has an effect on the growth of the Gross Domestic Product (GDP).
- **Market**: Agriculture can be a demand for industrial goods and services. Improved productivity in this sector is expected to improve incomes of the rural world and therefore increase their consumption. The agricultural sector can facilitate the emergence of new uncorked for industries.
- **Currency**: Export of agricultural products is a source of foreign exchange for the economy. In a context where agriculture is important, these currencies can be used to import machinery and raw materials needed by industry to develop. On the other hand, agriculture can afford to produce the foreign exchange savings commodities that were imported before.
- **Factors of production**: Agriculture provides to other sectors the labor surplus at its disposal.

These analyzes Kuznets appear in different works of development economists. The focus was on industrial development, since he alone was able to provide the conditions for a genuine economic development. This fascination with modernization allowed them to have an "industrializing primacy of doctrine on agricultural development, which has undermined the same time the potential contribution of agriculture to overall development." Kruegersummarized these early development theories as composed of several managers son:

- The desire and will to modernize;
- The interpretation of industrialization as a way of modernization;
- The certainty that a policy of "import substitution" was essential to protect "infant" industries;
- The distrust of the private sector and the market and the belief that the government, as paternalistic and benevolent guardian, should take the lead in development;
- The uncertainty towardsthe international economy and the lack of confidence in the possibilities of export development in developing countries.

STUDY OF THE AGRICULTURAL AND FISHERIES IN THE REGION OF MONASTIR

Agricultural: Agriculture in its broader concept means "lack of work transforming the natural environment for the production of plants and animals useful to man." A so near growing plants, are also integrated livestock, fishing and hunting. From the economic point of view, agriculture is a sector of activity, income generating activity from the exploitation of land, culture, animal husbandry, etc .; it responds to the most serious and essential needs of the human being: food. Agricultural activity is endowed with many specificities that must hold in order to understand its operation:

- **Earth:** it has a special role in farming. Farming techniques need to be increased and spread on large tracts of land. The area of farms frequently measured in hectares. Proportion to industrial activity, the Earth is a critical input for the implementation and development of agricultural activity.
- **Natural conditions and seasons:** dependence agriculture towards natural circumstances and variability of the seasons is notable. It is prevalent in developing countries where the mastery of sophisticated and advanced techniques is not yet a given. This interdependence creates many consequences which we quote: seasonal employment factors and risk. In fact, the seasonal factors, although it is not specific to agriculture, requires agricultural production function special features.
- **Rigidity of demand:** Regarding the demand for food, it is not very sensitive to price (Law King) and income (Engel's law). But it must still make the distinction between food and agricultural product. All food is not agriculture and all agricultural products are not food.

In what follows, we summarize the agricultural situation in the region of Monastir, investment incentives factors, the most important problems facing the agricultural sector faces in the region and the prospects for its development.

AGRICULTURAL SITUATION: GENERAL

The Governorate area is 102,385 ha (0.6% of the area of Tunisia), agricultural cultivated area is 81,400 ha. Forests and pastures occupy 4,700 ha (0.08% of the national total). The climate of the region is semi-arid and characterized by high temperatures in summer and stability of the climate over the rest of the year with low and erratic rainfall. The average rainfall is 360 mm, the annual rate of evaporation is 5.2 mm, the humidity average is 72.4%, the average wind speed: 15.1 km / h and the average duration of the sun is 8.3 hours. While the soil is characterized by a geographical nature that comes in the plains interspersed with some hills and a series of valleys that end in the sea. These plains are composed by soils which do not differ much in terms of their physical properties and chemical (soil depth, size, structure, mineral composition and fertility) due to natural conditions formed therein, as well as the quality of the original rock from which the soil is formed.

In 2011, the cultivated area is summarized as follows: cereals: 3700 ha gardening: 4290 ha legumes: 1280 ha fodder: 500 ha fruit trees: 71,640 ha (3.3% of the national area) of which approximately 63,600 ha of olive oil (88.7% of the area of fruit trees), 4050 hectares of almond 1875 ha and 330 ha caught pear tree.

RAINFALL: The average rainfall between 1995 and 2011, shows peaks sometimes up, sometimes down, the most remarkable is the one that corresponds to the year 1996 and beyond this year, the highest peak coincides with year 2004. Peaks less are found reduced in 2007 and 2008 and average rainfall eventually decrease and a slight rise between 2010 and 2011 15mm. We identify a rainfall of 658.5 mm peak in 1996, beyond that this year the average was down sometimes always spotted the slightest increase in 1996. Between 2000 and 2002, at the beginning a decline in average rainfall is indicated followed by a slight increase (2001-2002) due to a strong drought recorded during three consecutive years. In 2004, the average rainfall was 514 mm. From 2009, the average rainfall continues to decline reaching 417 mm in 2010 and noticed a slight increase in 2011.

WATER RESOURCES: The total water resources are estimated at 29 million m3, have renewable resources and vary from season to season depending on the amount of water available and the demands of farmers and precipitation. These resources consist mainly of water run-off: 13 million m3, a part was controlled through mountainous dam, seven small lakes and 54 storage units; Groundwater: 16,830,000 m3; Deep wells: 45 wells, 32 wells for irrigation, 7 wells intended for consumption, 6-well untapped and shallow wells 2950 wells. In addition to these own resources, 4.5 million m3 represent the portion of the water area of the dam Nebhana and 0.5 million m3 of wastewater. Thus, the total resources available will be 35 million m3 of which 22.6 million m3 are for exploitation. Water resources, public (Nebhana and deep groundwater) are managed by 42 groupings of developing and using economic means to irrigation water. The exploitation rate is 82% and the rate of increase is 90%.

IRRIGATION AREA: irrigated area has reached 5,755 hectares (6.9% of the plowed surface and 1.4% of the irrigated areas nationally) in 27 public irrigation schemes with private irrigated areas. Valid irrigable area for irrigation is distributed as follows: (Irrigated from large dams (public irrigation: 2646 hectares) Irrigated from shallow wells: 1709 ha Irrigated from deep wells: 1,283 ha; irrigated with treated water: 117 ha farm rate: 86%; intensification rate: 90%). Efforts in the field of irrigation water savings allowed the approximately 4900 ha equipment (88% of the total irrigated area and 98% of the exploited areas), and thanks to the encouragement given by the State to farmers in the form of a grant of between 40% and 60% of the cost of irrigation water saving equipment.

STRUCTURE OF FARMS: The total number of farms in Monastir is 14 200 farms (2.8% of farms in Tunisia), the average farm size is 5.8 ha and 85% of these farms are less than 10 hectares. The distribution of these operations is as follows: (98.4% of farms in the form of direct use (95% for domestic); 59.3% of farms are supplied with drinking water (45% for National) 67.7% of farms are equipped with electric lighting (76% for national); 0% of farmers living in rural areas (69% for national) and 79.2% of farmers have experience in agriculture more than 10 years (82% for national).

ANALYSIS OF PRODUCTIONS: The agricultural sector in Monastir includes various productions including: crop production (field crops, vegetable crops, olive trees, fruit trees and organic crops), animal production (Cattle, sheep, goats, poultry, etc.) and marine production (fishing).

Note that the governorate of Monastir specializes in crops of olive and vegetable crops and livestock.

- PLANT PRODUCTION: CEREALS: Cereal production in the region of Monastir is composed of soft wheat, durum and barley mainly. We note that the durum wheat is most noticeable over time because soft wheat production is absent beyond 2006 both before and during the period starting from the year 2000 to 2003 the quantities are in tons low compared to the quantities of durum wheat. While barley production is very important in 1998 of around 12111 tons, the minimum quantity of this production is of the order of 151 tons spotted 1995. However, in 2001 for the three categories of cereals, Production is zero (rainfall recorded in the year 2011 decreased by reaching 175 mm this can be the cause of this finding). For the amount of durum wheat, it has grown from a minimum of 34 tons in 1995 to a maximum of 3725 tons in 2006. While the amount of wheat has spent a minimum of 3 tons in 1996 to a maximum of 555 in 1990.

THE VEGETABLE CROPS: The area of irrigated vegetables is estimated at about 4,000 ha of which 2,400 ha (60%) devoted to off-season production of which 640 ha are for greenhouse crops with an intensifying rate reached 127%. The annual vegetable production is estimated at 170,000 tons, 110,000 tons of vegetables out of season. The governorate has about 10,000 greenhouses (25% of the national total), which generated an average production estimated at 57,000 tons (40% of national production).

The region specializing in market gardening produce (tomatoes, potatoes, peppers, watermelon and melon, etc.). We note that in 2011, the amount of tomatoes reached 162,000 tons in comparison with other productions. The production of other vegetables comes in 2nd position and potato production, and then the production of peppers finally production watermelon and melon that have relatively lower amounts compared to other market garden productions.

OLIVE TREES: The area occupied by olive trees is 63,636 ha or 74% of total agricultural area and 4% of the total area of the olive trees in Tunisia. The olive grove in the governorate has 3452045 olive feet. The average production of olives in the last decade is 62,000 tons, the equivalent of 12,400 tons of oil. The governorate has 168 olive presses which 88 are continuous chain type whose 03 devoted to organic oil extraction. Organic olive trees occupy an area of about 4000 ha or 200,000 feet. The average olive production is 4,000 tons or 800 tons of oil.Producing olives for oil is more remarkable in comparison with almonds productions, apricots and other fruits. The production of olive oil during evolves over time but every year it is sometimes up, sometimes down. She recorded a minimum of 2,500 tons in 2002 to a high of 103,790 in 2009 (average rainfall on that date is of the order of 417mm) .The minimum amount of almonds is 486 tons in 2001, while the amount maximum is 1717 1990.

FRUIT TREES: The area under fruit trees is about 8500 ha generating an average production of about 12,500 tons. The most important tree species in the area are dry almond, peach irrigated and dry apricot. For the production of apricots is minimum 302 tons in 2010, it is maximum in 1994 of around 850 tons. For other fruit production increased from a low of 2,284 tons in 1989 to 9869 tons in 2008.

ORGANIC CROP: The area approved by the control structures and certification in the year 2011 reached a total 4042 hectares, divided as follows: Olives: 4000 ha Fruit trees: 17 ha Vegetables: 4 ha, pastures: 6 ha, Prickly pear: 15 ha.

AREA OF ANIMAL PRODUCTION: Livestock production consists mainly of cattle, sheep and poultry. The distribution of the herd is made according to the number of heads of three categories: (Cattle, Sheep and Goats). Livestock production results through about 6360 head of cattle, 49,000 sheep and 4 strips (4 fillings buildings per year) of broilers.

The development of animal production during the period from 1989 to 2011, milk production in the region recorded a rise to 2001, and this production sometimes drops and sometimes increases, but keeps a widely abundant enough in comparison to the production of poultry which has the 2nd position, then the production of turkeys and other meat comes in 3rd position. Cattle production is relatively higher than goats.Egg production in the region has 300 million units in 2001 preceded by a smaller scale production of 80 million units in 1999. The production before and after these two years is relatively small amounts.

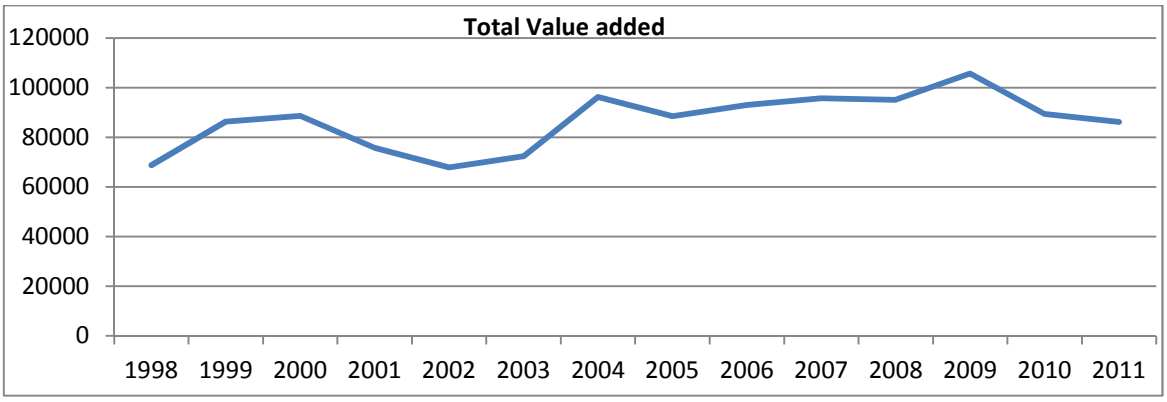
FISHERIES: The governorate has 64 km of coastline and 5 fishing ports (1 for deep fishing and 4 for coastal fishing). The region also specializes in sea fishing as this sector has assured in 2011, about 24,000 tons of fish, of which 19,193 tons of blue fish and 1962 tons from fish farming. It also provides about 4,000 jobs. Fish production in the region is about 15% of national production. The Port of "Teboulba" is one of the largest ports and most equipped and performs extensive fishing productions and clutter from 83% of production in the region. The fleet operating in this sector in 2011 is made up of 933 fishing units including 863 coastal fishing boats, 62 blue fish fishing units. Also, it is in the governorate 38 ice manufacturing plants and 17 manufacturing facilities and ship repair and 4 workshops for making nets.

Marine production is remarkable that after the fishing fires comparison to other means. It starts with a minimum of 6 tons in 1990 to 19,193 tons in 2011, while the production from trawling it is not important from a minimum of 13 in 1992 to a high of 563 in 1996. For coastal fisheries production has increased from a minimum of 1 943 tons in 2008 to a maximum of 3903 tons in 1996. For other ways of fishing, the minimum production increased from 27 tons in 2001 to 2167 tons in 2011.

Evolution of agricultural production between (2004-2008): The region of Monastir specializes in vegetable crops, the share of production for this period is on average 48.43%, followed by the production of olive oil which has an average of 24% and milk production with an average of a rate of 14.25%. Other agricultural products have very low production units that average between 1.33% and 4.18%. The advantage of this development is to show that the structure of production in the Monastir region is dominated by the market gardening sector against nationally (see table below) and a staggered period of one year (even duration: 4 years), this structure is predominated by the farming sector while the gardening ranks third.

Evolution of value added: (See Figure 1 below)

Figure-1 Evolution of the total value added (in thousand dinars) between 1998 and 2011



Source: *CRDA*

During the observation period, years 1998 - 2011, the value added by agriculture and fisheries has evolved from a low of 68.778 million dinars recorded in 1998 and a maximum of 105,641,000 dinars obtained 2009. This is indicated by the figure above. It appears that the data available agricultural value added, as the value of production, knows important variations. These lead to annual growth rates sometimes positive and sometimes negative. Despite its deployment, fishing is a relatively secondary place.

CLASSIFICATION OF THE REGION IN NATIONAL: There is Note that the Monastir region has achieved leadership rankings in the production at the national level in 2009 and this according to specialty (early vegetables in greenhouses, producing blue fish).

EXPORT OF AGRICULTURAL PRODUCTS: On the other hand, estimates of agricultural products exported from Monastir airport are: vegetables: 198.6 tons, cereals 12.4 tons of seafood: 84 tons.

EVOLUTION OF TRADITIONAL INDUSTRY GREENHOUSE: The governorate of Monastir is located in the coastal center of the country and covers a total area of approximately 1,024 square kilometers (0.7% of the country of Tunisia) and characterized a semi-arid climate where temperatures are relatively mild, particularly in winter which allowed him to cultivate greens off season especially early vegetables in greenhouses which represent the basic foundation of agricultural activity in the region. The culture of premieres began under traditional greenhouses since the 1975-1976 campaign (26 greenhouses). This sector has experienced a remarkable development in the area covered during the period (1975-1985) during which the total

number reached 6290 greenhouses. The highlight of the introduction of greenhouses occurred in both 1980-1981 and 1981-1982 campaigns by installing 3473 greenhouses. During the period since there has been a decline in the annual rate of acquisition of greenhouses (170 greenhouses) to reach after 30 years (in 2009) 10,500 greenhouses (525 ha). Current statistics 8470 greenhouses beyond the age of 20 or 86.5% of greenhouses and glasshouses 7670 exceed the age of 25 is 78.3% of the greenhouses.

Although this technique has, in a first stage, the development of the sector and meets the requirements of the protected cultivation, this structure have not had the desired evolution in design and has not kept pace technical development on the world stage. Inspections and field visits have shown a number of gaps in the features, which we quote:

- The aging of these structures with a single tunnel that cannot support the weight of exceptional plantations and fluids, especially during peak production. It was recorded in this context the collapse of many greenhouses, especially in case of natural disasters (strong winds, heavy rainfall);
- The lack of an effective ventilation system: a controlled ventilation system is necessary for the greenhouse to achieve the degree of consistency with plantations and reduce the high moisture content of the air especially in some coastal areas and thus reduce the occurrence of a large number of fungal diseases.

Traditional greenhouses have highlighted limitations in productivity compared to crops under the multi-chapels greenhouses that will not compete with the foreign market and provide a major production for export.

TECHNICAL AND ECONOMIC CHARACTERISTICS OF MULTI SERRES - CHAPELLES

Multi-chapels greenhouses have many technical and economic advantages that contribute to the achievement of high productivity and profitability as well as the rehabilitation of the futures industry in general. These benefits are listed as follows: Profit in the area covered by hectare; Earnings in the plastic cover; Economy in irrigation water; allow early and better production in terms of quantity and quality and thus enable improved profitability.

PROFIT IN THE AREA COVERED: In all cases, one hectare of land cannot support more than 13.5 ordinary greenhouses (6885 square meters), which implies 1563 square meters per hectare will not be exploited in the case of adoption of the common greenhouses. Multi-chapels greenhouses have an earth coverage rate estimated at 84%, while this ratio does not exceed 69% for ordinary greenhouse and is able to win 15% of the cultivated area.

BENEFIT UNDER COVER PLASTIC: For multi-chapels greenhouses, it is recommended to use the "Polyethylene" triple layers since it is a thermal insulator which prevents the low temperatures at night and has a thickness (60µ - 80µ - 60µ) and earnings in the amount of plastic to cover an acre multi-chapels greenhouse is estimated 20% to 30% compared with that used for ordinary greenhouses (one tunnel) and profit in the amount of plastic has a corresponding decrease in the cost Annual 3600 dinars considering the amortization of plastic is over 3 years.

ECONOMY IN IRRIGATION WATER: Multi-chapels allow the collection of rainwater greenhouses in channels provided for this purpose and to link them with a tank dedicated to irrigate crops in condensed homes and necessary in reducing soil salinity. They also help to reduce the pressure demands for irrigation of public irrigation schemes. And when you consider that the average annual precipitation is about 350 mm or 3500 m3 per hectare that only 50% of this water can be assembled, it will be able to build 1750 m3 per hectare, equivalent nearly 50% of the needs of one hectare of crops in a season that lasts about 9 months in greenhouses.

MATURITY AND QUALITY IMPROVEMENT: Compared with ordinary greenhouses, multi-chapels greenhouses provide good thermal equilibrium overnight which is estimated at two degrees and lead to significant improvement in the indoor climate of greenhouses and a positive effect on crop growth and generates a gain on early production especially melon and chilli. In addition to the features mentioned above, the multi-chapels spaced greenhouses allow an easy job and help reduce the temperature difference between day and night, allowing to control humidity and reduce the spread of fungal diseases and to provide a good quality production ready for export.

Thus, despite all these advantages mentioned above multi-chapels greenhouses which inevitably have a positive effect on the profitability of the sector is the high investment cost and rate of grants awarded relatively small today, which has hindered the expansion of this type of greenhouses and rehabilitation sector despite a demand from farmers of the region to the greenhouses category.

To address these obstacles, it is suggested in this context: An exemption of all equipment, components of multi-chapels greenhouses added value including ventilation and PVC layer and water connections. An increase in the roof of subsidies for the categories "B" and "C" to a limit of 40% as is well known in the rehabilitation of fishing and the economy in irrigation

sector. Given the age of the common equipment, it is essential to renew a third of the fleet over the next five years as follows: Funding Program: (Self-financing: 10% Grant: 40% Loan 50% proposed area for Renewal: 150 ha, current investment cost: 150 ha × 300 dinars = 45 million dinars investment cost by integrating the exemption from value added: 150 × 270 000 dinars = 40.5 million dinars.

SCALE AND EVALUATION OF COVERAGE AND INCREASED PRODUCTION: Multi-chapels greenhouses are characterized by the possibility of adoption of a high density of plants use throughout the area covered and the reduction of the distance between the lines, as it allows the horizontal trellis plants. The crops that are traded in the greenhouses are as follows: peppers, tomatoes, melons and by comparing the density of plants between ordinary greenhouses and those multi-chapels, it is clear that there is a difference that can up to 3900 seedlings for melon, 5770 plants for growing chillies and 7200 plants for growing tomatoes in favor of multi-chapels greenhouses.

Earnings in plants density can lead to increased production estimated at: (15 tons / ha for peppers, 30 tons / ha for tomatoes, 10.5 tons per hectare for melon).

Factors encouraging investment in the region: Monastir region occupies a strategic geographical location in the middle of the East coast of Tunisia. Despite its limited size and low natural resources, it is regarded as an evolutionary development center as it is considered an important urban center and an employment reservoir comprising qualified human resources, infrastructure and sophisticated utilities and motivating economic activities and a life of luxury quality.

STRATEGIC GEOGRAPHICAL SITECITY Monastir: It is at the center of the Tunisian coast, overlooking the Mediterranean Sea. It is located just 15 km from Sousse commercial port, at a distance of 60 km from the Enfidha International Airport and future deepwater port in off the coast Hergla for the flow of goods and commodities.

CITY CENTRE IMPORTANT: Population of 456,000 inhabitants, the high population density of 445 inhabitants / km2 compared to 64 inhabitants / km2 nationwide. Among the important areas that attract the migratory flow from other governorates. And this is how the governorate of Monastir is a huge consumer center.

QUALIFIED HUMAN RESOURCES: Eight vocational training centers total capacity of 3445 people including 2 centers specializing in agriculture and fishing. Close to two research centers for the development namely the Institute of the olive and fruit trees KalâaKbira and the center of the organic farming Chott Meriam.

INFRASTRUCTURE AND SOPHISTICATED EQUIPMENT GROUP

- Equipment environmental protection across the network ONAS (National Sanitation Office) to be used (proportion of network connection is 97.2%)treatment plants and sewage and supervised estuaries;
- Irrigated perimeters including an area equipped with the means of the estimated 5370 ha intensive irrigation ready to be expanded especially in inland regions of the Governorate of which 3670 ha of public irrigation schemes;
- Infrastructure developed that portconsists of five fishing harbors contributed effectively to the success of the national strategy for the development of fisheries for blue fish;
- Network of wholesale markets for fruits and vegetables, livestock and fishery products;
- Network storage units and packaging of the product, it consists of 44 cold storage of vegetables and total capacity of 3310 tons fruits; 14 Institutions for storage of fresh and frozen seafood products; 5 establishments processing and packaging of seafood.

ADMINISTRATION NEAR THE FARMER AND OPEN TO PROJECT CREATION OF ENVIRONMENT

Administration to listen to the concerns of farmers and new promoters, it provides them with the necessary technical support through extension and helps secure funding and take advantage of state privileges and this through:

- 11 Agricultural Extension cells covering all regions of the Governorate,
- 2 cells for fishing in Sayada and Téboulba.
- 42 agricultural centers of radiation.
- Agricultural map: helps guide developers and their management structures (offices and agricultural consultants) to the most appropriate agrarian activities to natural and economic data for the project, where there are different possibilities of activities that can be performed, listed in order of priority,
- A developed and varied banking network including five branches of the national agricultural bank.
- Promotion Agency Agricultural Investment (APIA)
- Agency Tunisian Solidarity Bank (BTS)

CHARACTERISTICS OF DIFFERENTIAL GOVERNORATE

- Close distances, which means lower costs for transport and distribution operations and supply and also a rapid export transactions of goods and import of inputs,
- Specializing in the production of early vegetables at national level,
- Possession of highly qualified technical skills and good command of such cultures,
- A futures of area represents 57% of vegetable area (10000 greenhouses)
- Production of early vegetables represents 76% of the total vegetable production
- With the highest productivity at the national level,
- High potential for export, directly or in partnership,
- A constant desire and a huge capacity of producers in the region to demand new production technologies in the fields of agriculture and fisheries.

OTHER AREAS OF INVESTMENT

- Organic crops such as vegetables, olives and some types of fruit.
- Export of vegetables out of season.
- Medicinal Plants and flowers.
- Nurseries the production of olive plants and fruit trees
- Breeding heifers, provided a solution for the supply of them from outside the governorate
- Aquaculture due to the availability of suitable sites for this type of activity and similar to sites Téboulba - Bekalta and Monastir - Khniss
- Packaging and olive oil packaging.
- Packaging of agricultural and fishery products
- Cold storage and freezing of poultry products.

PUBLIC AND PRIVATE INVESTMENT IN THE XIthPlan: Public and private investments in the XIth Plan in the region during the period (2007-2011) are shown in the Table below:

Table 1: Public and private investment in the XIth Plan (2007/2011)

INVESTMENTS (thousand dinars)		2007	2008	2009	2010	2011	GRAND TOTAL
PUBLIC		3410	3686	2776	2746	3013	15631
PRIVATE	"TO"	517	504	863	759	1251	3894
	"B" and "C"	11215	6800	14118	22021	30000	84154
GRAND TOTAL		15142	10990	17757	25526	34264	103679

Source:*CRDA (2012)*

Private investments for the three project types (A, B and C) as of 2011 are shown in the table below:

Table 2:Privateinvestment in 2011

Type Investment	Investment value (million dinars)	Value of privileges (million dinars)	Manyinvestors
Project Type A	1,251	0.390	188
Project types B and C	30,000	1,800	94
GRAND TOTAL	31.251	2,190	282

Source: *CRDA (2012)*

The investment program in the next Plan (2012-2016) is shown in the table below.

Table 3: Investment program over the next plan (2012-2016)

YEARS	2012	2013	2014	2015	2016	GRAND TOTAL
Programmed Area (ha)	20	30	30	35	35	150
Investment (dinars)	5400	8100	8100	9450	9450	40500
Ready (50%)	2700	4050	4050	4725	4725	20250
Subsidy (40%)	2160	3240	3240	3780	3780	16200
Cash flow (10%)	540	810	810	945	945	4050

Source: *CRDA (2012)*

In addition, the amounts of money included in the state budget for the year 2010 are shown in the table below:

Table No. 4: Appropriations included in the state budget in 2010

Securities	2009 residues (dinars)	Year loans (dinars)	Total credits (dinars)	Credits completed (dinars)	Completion Rate (%)
TITLE I	-	1112	1112	1051	94.5
TITLE II	1368	2999	4367	2785	64
GRAND TOTAL	1368	4111	5479	3836	70

Source: *CRDA (2011)*

AGRICULTURAL PROJECTS IN THE REGION OF MONASTIR: It is noteworthy that several projects at different stages of development located in the governorate or in certain delegations (Téboulba, Bekalta, Kouria) and are in progress.

AQUACULTURE PROJECTS IN THE REGION OF MONASTIR: Other projects that are completed, some who received the original agreement and some have received final approval.

New projects relating to the agricultural sector in the region are subsequently planned according to specific pre-planning. However, do not forget to mention the projects by the business incubator at the National Institute of Science and Monastir marine technologies up to 30 September 2011. The labor employed in the nursery companies totaled a number that exceeds 17 workers.

EMPIRICAL STUDY

In what follows, we will examine the impact of agriculture in the region of Monastir on the country's economic growth. In other words, the degree of contribution to growth and this through an empirical study (Methodology applied through the study of the variables over time "time series" over a period exceeding fifteen years) that will be developed in this frame starting from a Cobb-Douglas function.

Our model based on economic model taking into account the study of a single sector and combining agricultural added value of the region of Monastir to economic growth and this during 1995-2011. The general claim is to see whether an increase in agricultural production in Monastir has increased the level of economic growth over a given period of time.

The objective is to try to deliver an econometric model that can be used to assess the sensitivity of GDP per person to changes in total agricultural production (improving the total value added of the sector) following changes in the productivity of labor in this sector. This ambitious claim is the niche or the basic element of this study. In this part, a positive association was assumed between agriculture and the level of gross domestic product per person in 1995-2011.

Economic and econometric framework model: The theories of modern economic growth are driven by technology rather than physical capital. This was a significant change in the understanding and conceptualization of the process of agricultural contributions to economic growth is essential for development. The fundamental theoretical framework of this study is based on the unilateral economic or business model to one sector, in our case, it is the agricultural sector. The traditional sector has a fixed amount of land, little capital and a large preexisting labor. Thus, to analyze the impact of agriculture on the

economic development of our country during the period 1995-2011, the mathematical expression or identity largely authorized representative of the overall added value of the agriculture and fisheries sector is adopted.

The Cobb - Douglas in our case takes into account the added value of agriculture rather than production, it is of the following form:

$$Y = AK^{\alpha} S_{ir}^{\beta} M_{pv}^{\gamma} U_{pf}^{\theta}$$

This form can be linearized as follows:

$$\log Y = \log A + \alpha \log K + \beta \log S_{ir} + \gamma \log M_{pv} + \theta \log U_{pf} + \varepsilon_t$$

Where α, β, γ and θare parameters determined by technology. They are also assigned to the elasticity coefficients of the explanatory variables.

Objective and estimation method: Our goal is to estimate a function of the added value of the Cobb-Douglas type of agriculture based on some explanatory variables, some of which are exogenous to the model namely Sir reminiscent irrigated areas with economic water resources irrigation, Mpv representing the average rainfall in the governorate, UPF that indicates the number of fishing units at the lights used in fishing for blue fish.

Data and variables: The data collected from the CRDA correspond to time series. The evolution of variables related to agriculture and fisheries over time in the region are defined below. The subject study period spans seventeen years from 1995 to 2011.

Y: VA: Variable value, **A:** Technical progress, **K:** Variable investment, **Sir:** Variable irrigated areas with the economic means of irrigation water (taste to taste) **Mpv:** Variable average rainfall in the governorate of Monastir, **UPF:** variable number of fishing units with lights, ε_t: Error Term

Graphical representation of the series and various tests: stationary series in level: The graphical representation for each series can raise the nonstationarity which is justified by the presence in the trend curve (trend) or the seasonal component distinguished by regular peaks. According to the figures, we see that all the series in question are not stationary in levels. According to established correlograms, there is the non-stationary series.

- **Unit root test:** Before estimating the model, it should be stationarity tests of the variables for stationarity is a necessary condition to avoid spurious relations, and check the cointegration relationship between variables, that is to say, s' ensure the convergence of different growth path over the long term. Unit root tests can highlight the stationary or not chronic by determining a deterministic or stochastic trend. Indeed, we are referring to the Dickey-Fuller test increased (1981) and Phillips Perron test (1989) to determine the order of differentiation of macroeconomic series following its evolution over time.
- **Test Augmented Dickey-Fuller (1981):** Regarding the increased Dickey-Fuller test, it is used on macro series whose evolution over time shows no change, and whose fluctuations are stationary around a deterministic function. Indeed, determining the order of integration require the use of the unit root test in the three models comprising successively a trend and a constant, then only a constant and finally either constant or trend.

$$\text{a) } \Delta X_t = \Phi X_{t-1} + \lambda + \delta t + \sum_{j=1}^{p} \gamma_j \Delta X_{t-j} + \eta_t$$

$$\text{b) } \Delta X_t = \Phi X_{t-1} + \mu + \sum_{j=1}^{p} \gamma_j \Delta X_{t-j} + \eta_t$$

$$\text{c) } \Delta X_t = \Phi X_{t-1} + \sum_{p}^{j} \gamma_j \Delta X_{t-j} + \eta_t$$

And we deduce:

The null hypothesis of non-stationarity results in the invalidity of the coefficient Φ and for any model. The number of late P is chosen according to the Akaike information criterion (AIC) and Schwartz (SC). This number corresponds to the one that minimizes both information criteria. According to the curves of output per job in logarithms (log y) and the average number of years of study (S), we see that their changes over time have an upward trend and unique and pose breaking problem. This

leads us to test their stationarity by the Dickey-Fuller test increased in each equation (a, b or c) to choose the appropriate equation. The results below show that the model with constant and without trend (equation b) is most suitable.

The table below summarizes the results of the stationarity test for each variable to distinguish those that are stationary in level of those stationary in first difference.

STATIONARITY TEST:

MODELS	p. (Prob) Critical ADF test				
	Log VA	Log k	The Pvm	The Sir	The UPF
LEVEL	0.0251	0.83	0.0001	0.0003	.9855
DIFFERENCE	--------	0.03	------	--------	0.0655
CONCLUSION	Stationary in level	Stationary in first differences	Stationary in level	Stationary in level	Stationary in first differences

❖ **Estimated using ordinary least squares (OLS)**

- OLS, using observations from 1995-2011 (T = 17)

LVA	Coefficient	Standard deviation	Stat Z	P> | Z |
Constant	10,214	1,084	9.415	<0.0001 ***
LK	0.162	0,137	2,183	0.05956 **
LSIR	0,127	0,050	2,499	0.02794 **
l_Pvm	0.058	0.091	0.642	0.53255
l_Upf	0,350	0.292	1,196	0.25448

**Meaning the risk by 10%*
*** Signification risk of 5%*
**** Meaning the risk of 1%*

- **Heteroscedasticity corrected using the observations of 1995-2011 (T = 17)**

LVA	Coefficient	Standard deviation	Stat Z	P> | Z |
Constant	9.906	0.751	13.189	<0.00001 ***
LK	0.112	0,120	1,931	0.06983 **
LSIR	0.154	0,037	4,136	0.00138 ***
l_Pvm	0,114	0,061	1,873	0.08559 *
l_Upf	0.169	0.261	0,650	0.52762

** Meaning the risk by 10%*
*** Signification risk of 5%*
**** Meaning the risk of 1%*

RESULTS AND INTERPRETATION OF THE ESTIMATES OF THE VALUE ADDED FUNCTION

According to the results, we find that the regression explaining the VA per capita by various factors cited above, shows significant effects of most of the explanatory variables. Since the variables are expressed in logarithms, coefficients obviously correspond to elasticity.

Our estimate gives a coefficient of elasticity of the growth of the VA relative to Sir positive and is equal to 0.15. In other words, an increase in the variableirrigated areas with the economic means of irrigation water (taste to taste) Sir 10% leads, other things being equal, an increase of 1.5% of VA per capita which is logical and confirms the empirical studies . The investment variable is highly significant. An increase of 10% of the investment suggests an increase in VA per capita of 1.12%. In fact, any increase in investment is associated with an increase in VA per capita.

Regarding the average variable rainfall in the governorate of Monastir, we find a significant and positive effect of this indicator on the growth of the VA that a 10% increase in rainfall is associated with an increase in 1.4% at the VA per capita. This confirms the strong effect of this variable on the improvement of the agriculture sector.

The variable, number of fishing units with lights has a positive effect but not significant on improving VA per capita in the Monastir region. The increase in UPF and 10% work generates a VA improvement of 1.6% per capita.

CONCLUSION

In this research paper, we regressed some indicators of agriculture value added, we choose the Monastir region or the agricultural sector has taken in recent years, an important part of any strategy for economic development. We used a Cobb-Douglas production function over a period of seventeen years. We applied the new time series econometric techniques. Through this empirical study, we find that the predictors of agriculture in the region of Monastir have crucial effects on the improvement of agricultural value added. This result confirms the beneficial effect of agriculture on the agricultural regional development. Agriculture as any other economic sector is an important dimension that requires much attention for sustainable regional development.

The econometric results, different tests to the initial model, shows a significance of most of the explanatory variables namely the capital represented by the investment allocated to agriculture, irrigated areas with the economic means of irrigation water and the average of rainfall in the region of Monastir. While the variable number of fishing units to fire is not significant. That said, the study of the evolution of some explanatory variables and exogenous to the agricultural sector and the results of the econometric tests previously found evidence that it contributes to a less efficient way to growth and economic development of our country given that the share of agriculture and fisheries in the region of Monastir is 4.3% (17.7% nationally) in comparison with other sectors namely industry and services occupying respectively (45.3%, 35.7%) of the largest shares in the region and thus contribute more effectively to economic growth.

Definitely, through our empirical study to justify econometrically, using data on explanatory variables and exogenous to our model with a Cobb-Douglas function varied over a staggered period of seventeen years, we have seen the leading role and significant in agriculture and fisheries in the region and its contribution to economic growth in spite of the inferiority of the area of the governorate in comparison to other neighboring areas where agricultural areas are much larger. Thus, agriculture in the region of Monastir has a positive impact on economic growth alongside the success that achieved in other sectors namely industry, tourism and services in contributing to a more efficient way growth and economic development.

REFERENCES

[1] Anne O. Krueger (1995) Policy Lessons from Development Experience since the Second World War, in: J. Behrman and TN Srinivasan, ed., Handbook of Development Economics, Vol. IIIB, North-Holland Publishing Company, Amsterdam, p. 2501. Cited by Norton (2005), p.4
[2] BarroR.and Sala-i-Martin X. (1996)Economic growth , M.Graw Hill / Edi science.
[3] Brasseul J., Introduction to development economics, Armand Colin, Paris, 1989.
[4] CAPES (2008) Contribution of dry season crops in reducing poverty and improving food security in Burkina Faso, Final Report, Ouagadougou, 135P.
[5] De Boeck (2003) "Analyzing the North-South relations" For Guillaumont Patrick, Berg Elliot, McGillivray Mark, DeJanvry Alain, Development Economics Review No. 4 December 2003, Collective, published on 15 June 2004.
[6] FAO (1996), Investment in agriculture: evolution and prospects Technical Information Document, Rome.
[7] Lewis, Arthur W. (1954) "Economic Development with Unlimited Supplies of Labor." Manchester School of Economic and Social Studies, Vol. 22, pp. 139-91
[8] Malcolm Gillis et al. (1990) Development Economics, De Boeck-Wesmael his Brussels, 734 p.
[9] Norton R. D. (2005)*Agricultural development policies: concepts and experiences, p.7.*
[10] Norton R. D. (2005) Agricultural development policies: concepts and experiences, p.3.
[11] P. Winters, A. De Janvry, Sadoulet E., K. Stamoulis (1997) the role of agriculture in economic development: visible and invisible surplus transfers, p.2.
[12] ZononAbdoulaye (2003) Education and productivity of farmers. For producers of Burkina Faso, UEPA, Dakar, 50p.

International Journal of Innovation and Scientific Research
ISSN 2351-8014 Vol. 17 No. 2 Aug. 2015, pp. 303-315
© 2015 Innovative Space of Scientific Research Journals
http://www.ijisr.issr-journals.org/

A Review of Functionalized Graphene properties and its application

Md. Sajibul Alam Bhuyan[1], Md. Nizam Uddin[1], Ferdaushi Alam Bipasha[2], Md. Maksudul Islam[3], and Sayed Shafayat Hossain[1]

[1]Department of Mechanical Engineering,
Khulna University of Engineering and Technology,
Khulna, Bangladesh

[2]Department of Mechanical Engineering,
Bangladesh University of Engineering and Technology,
Dhaka, Bangladesh

[3]Department of Industrial Management Engineering,
Khulna University of Engineering and Technology,
Khulna, Bangladesh

Copyright © 2015 ISSR Journals. This is an open access article distributed under the ***Creative Commons Attribution License***, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT: With excellent electrical, optical, magnetic and mechanical properties as well as large specific surface area, graphene has been applied in next-generation nano-electronics, ultra-high frequency device, transparent electrical conductors, composite materials, and superior energy capacitors etc. Functionalization of graphene has become a focus of extraordinary interest, because they cannot only stabilize, but also induce new properties of graphene. This review concise the properties of graphene and enormous application, from a science perspective.

KEYWORDS: Nano-electronics, Ultra-high frequency device, Capacitor, Functionalization.

1 INTRODUCTION

Graphene, which consists of a two-dimensional (2D) sheet of covalently bonded carbon atoms, forms the basis of both 3D graphite and 1D carbon nanotubes. It has attracted massive attention in recent years owing to its large specific surface area and unique electrical, mechanical and thermal properties [1, 2, 3, 4, 5]. It exhibits excellent physical and chemical properties, which makes it promising for variety of applications in the areas such as solar-cells,[6] energy storage,[7] field effect transistors,[8] catalyst support,[9] sensors,[10] and nanocomposites.[11] In 2004, Geim and co-workers at Manchester University first isolated single-layer graphene samples from graphite is shown in **(figure 1)**.

Graphene is a thrilling material. It has a large theoretical specific surface area (2630 $m^2 g^{-1}$), high intrinsic mobility (200000 $cm^2 v^{-1} s^{-1}$), [12, 13] high Young's modulus (~ 1.0 TPa) [14] and thermal conductivity (~ 5000 $Wm^{-1} K^{-1}$), [15] and its optical transmittance (~ 97.7%) and good electrical conductivity merit attention for applications such as for transparent conductive electrodes, [16 , 17] among many other potential applications. Graphene has been experimentally studied for over 40 years, [18, 19, 20, 21, 22, 23, 24] and measurements of transport properties in micromechanically exfoliated layers [25], of graphene grown on (SiC) [26], large area graphene grown on copper (Cu) substrates.

Graphene has been characterized by a variety of microscopic and other physical techniques including atomic force microscopy (AFM), transmission electron microscopy (TEM), scanning tunneling microscopy (STM) and Raman spectroscopy [27, 28, 29, 30,2]. This literature is a comprehensive overview of all major recent experimental results related to graphene properties and its applications.

Corresponding Author: Md. Sajibul Alam Bhuyan

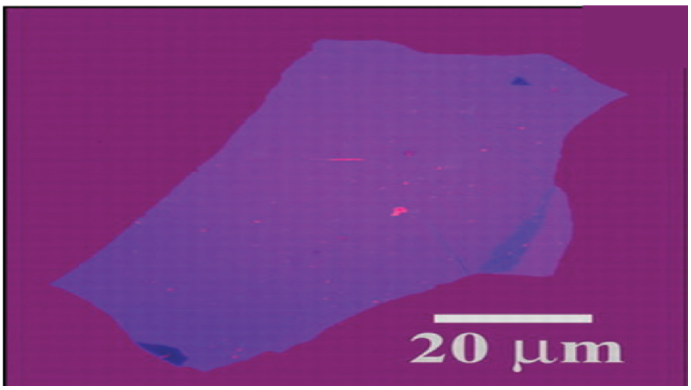


Figure 1. Single layer graphene was first observed by Geim and others at Manchester University. Here a few layer flake is shown, with optical contrast enhanced by an interference effect at a carefully chosen thickness of oxide [1].

2 SYNTHESIS OF GRAPHENE

Researchers are now making rapid progress toward generating process able graphene. After fine-tuning, the technique provided high-quality graphene crystallites up to 100 µm in size, which is adequate for an in-depth study of its properties. So far, several techniques have been established for graphene synthesis. However, mechanical cleaving (exfoliation) [31], chemical exfoliation [32, 33], chemical synthesis [34], and thermal chemical vapor deposition (CVD) [35] synthesis are the most commonly used methods today. Some other techniques are also reported such as unzipping nanotube [36, 37, 38] and microwave synthesis [39] however, those techniques need to be explored more extensively. Mono-layer graphene was first produced and reported in the year 2004, where Mechanical exfoliation using AFM cantilever (adhesive tape) was used to continually slice down the graphene layers on a substrate single-layer graphene is obtained by the reduction of single layer graphene oxide, CVD and other methods besides micromechanical cleavage. Few-layer graphenes are prepared by the conversion of nanodiamond, arc discharge of graphite and other means.

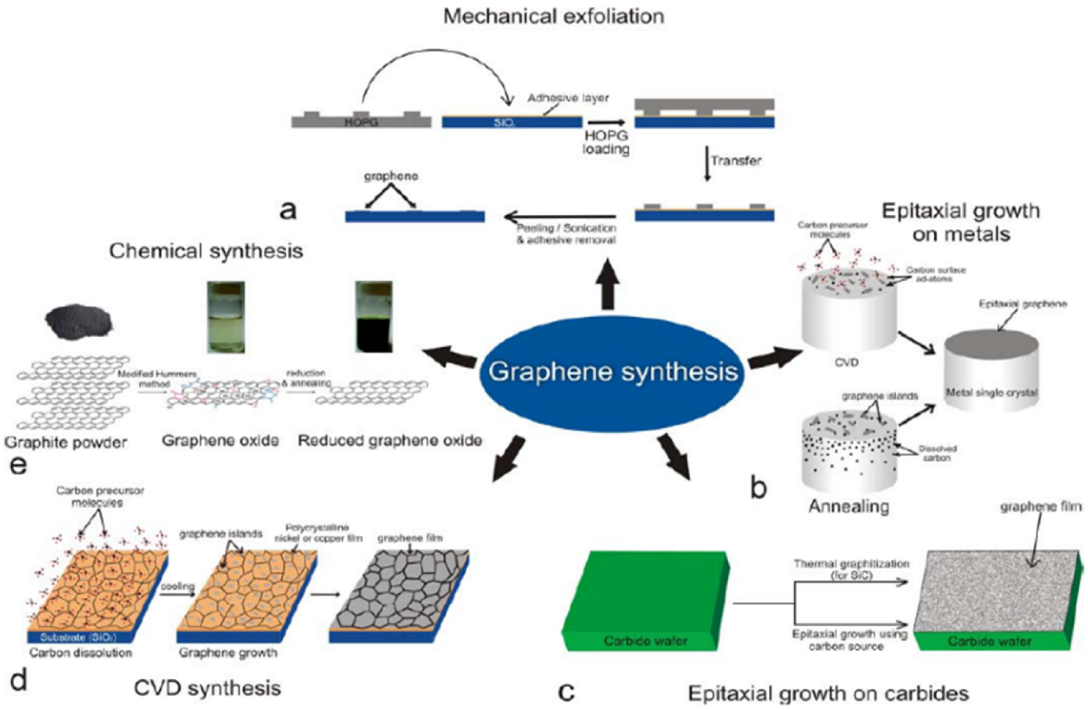


Figure 2. Flow diagram of various methods of synthesis grapheme

3 FUNCTIONALIZATION OF GRAPHENE

Graphene has been functionalized by both covalent and non-covalent means in order to disperse or solubilize them in different solvents [30, 2]. Using covalent modification, Haddon and co-workers had achieved functionalization of graphene by surface –OH and –COOH groups which was first reacted with $SOCl_2$ to create –COCl groups, followed by reaction with a long chain aliphatic amine to obtain the amide derivative soluble in nonpolar solvents [40].Soluble graphene layers in THF can be generated by the covalent attachment of alkyl chains to graphene layers via reduction of graphite fluoride with alkyl lithium reagents [41]. Such covalent functionalization enables solubilization in organic solvents such as CCl_4, CH_2Cl_2 and THF [42]. Graphene can be functionalized through π-π non-covalent modification structure by wrapping with surfactants or through interaction with aromatic molecules such as 1-pyrenebutanoic acid succinimidyl ester (PyBS) and the potassium salt of coronene tetracarboxylic acid [42].Fabrication of graphene-based devices and nanocomposites are exploiting the chemically oxidized graphene, namely graphene oxide (GO) and reduction graphene oxide (RGO).Generally, GO is produced using different variations of the Hummers' methods [43] in which graphite is oxidized using strong oxidants such as KMnO4 , KClO3 , and NaNO2 in the existence of nitric acid or its mixture with sulfuric acid. GO can be exfoliated into single or few layered nanosheets under mechanical forces such as ultrasonication.Thermally reduced GO can be produced by rapid heating of dry GO under inert gas and high temperature. The reduced graphene oxides (rGO) prepared via the two routes shows highly electrical, thermal conductivity, and ambipolarity [44]. Graphene-based polymer nanocomposites can be produced via in situ intercalative polymerization of monomers, melting blending, solution-based processes.

4 ELECTRONIC PROPERTIES

4.1 BAND GAP

Monolayer graphene shows a so-called ambipolar characteristic, where electrons and holes coexist symmetrically against the Fermi level. The first Brillouinzone has two in equivalent points K and K ' (called Dirac points). The tight-binding approach considering only the first nearest neighbor interaction provides the dispersion relation of the electrons near the *K* / *K* ' points [46, 47]. The energy band structures and dispersion relations for graphene are illustrated in (**figure 3**).

$$E \pm (\vec{K}) = \pm t \left(1 + 4 \cos \frac{\sqrt{3k_x}}{2} \cos \frac{k_y a}{2} + 4 \cos^2 \frac{k_y a}{2} \right)^{\frac{1}{2}} \quad (1)$$

Where $a = \sqrt{3} a_{cc}$, a_{cc} is the carbon-carbon bonding length (0.142 nm), and t is the transfer integral is the nearest neighbor hopping energy with a magnitude of about 2.8 eV.

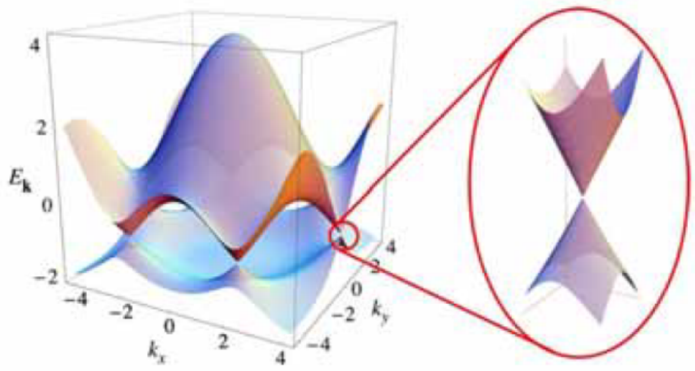


Figure 3. A schematic illustration of graphene's band structure from tight-binding bonding [47].

Due to the honeycomb lattice structure, graphene has two types of carrier transport: one is along with the armchair edge and the other is along the zigzag edge shown in (**figure 4**).

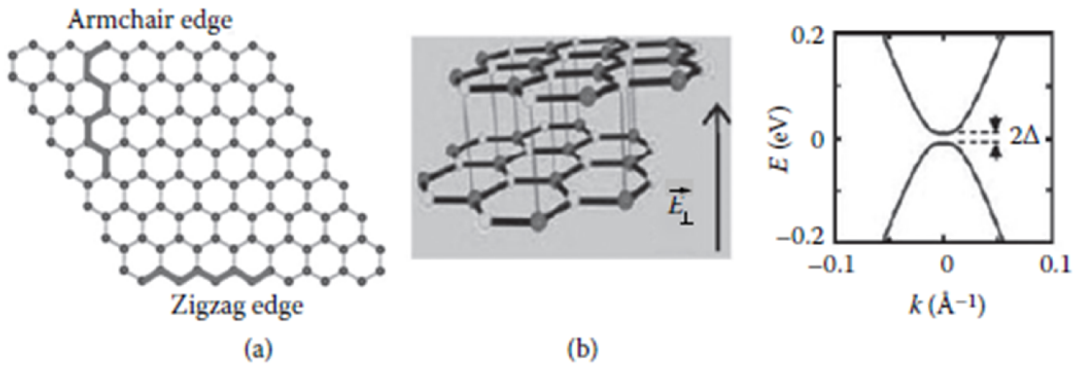


Figure 4. (a) Carrier transport for monolayer graphene and (b) band gap opening for chirally stacked bilayer graphene. [48]

Graphene nanoribbons exhibit an energy spectrum with a gap between the valence and conduction bands for armchair transport depending on the nanoribbon width dr [49].

$$\varepsilon_{p,n}^{\mp} = \pm\upsilon\{p^2 + (\pi\hbar/d_r)^2 n^2\}^{\frac{1}{2}} \quad (2)$$

where v ≈ 108 cm/s is the characteristic velocity of the electron (upper sign) and hole (lower sign) spectra, p is the momentum along the nanoribbon, ħ is the reduced Planck constant, and n = 1, 2, 3, … is the sub band index. A-B stacked bilayer graphene exhibits an energy gap Eg between the valence and conduction bands [50].

$$E = \frac{edV_g}{W} \quad (3)$$

Where d ≈ 0.36 nm is the effective spacing between the graphene layers in the graphenebilayer (GBL) which accounts for the screening of the electric field betweenthese layers, W is the distance between the gate and the graphene layer, and Vg is thegate-source voltage.

4.2 Ultra-High Mobility

The mobility of graphene is not significantly depend on temperature in the measurement. Thus, mobility of graphene is found to be ultra-high (exceeding 15, 000 $cm^2\ V^{-1}\ s^{-1}$ at room temperature [5]. In the meantime, theoretically, electrical resistance of grphene calculated from the ultra-high mobility values can be as low as $10^{-6}\ \Omega^{\bullet}cm$, which is even lower than that of silver. However, electrical resistance of graphene in real application may not reach its theoretical value due to effect of solid substracts, phone scattering from graphene to environment, so that the mobility and electrical resistance of graphene are usually restricted.

5 Mechanical Properties

The mechanical properties of monolayer graphene including the Young's modulus and fracture strength have been investigated by numerical simulations such as molecular dynamics [51, 52, 53]. Defect-free graphene is the stiffest material, with Young's modulus of 1.0 TPa, ever reported in nature and also has superior intrinsic strength, ~ 130 GPa [5]. The average Young's modulus and the highest fracture strength of functionalization, assembly, and cross-linking of graphene sheets [54] obtained were ~ 32 GPa and ~ 120 MPa [55]. The elastic properties and intrinsic breaking strength of free-standing monolayer graphene were measured by nano indentation using an AFM (atomic force microscope). The mechanical properties of this 'graphene oxide paper' were improved by introducing chemical cross linking between individual platelets using divalent ions[56] and polyallylamine [57]. The mechanical properties as prepared graphene papers were investigated by tensile, bending, indentation, and superior hardness test.

5.1 Tensile Test

Stress and strain amounts based on their dimensions and following equations:

$$\varepsilon_x = U_x\,, \quad (4)$$

$$\sigma_x = \frac{F}{A}, \quad (5)$$

$$\varepsilon_x = 1 * \frac{(\sigma_x - \upsilon\sigma_y)}{E}, \quad (6)$$

Where E is the Young's modulus, F the tensile force, A the cross section area, υ the Poisson's ratio, u and ε_x the displacement and the strain in x direction, σ_x and σ_y the stresses in x and y directions. Stress-strain curves of Graphene paper (GP) and Graphene attachment with octadecylamine (G-ODA) shown in (**figure 5**) straightening behavior at the starting roughly linear [58, 59].

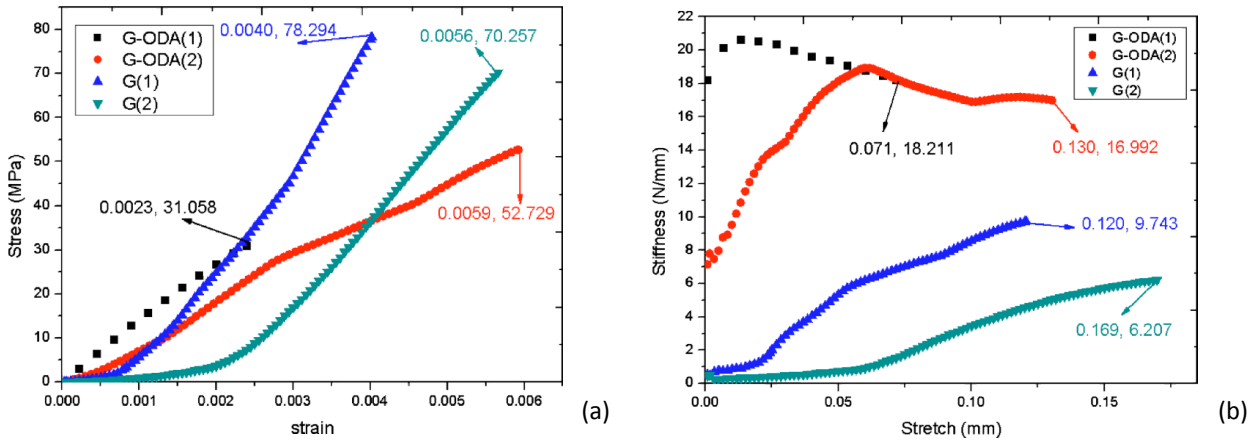


Figure 5. (a) Stress-strain curves of GP and G-ODA strips. (b) Stiffness vs stretch of GP and G-ODA strips. [60]

Stiffness (S) which is an extensive material property, can be defined as a resistance of elastic body to stretch (δ)

$$s = \frac{F}{A}, \quad (7)$$

Relationship between Young's modulus and stiffness is determined as below,

$$F = \frac{AE}{L}, \quad (8)$$

Where L is the length of strip. From (**figure 5.b**) shows that GP has greater Young's modulus and ultimate strength but G-ODA sheets exhibit higher stiffness.

Bucky papers prepared by different synthesize methods; Young's modulus (0.8–24 GPa), ultimate tensile strength (10–74 MPa) and strain (1.5%–5.6%). Maximum Young's modulus and ultimate tensile strength of our GP samples are 31.69 GPa and 78.294 MPa [61]. Young's modulus of 20–40 GPa, ultimate tensile strength of 70–80 MPa, and ultimate tensile strain of 0.3%– 0.4% were stated as mechanical properties of GP and graphene oxide papers [58, 59].

5.2 INDENTATION TEST

Spherical indenter of radius 100 µm as the most suitable indenter for thin films was selected to measure hardness, elastic modulus, yielding strength, and Poisson's ratio of GP, G-ODA. Indentation tests were carried out by an ultramicro indentation system (UMIS) and repeated on several points of GP, heat treated GP (thickness: 3 µm) and G-ODA (thickness: 7 µm) [60]. There followed this equation: [62]

$$\frac{1}{E^*} = \frac{(1-\vartheta^2)}{E} + \frac{(1-\vartheta'^2)}{E'}, \quad (9)$$

$$E = \frac{P_h}{2a}, \quad (10)$$

Hardness is calculated as,

$$H_y = \frac{P}{\pi a^2}, \quad (11)$$

Hardness, yielding strength of materials can be appraised as

Table 1. Dimensions and tensile test results of GP and G-ODA strips [63, 64].

	Length (mm)	Width (mm)	Thickness (μm)	Ultimate strain	Ultimate Strength (MPa)	Young's modulus (GPa)	Stiffness (N/mm)	Maximum stretch (mm)
GP(1)	30	5	3	0.0040	78.294	31.6969	15.8485	0.1205
GP(2)	30	5	3	0.0056	70.257	21.1987	10.5993	0.1697
G-ODA(1)	30	6	7	0.0023	31.058	15.4701	21.6582	0.0715
G-ODA(2)	30	6	7	0.0059	52.729	12.3094	23.4998	0.1302

5.3 BENDING TEST

Modulus of elasticity and bending rigidity of GP and G-ODA sheets were ascertained via bending test. Deflection equation of intensively loaded circular plate is:

$$w = \frac{F}{16\pi D}\left[2r^2\, ln\frac{r}{r_0} + (r_0^2 - r^2)\right], \quad (12)$$

$$D = \frac{Eh^3}{12(1-\vartheta^2)}, \quad (13)$$

Where r_o is the inner radius of ring, r the radial distance of intensive load to the sheet's center, F the concentrated force, D the bending rigidity, E the modulus of elasticity, h the sheet thickness, and w the deflection of sheet. Two flat rings of 3 mm inner radius were prepared; GP and G-ODA sheets with 3 and 7 μm thicknesses were firmly stuck with glue on the flat surface of these rings. For GP bending modulus of elasticity was 3.0440 TPa and for G-ODA was 0.7647 TPa [64, 65].

6 OPTICAL PROPERTIES

One of the most widely renowned optical properties of graphene is that it can act as a strong quencher for various luminescent dyes and nanoparticles [66] .This is accredited to two possible competitive processes: photo-induced electron transfer and intra-molecular energy transfer facilitated by a through-bond mechanism due to covalent binding of the luminophore [67].Graphene's transparency is more closely related to quantum effect than natural material properties. The zerogap Dirac band structure avail a fine-structure constant of graphene which can be expressed by following equation:

$$a = \frac{e^2}{\hbar c}, \quad (14)$$

Where dynamic conductivity (G) of graphene is constant ($e^2/4\hbar$) [68], Transparency (T) and reflectance (R) of graphene can be calculated by following this equation:

$$T \approx 1 - \pi a, \quad (15)$$

$$R = \frac{\pi^2 a^2 T^2}{4}, \quad (16)$$

Its constant transmittance (T ≈ 97.7%) of incident light has been experimentally observed in the visible-infrared range (300–2500 nm) and the transmittance linearly decreases withthe number of layers for n-layer graphene.

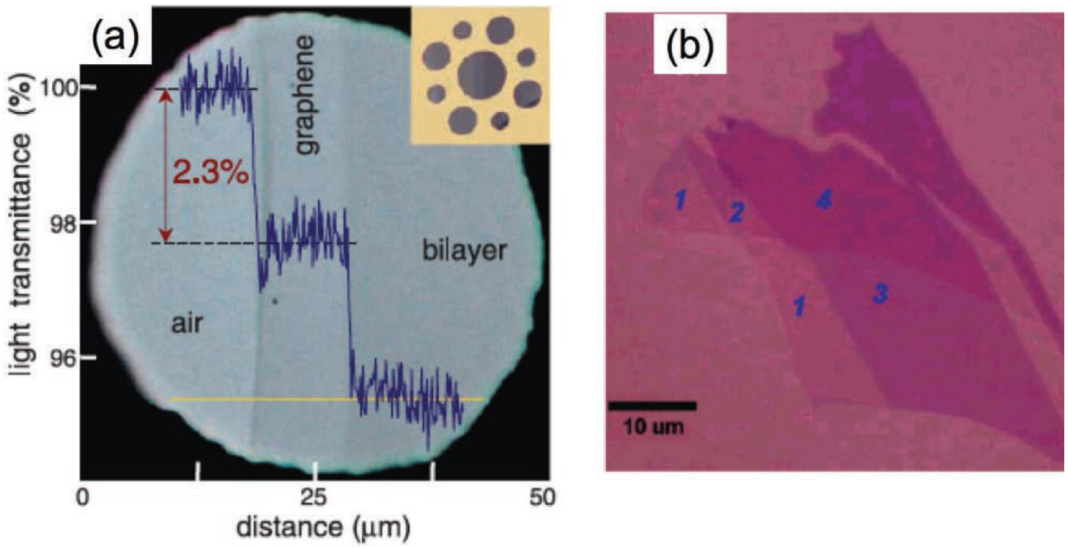


Figure 6. (a) Photograph of a 50-μm aperture partially covered by graphene and its bilayer. The line scan prof le shows the intensity of transmitted white light along the yellow line. Inset shows the sample design: a 20-μm thick metal support structure has apertures 20, 30, and 50 μm in diameter with graphene flakes deposited over them; (b) Optical image of graphene flakes with one, two, three, and four layers on a 285-nm thick SiO_2-on-Si substrate [69,70]

7 MAGNETIC PROPERTIES

Occurrence of magnetism in graphene has been a topic of considerable interest. The magnetism in graphene can be induced by vacancy defects or by hydrogen chemisorption [70]. Some researcher suggest that the zig-zag edges are responsible for the magnetic properties of graphene [71]. Graphene could have certain magnetic features including paramagnetism, spin-glass behavior and magnetic switching phenomena (ferromagnetic or antiferromagnetic) [72].

At room temperature ferromagnetism in graphene samples with very small saturation magnetization values from 0.004 to 0.020 emug−1 after subtracting the diamagnetic background [73] Magnetic properties of graphene samples prepared by EG, conversion of nanodiamond (DG), and arc evaporation of graphite in hydrogen (HG) show divergence between the field-cooled (FC) and zero-field-cooled (ZFC) data, starting around 300 K. In Figure 1(a) shows the temperature dependence of magnetization of EG and HG samples measured at 500 Oe and The graphene samples show magnetic hysteresis at room temperature (Figure 1b) and the MS increases with increase in temperature. HG shows the best hysteretic features with saturation. While DG shows saturation magnetization, MS, it is low when compared to HG.

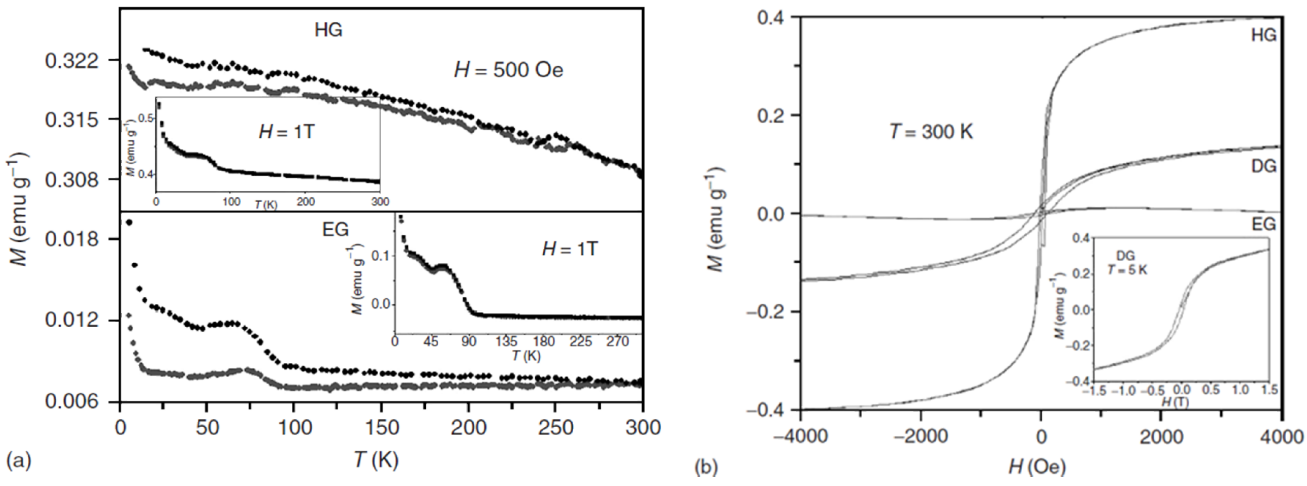


Figure 7. (a) Temperature variation of magnetization of few-layer graphenes EG and HG at 500 Oe, showing the ZFC and FC data. The insets show the magnetization data at 1 T. (b) Magnetic hysteresis in EG, DG, and HG at 300 K. Inset shows magnetic hysteresis in DG at 5 K. [74,75]

Recently modification of graphene with magnetic nanoparticles is usually accomplished by in situ reduction of iron, [76] cobalt [77] or nickel [78] salt precursors, or assembly of the pre-synthesized magnetic nanoparticles [79] on the surface of graphene-based frameworks.

8 SURFACE AREA AND GAS ADSORPTION

Single layer graphene (SG) is theoretically prophesied to have a large surface area of 2600 $m^2 g^{-1}$ [80], however the surface area of few layer graphene (FG) is 270–1550 $m^2 g^{-1}$ [81]. H_2 adsorption on FG samples prepared by the EG and transformation from nanodiamond (ND, DG) have revealed a H_2 uptake value of 1.7 wt% at atmospheric pressure and 77 K [82]. Adsorption of H_2 was found to be directly proportional to the surface area of the samples (**Figure 8a**). A maximum adsorption of 3 wt% was achieved at 298 K and 100 atm for EG. The CH_4 uptake of the graphene samples varies between 0 and 3wt% at 273 K and 5MPa. (**Figure 8b**) shows the CO_2 and methane uptake of graphene samples as well as activated charcoal against their surface areas.

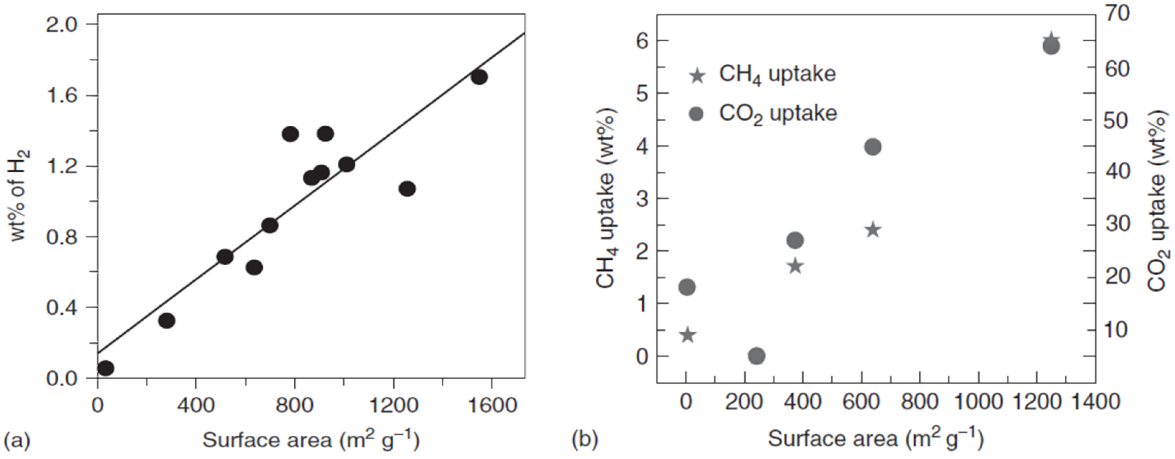


Figure 8.(a) Linear relationship between the BET (Brunauer-Emmett-Teller) surface area and weight percentage of hydrogen uptake at 1 atm pressure and 77 K for various graphene samples.[81] (b) Plot of weight percentage of CO_2 uptake (at 195 K and 1 atm) and methane uptake (at 298 K and 5 MPa) versus surface area for different graphene samples. [82]

9 SUPERCAPACITOR

Electrochemical supercapacitors with different graphene samples as electrode materials in aqueous H_2SO_4 as well as in an ionic liquid (*N*-butyl-*N*-methylpyrrolidinium bis(trifluoromethanesulfonyl)imide, PYR14TFSI) that were used as electrolytes [83] . High-surface-area graphite prepared by ball milling showed a large specific capacitance of 33 F cm^{-2} in aqueous medium, which might be due to high open surface area, lattice defects, and oxygen functional groups in the sample [84]. EG and DG exhibit high specific capacitance in aqueousH_2SO_4, the value reaching up to 117 and 35 Fg^{-1}. Chemically modified graphene sheets obtained by the reduction of graphene oxide with hydrazine when used as electrode material in supercapacitors gave specific capacitances of 135 and 99 F g^{-1} in aqueous and organic electrolytes [85]. Graphene/polyaniline composites capacitance is 1046 F g^{-1} and Graphene/$Co(OH)_2$ is 972.5 F g^{-1}.

10 OTHER PROPERTIES

Graphene is an inimitable gift of modern century. It have also some remarkable properties like Field Emission and Blue Light Emission [86, 87, 88], Molecular Charge Transfer [89, 90] Decoration with Metal and Oxide Nanoparticles [91].

11 APPLICATION

11.1 ELECTRONIC AND PHOTONIC APPLICATIONS FOR ULTRAHIGH-FREQUENCY GRAPHENE-BASED DEVICES

Due to its unique carrier transport and optical properties, including massless and gapless energy spectra graphene uses in electronic devices is as the channel material in FETs. The optical properties of graphene can provide many advantages in

optoelectronic applications. One typical example is ultrasensitive, ultrafast photodetector and phototransistor operation of graphene in junction and graphene-channel FETs.

11.2 NANOSIZED GRAPHENE IN MATERIAL SCIENCE

Nano-sized graphenes play very significant roles in materials science for its good self-assembling and charge transporting properties, and unusual absorption and emission behavior. Tuning the water solubility and preserving the fluorescence of nano-sized graphenes are the key issues for bio-imaging applications.

11.3 IN CERAMICS

Graphene-incorporated ceramic nanocomposites are also explored for Ni removal from water. MnO_2–graphene composite is studied as an absorbant for removing toxic Ni content from the water through a chemical sorption process. Graphene addition to MnO_2 is stated to enhance the adsorption capacity and mechanical intension of the composite, which improves the Ni adsorption efficiency by 52% over MnO_2 alone [92].

11.4 ANODE FOR LI-ION BATTERY

Graphene has been explored as a second-phase addition to silicon for Li-ion battery anode material [93]. Graphene, as an addition to silicon, is a potential solution to this problem because of its good conductivity, chemical stability, and mechanical properties. The presence of graphene in Si improves its suitability as a Li-ion anode material.

11.5 SUPERCAPACITOR

Due to high surface area of the composite along with the excellent electrical conductivity from both graphene and platinum makes Pt–graphene a very promising material for supercapacitors. Thus composite structure shows 19 times larger capacitance than graphene alone.

11.6 SOLAR CELL

Graphene has been and is being used as a transparent conducting electrode material in various types of inorganic, organic, and dye-sensitized solar cells, and also as counter electrodes in DSSCs (Figure 9).

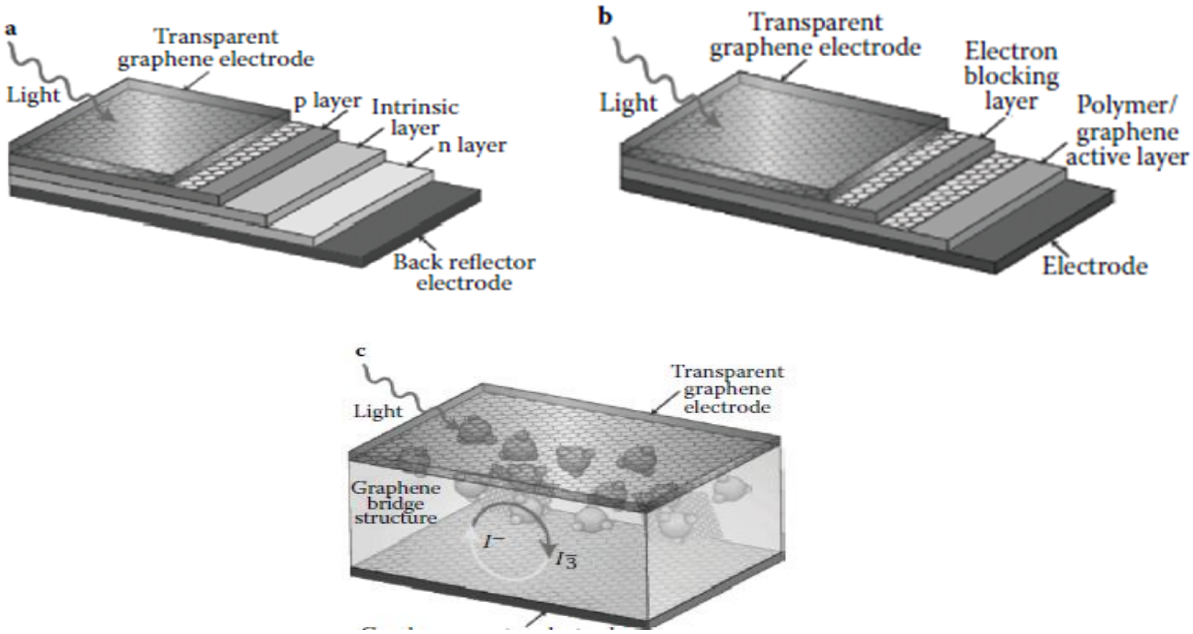


Figure 9.Schematics of graphene-based solar cells: (a) inorganic, (b) organic, and (c) dye-sensitized solar cells. [94]

12 CONCLUSION

In concise, we discuss recent advances in the unique electronic, optical, magnetic, surface area, and mechanical properties of functionalized graphene materials. We should inform that the electrical conductivity of graphene is extremely high, and functionalization of graphene is helpful for the utilization of this property. Various magnetic features of graphene can be induced through both covalent and non-covalent-functionalization (atom adsorption) of graphene sheets. Optical properties of electroluminescence was recently reported in pristine graphene and Optical properties of electroluminescence was recently reported in pristine graphene. Recently Graphene use in LED display, Bullet proof jacket even in medical science.

ACKNOWLEDGMENT

We express deep sense of gratitude and gratefulness to our project supervisor Md. Nizam Uddin, Assistant Professor, Department of Mechanical Engineering for providing precious guidance, inspiring discussions and constant supervision throughout the course of this work. His help, constructive criticism, and conscientious efforts made it possible to present the work contained in this project.

REFERENCES

[1] A.K. Geim, "Graphene: Status and Prospects", *Science (2009), Vol.* **324**, pp. 1530.
[2] C.N.R. Rao, A.K. Sood, K.S. Subrahmanyam, A. Govindaraj, *Angew.* "*Graphene: The New Two-Dimensional Nanomateria". Chem. Int. Ed. (2009), Vol.***48**, pp. 7752.
[3] A.K. Geim, K.S. Novoselov, "The rise of graphene", *Nat. Mater* (2007), Vol.**6**, pp. 183.
[4] M. Segal, "Selling graphene by the ton", *Nat. Nanotechnol(2009),vol.* **4**, pp. 612.
[5] K.S. Novoselov, A.K. Geim, S.V. Morozov, D. Jiang, S.V. Dubonos, I.V. Grigorevia, A.A. Firsov, "Electric field effect in atomically thin carbon films", *Science (2004),vol.* **306**, pp666 .
[6] X. Wang, L. Zhi, K. Mullen, "Graphene-Based Ultracapacitors",*Nano. Lett*. (2008) Vol.**8**, pp.3498 .
[7] M.D. Stoller, S. Park, Y. Zhu, J. An, R.S. Ruoff, "Transparent, Conductive Graphene Electrodes for Dye-Sensitized Solar Cells", *Nano. Lett (2008),vol.* **8**, pp.323 .
[8] L.A. Ponomarenko, F. Schedin, M.I. Katnelson, R. Yang, E.W. Hill, K.S. Novoselov, A.K. Geim, "Graphene and Emerging Materials for Post-CMOS Applications", *Science (2008),Vol.* **320**, pp.356.
[9] Y. Si, E.T. Samulski, "Exfoliated Graphene Separated by Platinum Nanoparticles",*Chem. Mater*.(2008),Vol. **20**, pp.6792.
[10] F. Schedin, A.K. Geim, S.V. Morozov, E.W. Hill, P. Blake, M.I. Katnelson, K.S. Novoselov, Detection of individual gas molecules adsorbed on graphene. *Nat. Mater* (2007) vol.**6**, pp.652.
[11] S. Stankovich, D.A. Dikin, H.B. Geoffrey Dommett, K.M. Kohlhaas, E.J. Zimney, E.A. Stach, R.D. Piner, S.T. Nguyen, R.S. Ruoff, "Synthesis, Characterization, and Properties of Large-Area" *Nature* **442**, 282 (2006).
[12] K. I. Bolotin , K. J. Sikes , Z. Jiang , M. Klima , G. Fudenberg , J. Hone , P. Kim , H. L. Stormer ,. "Ultrahigh electron mobility in suspended graphene". Solid State Commun (2008), vol.146, pp.351.
[13] S. V. Morozov , K. S. Novoselov , M. I. Katsnelson , F. Schedin , D. C. Elias , J. A. Jaszczak , A. K. Geim , "Effect of gap opening on the quasiparticle properties of doped graphene sheets Phys." Rev. Lett. (2008), vol.100, pp.016602.
[14] C. Lee , X. D. Wei , J. W. Kysar , J. Hone, "Measurement of the elastic properties and intrinsic strength of monolayer graphene." Science (2008), vol.321, pp.385.
[15] A. A. Balandin , S. Ghosh , W. Z. Bao , I. Calizo , D. Teweldebrhan , F. Miao , C. N. Lau, "Superior Thermal Conductivity of Single-Layer Graphene." Nano Lett. (2008), vol.8, pp.902.
[16] W. Cai , Y. Zhu , X. Li , R. D. Piner , R. S. Ruoff, "Graphene and graphene oxide: Synthesis, properties, and applications" Appl. Phys. Lett.(2009), vol.95, pp.123115.
[17] X. Li, Y. Zhu , W. Cai , M. Borysiak , B. Han , D. Chen , R. D. Piner , L. Colombo , R. S. Ruoff, "Transfer of Large-Area Graphene Films for High-Performance Transparent Conductive Electrodes." Nano Lett. (2009), vol.9, pp.4359.
[18] H. P. Boehm, A. Clauss , G. O. Fischer , U. Hofmann , Z. Anorg. Allg. Chem. "Chemical methods for the production of graphenes" (1962), vol.316, pp.119.
[19] H. P. Boehm, R. Setton , E. Stumpp, "Graphene and Emerging Materials for Post-CMOS Applications" Pure Appl. Chem. (1994), vol.66, pp.1893.
[20] H. P. Boehm, R. Setton , E. Stumpp, "Emerging Two-dimensional Materials: graphene and its other structural analoguesCarbon" (1986), vol.24, pp.241.
[21] J. Wintterlin , M. L. Bocquet, "Graphene Nanoelectronics: Metrology, Synthesis, Properties and Applications" Surf. Sci. (2009), vol.603, pp.1841.

[22] A. J. Vanbommel, J. E. Crombeen , A. Vantooren, "Scanning Probe Microscopy in Nanoscience and Nanotechnology" Surf. Sci. (1975), vol.48, pp.463.
[23] X. K. Lu, M. F. Yu , H. Huang , R. S. Ruoff "Graphene-based and Graphene-derived Materials, Nanotechnology" (1999), vol.10, pp.269.
[24] X. K. Lu , H. Huang , N. Nemchuk , R. S. Ruoff, "Personal perspectives on graphene" Appl. Phys. Lett.(1999), vol. 75, pp.193.
[25] K. S. Novoselov , A. K. Geim , S. V. Morozov , D. Jiang , Y. Zhang , S. V. Dubonos , I. V. Grigorieva , A. A. Firsov "Electric field effect in atomically thin carbon films." Science (2004), vol.306, pp.666.
[26] C. Berger , Z. M. Song , T. B. Li , X. B. Li , A. Y. Ogbazghi , R. Feng , Z. T. Dai , A. N. Marchenkov , E. H. Conrad , P. N. First, W. A. De Heer , J. Phys. "Physical Properties of Ceramic and Carbon Nanoscale Structures", Volume Chem. B (2004), vol.108, pp.19912.
[27] Geim, A. K. and Novoselov, K. S "The rise of graphene", Nat. Mater. (2007), vol.6, pp. 183-191.
[28] Li, D. and Kaner, R. B "Graphene-Based Materials", Science (2008), vol.320, pp. 1170-1171.
[29] Katsnelson, M. I. "Graphene: carbon in two dimensions", Materials Today (2007), 10, pp. 20-27.
[30] Rao, C. N. R., Biswas, K., Subrahmanyam, K. S. and Govindaraj, A. "Graphene, the new nanocarbon", J. Mater. Chem, (2009), vol.19, pp. 2457-2469.
[31] Novoselov, K. S., A. K. Geim, S. V. Morozov, et al. 2004. "Electric field effect in atomically thin carbon films". Science 306 (5696):666–669.
[32] Allen, M. J., V. C. Tung, and R. B. Kaner. 2010. Honeycomb carbon: A review of graphene. Chemical Reviews 110 (1):132–145.
[33] Viculis, Lisa M., Julia J. Mack, and Richard B. Kaner. 2003. A chemical route to carbon nanoscrolls. Science 299 (5611):1361.
[34] Park, S., and R. S. Ruoff. 2009. Chemical methods for the production of graphenes. NatureNanotechnology 4 (4):217–224.
[35] Reina, A., X. T. Jia, J. Ho, et al. 2009. Large area, few-layer graphene films on arbitrary substrates by chemical vapor deposition. Nano Letters 9 (1):30–35.
[36] Jiao, L. Y., X. R. Wang, G. Diankov, H. L. Wang, and H. J. Dai. 2010. Facile synthesis of highquality graphene nanoribbons. Nature Nanotechnology 5 (5):321–325.
[37] Kosynkin, D. V., A. L. Higginbotham, A. Sinitskii, et al. 2009. Longitudinal unzipping of carbon nanotubes to form graphene nanoribbons. Nature 458 (7240):872–876.
[38] Jiao, L. Y., L. Zhang, X. R. Wang, G. Diankov, and H. J. Dai. 2009. Narrow graphene nanoribbons from carbon nanotubes. Nature 458 (7240):877–880.
[39] Xin, G. Q., W. Hwang, N. Kim, S. M. Cho, and H. Chae. 2010. A graphene sheet exfoliated with microwave irradiation and interlinked by carbon nanotubes for high-performance transparent flexible electrodes. Nanotechnology 21 (40).
[40] Niyogi, S., Bekyarova, E., Itkis, M. I., McWilliams, J. L., Hamon, M. A. and Haddon, R. C "Solution Properties of Graphite and Graphene", J. Am. Chem. Soc(2006**)**, vol.128, pp. 7720-7721.
[41] Worsley, K. A., Ramesh, P., Mandal, S. K., Niyogi, S., Itkis, M. E. and Haddon, R. C. "Soluble graphene derived from graphite fluoride", Chem. (2007). Phys. Lett., vol.445, pp. 51-56.
[42] Subrahmanyam, K. S., Vivekchand, S. R. C., Govindaraj, A. and Rao, C. N. R "A study of graphenes prepared by different methods: characterization, properties and solubilization, J. Mater. Chem. (2008), vol.18, pp.1517-1523.
[43] Ghosh, A., Rao, K. V., George, S. J. and Rao, C. N. R. "Non-Covalent Functionalization, Exfoliation and Solubilization of Graphene in Water Employing a Fluorescent Coronene Carboxylate." Chem. Eur. J. (2010), vol.16, pp.2700.
[44] W. S. Hummers , R. E. Offeman , J. Am. "Preparation of graphitic oxide" Chem. Soc. (1958), vol.80, pp.1339 – 1339.
[45] O. C. Compton, S. T. Nguyen, "Graphene Oxide, Highly Reduced Graphene Oxide, and Graphene: Versatile Building Blocks for Carbon-Based Materials" Small (2010), vol.6, pp.711 – 723.
[46] P. R. Wallace, "The Band Theory of Graphite" Physical Review (1947), vol.71, pp.622.
[47] A. H. C. Neto, F. Guinea , N. M. R. Peres , K. S. Novoselov ,A. K. Geim, "The electronic properties of graphene" Rev. Mod. Phys. (2009), vol.81, pp.109.
[48] J. B. Oostinga et al. 2008. Nature Materials 7: 151.
[49] V. Ryzhii, M. Ryzhii, A. Satou, and T. Otsuji. "Current-Voltage Characteristics of a Graphene Nanoribbon Field-Effect Transistor." *J. Appl. Phys.* (2008). *Vol.*103, pp.094510.
[50] V. Ryzhii, M. Ryzhii, A. Satou, T. Otsuji, and N. Kirova. Device model for graphenebilayer field-effect transistor. J. Appl. Phys. (2009), vol.105, pp.104510.
[51] G. Van Lier , C. Van Alsenoy , V. Van Doren , P. Geerlings, "Influence of Structural Defects and Chemical Functionalisation on the Mechanical Properties of Graphene" Chem. Phys. Lett. (2000), vol.326, pp.181.

[52] C. D. Reddy , S. Rajendran , K. M. Liew, "Equilibrium configuration and continuum elastic properties of finite sized graphene", Nanotechnology (2006), 17 , 864.
[53] K. N. Kudin, G. E. Scuseria , B. I. Yakobson , "Trends in Nanoscale Mechanics: Mechanics of Carbon Nanotubes, Graphene" Phys. Rev. B (2001), vol.64, pp.235406.
[54] M. Terrones , O. Martín , M. González , J. Pozuelo , B. Serrano , J. C. Cabanelas , S. M. Vega-Díaz , J. Baselga , Adv. Mater. 2011, 23, 5302 – 5310 .
[55] Z. An , O. C. Compton , K. W. Putz , L. C. Brinson , S. T. Nguyen, "Functionalized Graphene Oxide and Graphene" (2010), vol.6, pp.711-723. [53] [71] S. Park , K. S. Lee , G. Bozoklu , W. Cai , S. T. Nguyen , R. S. Ruoff , ACS Nano 2008 , 2 , 572 .
[56] S. Park , K. S. Lee , G. Bozoklu , W. Cai , S. T. Nguyen , R. S. Ruoff, "Graphene-Based Materials: Science and Technology" ACS Nano (2008), vol.2, pp.572.
[57] S. Park, D. A. Dikin , S. T. Nguyen , R. S. Ruoff , "Graphene Oxide as an Electrophile for Carbon Nucleophiles." Phys. Chem. C (2009), vol.113, pp.3842 – 3846.
[58] D. A. Dikin, S. Stankovich, E. J. Zimney, R. D. Piner, G. H. B. Dommett, G. Evmenenko, S. T. Nguyen, and R. S. Ruoff, Nature London 448, 457 (2007)
[59] H. Q. Chen, M. B. Müller, K. J. Gilmore, G. G. Wallace, and D. Li, Adv. Mater. Weinheim, Ger. 20, 3557 (2008).
[60] A. R. Ranjbartoreh,B. Wang,1,2 X. Shen, and G. Wang. "Advanced mechanical properties of graphene paper", JOURNAL OF APPLIED PHYSICS 109, 014306 (2011)
[61] L. Berhan, Y. B. Yi, A. M. Sastry, E. Munoz, M. Selvidge, and R. Baughman, "Fabrication of Metal Alloy Deposited Flexible MWCNT Buckypaper for Thermoelectric Applications" J. Appl. Phys. (2004), vol.95, pp.4335.
[62] A. C. Fischer-Cripps, J. Mater. Res. 16, 3050 (2001).
[63] H. Hertz, J. Reine Angew. Math. 92, 156 1881; "Translate and reprinted in English in Hertz's Miscellaneous Papers, Macmillan & Co., London", (1896), Chap.5.; b)H. Hertz, J. Reine Angew. Math. 92, 156 1881; "Translate and reprinted in English in Hertz's Miscellaneous Papers, Macmillan & Co., London", (1896), Chap.6.
[64] S. P. Timoshenko and S. Woinowsky-Kreiger, "Theory of Plates and Shells", 2nd ed. McGraw-Hill, New York, (1959), pp. 51–68.
[65] S. Timoshenko, Strength of Materials, Part II Advanced Theory and Problems D. Van Nostrand Company, Inc. Princeton, (1966), pp. 92–96.
[66] W. Wei , K. Qu , J. Ren , X. Qu , Chem. Sci. 2011 , 2 , 2050 – 2056 ; b) W. Wei , C. Xu , J. Ren , B. Xu , X. Qu , Chem. Commun. 2012.
[67] M. Terrones , O. Martín , M. González , J. Pozuelo , B. Serrano , J. C. Cabanelas , S. M. Vega-Díaz , J. Baselga, "Synthesis Techniques for Polymer Nanocomposites" Adv. Mater. (2011), vol.23, pp.5302 – 5310.
[68] K. P. Loh , Q. Bao , P. K. Ang , J. Yang, "The Chemistry of Graphene - Powerpoint Review" - J. Mater. Chem. (2010), vol.20, pp.2277.
[69] R. R. Nair , P. Blake , A. N. Grigorenko , K. S. Novoselov , T. J. Booth , T. Stauber , N. M. R. Peres , A. K. Geim , Science 2008 , 320 , 1308 .
[70] Yazyev, O.V. and Helm, "Defect-induced magnetism in graphene" L. (2007) Phys. Rev. B, vol.75, pp.125408
[71] Bhowmick, S. and Shenoy, "Graphene: Synthesis, Properties, and Phenomena" V.B. (2008) J. Chem. Phys., vol. 128, pp.244717.
[72] C. N. R. Rao, H. S. S. R. Matte, K. S. Subrahmanyam, "Nanoscience: Nanostructures through Chemistry", U. Maitra, Chem. Sci. (2012), vol.3, pp.45 – 52.
[73] Y. Wang , Y. Huang , Y. Song , X. Y. Zhang , Y. F. Ma , J. J. Liang ,Y. S. Chen , Nano Lett. 2009, 9, 220 – 224.
[74] Matte, H.S.S.R., Subrahmanyam, K.S., and Rao, C.N.R. (2009) J. Phys. Chem.C, 113, 9982.
[75] Z. H. Ni , H. M. Wang , J. Kasim , H. M. Fan , T. Yu , Y. H. Wu , Y. P. Feng , Z. X. Shen , Nano Lett. 007, 7, 2758
[76] T. Szabó , A. Bakandritsos , V. Tzitzios , E. Devlin , D. Petridis , I. Dékány , J. Phys. Chem. B 2008 , 112 , 14461 – 14469
V. K. Singh , M. K. Patra , M. Manoth , G. S. Gowd , S. R. Vadera , N. Kumar , New Carbon Mater. 2009 , 24 , 147 – 152
X. Yang , X. Zhang , Y. Ma , Y. Huang , Y. Wang , Y. Chen , J. Mater. Chem. 2009, 19, 2710 – 2714
C. Gao , H. K. He, ACS Appl. Mater. Inter. 2010, 2, 3201 – 3210.
[77] Z. Ji , X. Shen , Y. Song , G. Zhu, "Classification of Electrochemically Active Polymers" Mater. Sci. Eng. B-Adv. (2011), vol.176, pp. 711 – 715.
[78] B. Li , H. Cao , J. Yin , Y. A. Wu , J. H. Warner, "Aquananotechnology: Global Prospects" J. Mater. Chem. (2012), vol.22, pp.1876 – 1883.
[79] F. He , J. Fan , D. Ma , L. Zhang , C. Leung , H. L. Chan , Carbon 2010 , 48 , 3139 – 3144 ; b) T. A. Pham , N. A. Kumar , Y. T. Jeong , Synthetic Met. 2010, 160, pp. 2028 – 2036.
[80] Peigney, A., Laurent, C., Flahaut, E., Bacsa, R.R., and Rousset, A. (2001) Carbon, 39, 507.
[81] Ghosh, A., Subrahmanyam, K.S.,Krishna, K.S., Datta, S., Govindaraj,A., Pati, S.K., and Rao, "Graphene: Synthesis, Properties, and Phenomena" C.N.R. (2008) J. Phys. Chem.C, vol.112, pp.15704.

[82] Kumar, N., Subrahmanyam, K.S., Chaturbedy, P., Raidongia, K., Govindaraj, A., Hembram, K.P.S.S., Mishra, A.K., Waghmare, U.V., and Rao, C.N.R. (2011) Chem. Sus. Chem., 4, 1662–167
[83] Vivekchand, S., Rout, C., Subrahmanyam, K., Govindaraj, A., and Rao, C. (2008) "Graphene: Synthesis, Properties, and Phenomena" J. Chem. Sci., vol.120, pp.9.
[84] Li, H.-Q., Wang, Y.-G., Wang, C.-X., and Xia, Y.-Y. (2008) J. Power Source, 185, 1557.
[85] Stoller, M.D., Park, S., Zhu, Y., An, J., and Ruoff, "Graphene-Based Ultracapacitors" - Nano Letters R.S. (2008) Nano Lett., vol.8, pp.3498.
[86] Eda, G., Unalan, H.E., Rupesinghe, N.,Amaratunga, G.A.J., and Chhowalla, "Graphene Oxide: Physics and Applications." (2008) Appl. Phys. Lett., vol.93, pp.233502.
[87] Malesevic, A., Kemps, R., Vanhulsel,A., Chowdhury, M.P., Volodin, A., andVan Haesendonck, "Carbon Nanotube and Related Field Emitters: Fundamentals "C. (2008) J. Appl. Phys., vol.104, pp.084301.
[88] Jung, S.M., Hahn, J., Jung, H.Y., and Suh, "Improved field emission of few-layer graphene–carbon" J.S. (2006) Nano Lett., vol.6, pp.1569
[89] Palnitkar, U.A., Kashid, R.V., More, M.A., Joag, D.S., Panchakarla, L.S., and Rao, "Graphene: Synthesis, Properties, and Phenomena" C.N.R. (2010) Appl. Phys. Lett., 97, 063102.
[90] 168. Prashant, K., Panchakarla, L.S., Bhat, S.V., Urmimala, M., Subrahmanyam, K.S., and Rao, C.N.
[91] Subrahmanyam, K.S., Manna, A.K., Pati, S.K., and Rao, C.N.R. (2010) *Chem. Phys. Lett.*, **497**, 70.
[92] Ren, Y., Yan, N., Wen, Q., Fan, Z., Wei, T., Zhang, M., and Ma, J.. "Graphene/δ-MnO2 composite as adsorbent for the removal of nickel ions from wastewater", Chem. (2010).
[93] Chou, S. L., Wang, J. Z., Choucair, M., Liu, H. K., Stride, J. A., and Dou, S. X. "Enhanced reversible lithium storage in a nanosize silicon/graphene composite." Electrochem. Commun (2010), Vol.12 pp.303–306.
[94] Bonaccorso, F., Sun, Z., Hasan T., and A.C. Ferrari. "Graphene photonics and optoelectronics". Nature Photonics (2010), vol. 4, pp. 611–622.

International Journal of Innovation and Scientific Research
ISSN 2351-8014 Vol. 17 No. 2 Aug. 2015, pp. 316-335
© 2015 Innovative Space of Scientific Research Journals
http://www.ijisr.issr-journals.org/

Comparative Effects of Boron Toxicity and Deficiency on the Growth, Chlorophyll, Protein and some Cations Accumulation in Zea mays Seedlings

Ayodeji Adeyemi OGUNWOLE[1], Olutobi Olufunmilayo OTUSANYA[2], Fatai Adekanye OLOYEDE[2], and Tijani Musa Olabamiji[2]

[1]Department of Biological Sciences,
Wesley University of Science and Technology,
Ondo, Ondo State, Nigeria

[2]Department of Botany,
Obafemi Awolowo University,
Ile-Ife, Osun State, Nigeria

Copyright © 2015 ISSR Journals. This is an open access article distributed under the ***Creative Commons Attribution License***, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT: The understanding of the effects of boron (B) toxicity and deficiency on the growth and nutrients accumulation of crop seedlings in the field is required to substantiate the need of adequate dosage for their survival and optimal production. In this study, the susceptibility of *Zea mays* to excess and deficiency of B was obtained by feeding the seedlings with varied concentrations of B in standard nutrient solution. B was applied as Boric acid (H_3BO_3) and at the rate of 0.33ppm (FN/B-optimal dosage) which served as control, 0 ppm (-B) served as B-deficient level, 1.65, 3.30 and 6.60ppm (×5B, ×10B and ×20B respectively) served as toxic levels. Results showed that the number of leaves, leaf area, leaf area ratio, shoot fresh and dry weights, root fresh weight and biomass, chlorophyll a, b and total chlorophyll, calcium (Ca), Magnesium (Mg), nitrogen (N), and protein accumulation were significantly reduced by the application of 3.30 ppm (×10B) and 6.60 ppm (×20B) B dosage. The retardation effects of the ×20B level was not significantly different from ×10B level at $P<.05$ indicating 3.30 ppm (×10B) as the critical level of toxicity for maize seedlings growth and development. The data also showed that toxicity of B was more harmful to juvenile maize than its deficiency since B deficiency diminished just few parameters such as the shoot dry weights, chlorophyll b and total chlorophyll at $P<.05$. Moreover, the study suggested three different optimal concentrations; 0.33, 1.65 and $\geq$ 3.30 ppm respectively for general growth, chlorophyll and carotenoids synthesis in maize seedlings. Lastly, the study emphasized the accumulation of carotenoids and potassium (K) as possible adaptive mechanisms evolved by the maize seedlings to B-stress tolerance and suggested an under-play physiological role for B in the formation and development of the seedlings leaf.

KEYWORDS: Accumulation, Boron, Chlorophyll, Comparative, Deficiency, Protein, Seedlings, Toxicity.

1 INTRODUCTION

The deficiency of a mineral nutrient occurs when an essential element is completely absent or available in insufficient quantity to meet the needs of the growing plant while nutrient toxicity occurs when an element is in excess of plant needs and decreases plant growth, quality and quantity [1]. Boron (B) is one of the important micronutrients of vascular plants whose deficiency or toxicity causes impairment in several metabolic and physiological processes [2,3,4]. According to [5], primary function of B in plants is connected with the cell wall structure and function, that is, cross-linking the cell wall rhamnogalacturonan II (RGII) and pectin assembly. Also, B has been implicated in affecting the growth and yield of crops [6,7]. However, like the other abiotic stressors, B also enhances oxidative damage induced by the formation of reactive oxygen species (ROS), which are strong oxidizers of lipids, proteins, and nucleic acids [8,9]. [10] stated that the maintenance of cell membrane integrity and improvement of cellular defense mechanism is a novelty role of B. Despite the obvious importance of B, the mechanisms of B tolerance to deficiency and toxicity in plants are poorly understood [11,9,12,13]. [14]

noted that the response of crops to B does not only vary with plant species, soil type and environmental conditions, but also its excess/deficiency may affect the availability and uptake of the other plant nutrients.

Crop production, according to [15] is limited worldwide because B in the soil is either insufficient or at toxic levels. Deficiency of B is very common and widespread around the world, causes both quantitative and qualitative losses in crop production [16]. Physiological damages such as; inhibition of root elongation [17,18], loss of integrity and function of membrane, and decrease in cell wall stability resulting in structural damage in plants [19,20,3] had been attributed to the deficiency of B. According to [21], B deficiency first affects the shoot apex and the actively growing leaves with the latter becoming small, dark green, deformed in shape, and brown purple pigmented. Also, the reduction in the cytokinin level as well as the indole acetic acid (IAA) export out of the shoot apex in pea plants grown in B-deficient medium had been reported [22]. In another study, [23] attributed the observed reduction in the photosynthetic efficiency of sunflower leaves to the deficiency of B in the medium. Furthermore, the shoots of plants grown in B deficient medium characteristically had shorter internodes and petioles and stems with bigger diameter [18]. Similarly, toxicity of B constitutes a very serious threat to agriculture in arid and semiarid regions where salt affected soils and saline irrigation water are prevalent [24]. Though, [2] were of the opinion that fertilizers and mining would increase the concentration of B in the soils, irrigation water according to [25] is the most important contributor to high level of B in the soil. In terms of management in crop production system, B toxicity is more difficult than its deficiency which can be corrected through fertilization [26]. However, the fertilization of crop with B to avoid deficiency can result in toxicity since the concentration range between B deficiency and toxicity is narrower than for any other plant essential nutrient [27,28]. Nevertheless, B fertilization is required in boosting the production of many crops [29]. Some of the reported physiological effects of B toxicity include; reduced root cell division [30], decreased shoot and root growth [31,32], reduced vigor, retarded development, chlorotic and necrotic patches in older leaves, inhibition of cell wall expansion, lower leaf chlorophyll contents and photosynthetic rates, deposition of lignin and suberin [33]. Others are; impairment of nitrogen assimilation pathways by affecting key enzymes involved in those processes (Herrera-Rodrı´guez *et al.,* 2010), disruption of RNA splicing [34,12], increased membrane leakiness, peroxidation of lipids and altered activities of antioxidant pathways [35,36].

Among cereal crops, maize (*Zea mays*) in the family poaceae has the highest productivity rate (Nawaz, 2007, unpublished). It is one of the most important food resources of human and second most important crop to soyabean for biodiesel production [37]. As a C_4 crop, it absorbs high amounts of nutrients from the soil and grows under wide range of environmental conditions, majorly for grain and forage consumed by both humans and animals respectively [38]. Because of its great yield potential, a good food source of food for humans and animals and its efficient absorption and maximum use of micro elements in various conditions of soils, this study therefore investigated the effect of the deficiency and supra-optimal concentrations of B on the growth and accumulation of chlorophyll, carotenoids, selected cations, nitrogen and protein in *Zea mays* seedlings.

2 MATERIALS AND METHODS

2.1 EXPERIMENTAL SITE AND MATERIALS SOURCES

The experiment was carried out at the Department of Biological Sciences, Wesley University of Science and Technology, Ondo, Nigeria. The seeds of *Zea mays* L. (CV. NS1) were collected from National Horticultural Research Institute (NIHORT) Ibadan.

2.2 SOIL TREATMENT AND GERMINATION OF SEEDLINGS

Seedlings of *Zea mays* L. ('CV. NS. 1) were utilized in this experiment. Sand was soaked in 1.5N hydrochloric acid for one hour to eliminate microbes and solubilize mineral elements which might be present in it. The acid was drained off, thereafter, the sand was washed with tap water and then double distilled water until the pH of the decantable water was between 6 and 7, which was optimal for the germination and growth of the maize seedlings. *Zea mays* seeds were randomly selected for uniformity on the basis of size and soaked for five minutes in 5% sodium hypochlorite to prevent fungal growth. Thereafter, the seeds were rinsed in running tap water for 5 mins and then thoroughly washed in double distilled water. Ten of these seeds were sown in each of the experimental pots (24 cm diameter × 21cm depth) that were already filled with washed and air-dried sand. Each experimental pot had four holes perforated at the bottom for good drainage. All the pots were initially irrigated with 200 mL of water on a daily basis for nine days. On the ninth day, the seedlings in each pot were thinned down to five uniform seedlings per pot based on uniformity of vigour and transferred to an open environment where the seedlings received approximately eight hours of sunlight daily. Temperature at soil level varied between 27^0C and 32^0C, and 22^0C and 25^0C during the day and night respectively.

2.3 NUTRIENT SOLUTION COMPOSITION AND ALLOCATION OF NUTRIENT REGIMES

The nutrient solution was prepared according to the modified Long Ashton Formula [39]. The nutrient solution composition were given the subscripts; FN (Full Nutrient containing 0.33 ppm B which is the optimal concentration of B) served as the control, -B (that is, FN with 0 ppm B), ×5B, ×10B and ×20B {that is, FN with five (1.65 ppm), ten (3.30 ppm) and twenty (6.60 ppm) times optimal concentration of B respectively}. The pots were then allocated to the control/FN and four different treatments, that is, -B, ×5B, ×10B and ×20B and then arranged in a complete randomized design. Thereafter, each pot was supplied with 200 mL of appropriate feeding solution in the morning and 200 mL of distilled water in the afternoon in order to keep the growth medium moist at all times. On the ninth day when nutrient feeding commenced, seedlings were harvested just before the application of the nutrient solution. Thereafter, harvesting of the plant was on three days intervals for a period of twenty four days.

2.4 MEASUREMENT OF PHYSICAL PARAMETERS

Recording of the following growth parameters (shoot height, number of leaves) data was carried out according to standard methods. The leaf area was determined using the method of [40] and the leaf area ratio calculated. Five shoots in each regime were weighed on Mettler Toledo balance to obtain the fresh weight. The shoots were then packaged separately in envelopes and dried to constant weight at 80^0C in a Gallenkhamp oven (Model IH-150) to obtain the dry weight. Chlorophyll contents of the fresh shoot were extracted with 80% acetone and quantified following the procedure of [41]. For carotenes and xanthophylls extraction, Five gram of maize seedlings leaves was macerated in 20 ml of 80% acetone using a mortar and a pestle. The extract was filtered through a Whatman's No.1 filter paper. 25 ml of petroleum ether was placed in a separating funnel and the acetone extract of the pigment was added. The funnel was gently rotated, releasing the pressure periodically. 35ml of distilled water was poured down the sides of the funnel and the funnel rotated until the upper layer was green; the two layers were allowed to separate before the lower acetone layer was then drawn off. The petroleum ether fraction was later washed with 25 ml of distilled water at three consecutive times and discarded each time. This removed any trace of acetone that remained in the petroleum ether fraction. Twenty five (25) ml of 92% (v/v) methanol was added to the petroleum ether fraction, rotated and then separated into upper and lower fractions (carotenes and xanthophylls). The absorbance of both fractions was determined using Digital Spectrophotometer. Petroleum ether and diethyl ether served as blanks [42].

2.5 EXTRACTION OF MACRONUTRIENTS (K, CA AND MG)

Potassium (K), calcium (Ca) and magnesium (Mg) were measured using a flame photometer (Jenway, PF P7). Percentage nitrogen and protein were determined according to the micro-Kjeldahl nitrogen method as described by [43].

The percentage crude protein accumulation in the shoot of *H. sabdariffa* was estimated using the formulae below.

$$\% \text{ Total Nitrogen} = \frac{(A-B)\times N \times 14.01 \times 100}{\text{gram of Sample} \times 10}$$

% Crude Protein = % Total Nitrogen × 6.25

Where A = sample reading, B = blank reading; N = Normality of acid used for titration, 100 = conversion to % and 6.25 is the correction factor (F)

2.6 STATISTICAL ANALYSIS

All experiments were conducted in five replicates and the data obtained was subjected to analysis of variance (ANOVA) using Statistical Package for Social Sciences (SPSS) software version 20. Treatment means were compared using least significant difference (LSD $P<.05$).

3 RESULTS

3.1 PLANT GROWTH CHARACTERISTICS

There was though no visible symptom of excess or deficiency of B for the first 23 days after planting. However, faint yellow–green coloration at the edge of one of the mature leaf of maize grown in the supra-optimal concentration (×20B) was observed on the last (24th) day of the experiment.

In the control/FN regime, the shoot height and number of leaves on the maize seedlings were 9.84cm and 4.20 respectively (Figures 1&2). These values were reduced to 9.32cm and 3.64 in B-deficient regime. However, application of ×5, ×10 and ×20 optimal concentrations of B respectively increased the shoot height by 15.14, 27.18 and 39.51%. Oppositely, the number of leaves on the seedlings was reduced by 27.62, 42.35 and 47.47% respectively in the ×5B, ×10B and ×20B regime. There was no significant difference between the shoot height of the control seedlings and those of B-deficient and excess B seedlings at *P<.05* while the number of leaves on seedlings treated with ×10B and ×20B were significantly reduced at *P<.05*.

Data illustrated in the Figures 3&4 showed that the leaf area and leaf area ratio of maize seedlings in the control (FN) regime were greater than those of B excess and B-deficient seedlings. Complete absence of boron (-B) as well as application of ×5 optimal concentration of B did not significantly diminish the leaf area and the leaf area ratio of the seedlings. The increase of the applied B up to ×10 optimal concentration however resulted in significant reduction (53.53 and 24.83% respectively) of both parameters at *P<.05* However, the maximum reduction of the leaf area and leaf area ratio was obtained in ×20B-treated regime but the value was not significantly different from that of ×10B-treated seedlings at *P<.05*.

Also, maize seedlings in the control (FN) regime recorded the highest values for shoot fresh and dry weights as well as root fresh weight and biomass (Figures 5-8). While 5.792 and 0.615 g were obtained for shoot fresh and dry weights respectively, the root fresh weight and biomass of the seedlings were 2.841 and 0.272 g respectively. However, seedlings in the ×10B and ×20B regimes recorded a significantly lowered values for these growth parameters at *P<.05* with maximum reduction observed in the ×20B regime. On the contrary, only the shoot dry weight of the seedlings was significantly diminished by the deficiency of B. Statistically, the shoot fresh and dry weights as well as the root fresh weight and biomass of ×10B-treated seedlings were not significantly different from ×20B-treated seedlings at *P*<.05. In the case of application of ×5B dosage, the observed reductions in these parameters were not significant at *P<.05*.

3.2 PHOTOSYNTHETIC PIGMENTS

Figures 9-11 showed that accumulation of chlorophyll a, b and total chlorophyll followed almost the same pattern. The ×20B–treated seedlings recorded the lowest value of chlorophyll a (5.406 µM), b (1.489 µM) and total chlorophyll (7.007 µM) the respective highest accumulations (10.527, 2.845 and 13.372 µM) were obtained in the ×5B-treated regime. In other words, the accumulation of chlorophyll a in the ×5B seedlings was slightly greater than that of the control (FN) seedlings. On the average, the chlorophyll contents in the B-deficient seedlings were slightly reduced compared with the control seedlings. However, formation of chlorophyll in ×10B and ×20B-treated seedlings were significantly reduced at *P<.05.* Comparison of the accumulated chlorophyll in the ×10B-treated seedlings and those of ×20B-treated seedlings showed no statistical significance at *P<.05*.

The lowest and highest accumulation of carotenoids was recorded in the control and ×20B-treated seedlings respectively (Figure 12&13). The control seedlings recorded 1.764 and 4.462 µM carotene and xanthophylls contents respectively while 2.110 µM and 4.525 µM were obtained for -B-treated seedlings. However, application of ×5B increased the accumulation of carotene and xanthophylls in the maize seedlings by 100 and 20% respectively while ×10B concentration increased these pigment contents by 205 and 25% respectively. Statistically, the difference between the accumulated carotene in the control seedlings and those of ×10B and ×20B-treated seedlings was significant at *P<.05* However, the increase in the accumulated xanthophylls observed for B-deficient and B-excess seedlings was not significantly different from that of the control seedlings at *P<.05*.

3.3 PROTEIN AND MINERAL NUTRIENTS CONCENTRATIONS

The percentage nitrogen and protein contents in both the control *Zea mays* seedlings was higher than those treated with excess and deficiency of B (Fig 14 &15 respectively). While 0.399 and 2.495% nitrogen and protein contents were recorded for the control seedlings, the application of ×5B slightly boosted these parameters by 5% while absence of B (-B) in the nutrient solution slightly depressed the nitrogen and protein percentages by 5%. On the other hand, significant reductions in these percentages were observed for ×10B and ×20B seedlings at *P<.05*.

Figures 16 showed the positive correlations between the K accumulation and toxicity of B, in other words, the K accumulation in maize seedlings increased with increasing B concentration. The pattern of accumulation of Ca and Mg in these seedlings was similar (Fig. 17&18). Complete deficiency of B in the nutrient solution slightly decreased the accumulation of these mineral nutrients while application of ×5B dosage slightly increased it. However, by increasing B concentrations to ×10 and ×20, the diminutions were significant at *P<.05.*

4 DISCUSSION

The observed discolouration at the edge of one of the mature leaves on the last day of the study was could be attributed to high dosage of B in that regime. This result indicated that juvenile maize seedlings were more susceptible to B toxicity than its deficiency. Earlier workers have reported similar observation in barley [44,45].

The toxic levels of B slightly increased the maize seedlings shoot height but critical observations showed that these seedlings lacked vigour compared with the control seedlings. Similarly, the seedlings in these regimes (×5B, ×10B and ×20B) therefore have probably devoted more of their nutrient for stem extension as apical dominance was more pronounced in them. This was in agreement with the results of [46] and [47] that plants growing in supra-optimal concentration of nutrient respond to nutrient stress by devoting more of their available carbon to shoot growth resulting in elongated stems. Similar non-significant increase in plant height was reported by [29] on fodder beet plant sprayed with 75 and 100 ppm B. The control (FN) seedlings had adequate nutrient supply and so do not require extra carbon for shoot growth; this invariably led to the normal seedlings height, better vigour and short peduncles observed in this regime. Adequate supply of B which played role in synthesis and translocation of sugar could also account for the improved vigour observed in the control seedlings [48]. The reduction in the shoot height of the B-deficient seedlings was similar to the findings of [49] who reported inhibition of the growth of the plant apex which resulted in a relatively weak apical dominance and a subsequent sprouting of lateral buds in B-deficient medium. [26] and [22] stated that B deficiency first affects the shoot apex and the actively growing leaves reducing significantly the cytokinin level and inhibiting the export of Indole Acetic acid (IAA) out of the shoot apex. This phenomenon could probably account for the reduced shoot height observed in this regime. However, it could be due to the reduction in the seedlings meristematic cell division and cell elongation triggered by B-deficiency which according to [50], could result in diminished shoot growth. In addition, the seedlings in B-deficient regime had shorter internodes and petioles and stems with bigger diameter–the characteristics similar to those observed by [18] in some higher plants.

The leaf parameters (number of leaves, leaf area and leaf area ratio) of the control/FN seedlings appear more luxuriant than those in the B-deficient and B-treated regimes. This suggested an under-played physiological role for B in leaf formation and/or development. In other words the dependence of the formation and/or development of leaf on B concentration in juvenile maize were suspected. Earlier workers had reported that normal application of B could increase significantly the leaf area and ultimately the yield of crops compared to treatment with excess B [51,52,53]. B applied at optimal dosage could influence the cell division, transfer of sugars along cell membranes as well as pectin, RNA and DNA synthesis, thus, enhancing optimal growth of the leaves especially the leaf area [50,54]. In B-deficient seedlings, the actively growing leaves could be affected resulting in the reduced leaf area and leaf area ratio. Similarly, the significant diminution in these parameters triggered by the application of ×10B indicated that this concentration (3.30 ppm B) gave adequate concentration for inhibition of *Zea mays* leaf growth. This could result from the impairment of cell division in the leaves or inhibition of shoot and root growth by excess B [33]. These results were similar to the findings of [55] who reported that application of 0.16M concentration of B was more effective in improving the elongation of 4th leaf on rice than 0 ppm whereas ×3B (0.48M) concentration was toxic, decreased the leaf elongation even than 0 ppm. [56] also reported similar findings.

The optimal weights of shoot and root (especially the dry matter yield) rercorded for the control seedlings can be attributed to optimal rate of photosynthesis, adequate nutrient supply and greater leaf surface area. Adequate nutrient supply increased the dry matter production in optimal condition, a situation that corroborated the findings of [57] and [58] where higher dry weight was correlated to optimal leaf expansion rates. It was noted that the magnitude of the decreasing effect of B toxicity on the fresh and dry weight of the seedlings increased up to ×10B (3.3 ppm) concentration and no statistical significance between these values and those obtained for ×20B (6.6 ppm) dosage. This implied that presence of 3.30 ppm B in the soil could seriously hamper the shoot and root yield, hence, the general growth of the seedlings. The diminution in the shoot and root weights of the ×10B and ×20B-treated seedlings might not be unconnected with the lowered leaf area, photosynthetic rates and decreased lignin and suberin contents triggered by excess B in the soil [2,59]. The slight reduction observed for seedlings in the –B regime was not surprising. According to [54], deficiency of only one of the mineral nutrients could potentially depress the growth, thus the biomass production of higher plants. Earlier workers have also reported that deficiency of B inhibits root elongation [17,18,60] which eventually resulted in significant loss of shoot and root yields. This result was consistent with the findings of [61] who reported that shoot and root fresh and dry weights of maize decreased with increasing B applied. [62] and [63] showed respectively that the shoot dry matter yield and root yields of wheat decreased with increasing B application. Similarly, [64] found significant decrease in the shoot dry matter yield of maize plant treated with elevated B concentration. Other workers had also reported similar findings on tomato [65,66], melon [67], tobacco [68] and pea plants [69].

The chlorophyll content is one of the main factors that reflect the photosynthetic rate of crop plants [70]. The optimal synthesis of chlorophyll in control/FN seedlings could be attributed to the protection of the thyllakoid membrane through decreasing the production of oxygen radicals which according to [23] was a novelty role of B in crop plant. Also, the dual effects of B toxicity on accumulation of chlorophyll followed the trend; ×5B > FN > ×10B > ×20B.This indicated that the 0.33 ppm B (in the control/FN regime) recommended as optimal concentration by Long Ashton and modified by [39] was not optimal for the purpose of chlorophyll accumulation since highest chlorophyll contents was recorded in ×5B regime. Though, it was appropriate for the general growth of the seedlings as evidenced from the parameters described above. Compare with the control, the increase in chlorophyll contents of ×5B-treated seedlings could be a response of the seedlings to compensate for the loss of leaf area owing to smaller leaf size. However, there was significant reduction in the chlorophyll contents of the seedlings in the ×10B-treated seedlings, a phenomenon that could be considered a mark of either the commencement of chlorosis or tolerant/critical level of toxicity for maize seedlings. This diminution could be due to oxidative injuries inflicted on the seedlings by B toxicity – injuries which enhanced chlorophyll degradation or inhibited chlorophyll synthesis. [8] and [9,71] had earlier observed an increase in the Malondialdehyde (MDA) and Hydrogen peroxide (H_2O_2) contents of plants exposed to B toxicity and attributed their observations to oxidative stress and membrane peroxidation which could increase the chlorophyll degradation and inhibited chlorophyll synthesis in crops. This result was similar to the findings of [72] who reported a maximum increase in chlorophyll contents of mung bean (*Vigna radiata* (L.) treated with 4μgg^{-1} B concentrations while application of 8, 16 and 32 μgg^{-1} concentrations significantly reduced the chlorophyll contents in the crop. The finding that B-deficient leaves had lower content of chlorophyll pigments is similar to the recent study by [73] who observed a decline in chlorophyll contents of coconut leaflets grown in B-deficient sand and suggested that chlorophyll synthesizing system and/or chlorophyllase activity might have been affected by B deficiency. It was also in congruent with those reported by [74] and [75].

Carotenoids can act as alternative antennas capture light, absorbing the blue region of the spectrum (400-600 nm) and transferring the energy to the chlorophyll. Carotenoids biosynthesis pathway also supplements the chlorophyll contents of plants through the production of the geranyl geranyl pyrophosphate intermediate to make a phytyl group of chlorophyll, thus maintaining the pigments levels and enhanced the growth and yield performance of crops [76]. The above statements probably explains the possible adaptive mechanism evolved by maize seedlings to B toxicity tolerance since the amount of carotene in the B-treated seedlings increased significantly with increasing B levels. However, the main function of carotenoids is to protect the photosynthetic apparatus, dissipating energy to avoid photo-oxidation [77]. Thus, this significant boost in carotene contents of ×10B and ×20B-treated seedlings could be a response of the seedlings to prevent the excessive loss of chlorophyll contents through oxidative injuries mentioned above. The enhancement of the accumulation of the two pigments (carotene and xanthophylls) therefore suggested the direct or indirect involvement of these pigments in the protection against oxidative stress triggered by B toxicity and maintenance of the chlorophyll levels in the juvenile maize growth. The deficiency of B on the other hand could affect photosynthesis directly or indirectly [23] and the first targets were usually the shoot apex and the actively growing leaves [21]. In this study however, it could be deduced that the reduction of the chlorophyll and carotenoids contents constituted the direct primary effects of B-deficiency while the diminished growth and yield in maize seedlings were its secondary or indirect effects on photosynthesis. These results were similar to the findings of [78] and [23] in which both authors respectively attributed the observed reduction in the carotenoids and photosynthetic efficiency of *Taxodium distichum* and sunflower leaves to the deficiency of B in the medium.

The experimental evidence for a direct and specific involvement of B in the nucleic acids metabolism or protein synthesis is scanty [28]. However, the respective optimum value and the slight increase in protein percentage observed for control/FN and ×5B-treated seedlings could be due to increased level of expression of genes related to nitrogen metabolism. Several reports have indicated that B applied at optimal dosage (FN) may influence positively the expression level of genes related to nitrogen metabolism [79,80]. The nitrogen and protein percentage in the B-deficient, ×10B and ×20B-treated seedlings were affected negatively. These reductions according to [26] could result from a decreased nitrate uptake due to lower expression of plasma membrane H^+-ATPase in B-deficient plant. Similarly, [11] affirmed that excess B could potentially cause metabolic disruption by binding ribose RNA, thereby reducing protein synthesis in plant. These results probably explain the basis of the general enhancement observed in the growth and vigour of the control/FN seedlings than the B stressed seedlings. Similar findings were reported by [36]. The authors observed higher amount of soluble protein in the optimal B containing leaves of orange plants irrigated with relatively high and low amounts of B. [81] found an inhibition of DNA within 6 hours of transferring squash plants to the B-deficient media. Several workers had earlier reported significant depression in the leaf nitrogen of crops including maize [82], tomato [83], Sauvignon vine plant [84].

Depending on the concentration of B applied, the interactions of B with other plant nutrients was either antagonistic or synergistic. In this study, while the excess-B-K interaction was synergistic, the interaction of excess-B with Ca, Mg and N was antagonistic. The significant increase in the K concentration observed for ×10B and ×20B seedlings suggested that the survival

of B-stressed maize seedlings could be a function of their ability to maintain higher levels of K. In other words, the tendency of the maize seedlings to accumulate K could be considered as an adaptive mechanism to B-stress tolerance. Such positive correlation between K and excess B according to [85] could be due to the increased activation of the ATPase proton pump by B. On the other hand, the lowered concentrations of the Ca and Mg in both regimes treated with excess and deficiency of B suggested that these treatments influenced the membrane permeability by increasing Ca and Mg leakages from the cells of the seedlings. [86] suggested an increase of membrane permeability which resulted in leakages of mineral nutrients as the primary effects of B deficiency. This reduction however could be due to inhibition of the translocation of the two mineral nutrients from the root to the leaves or decrease in number of negative charges and of Ca^{2+}-borate complex in B-deficient maize seedlings. According to [87], the decrease of membrane associated Ca^{2+} in the B-deficient faba bean plants is primarily caused by a reduction in the number of negative charges and of Ca^{2+}-borate complex. [88] also observed inhibition of the translocation of Ca to the upper leaves in B applied tomato. The increased K concentration, according to [89] was the indirect effect of added B, while the decreased concentration of Ca (as well as Mg) at higher levels seems to be the direct effect of B which also resulted in a reduction in growth and yields. Therefore, these results also explained to some extent the deteriorative role of excess and deficiency of B on the growth parameters and chlorophyll contents of the *Zea mays* seedlings. Earlier workers had reported similar findings [82,90,91,84].

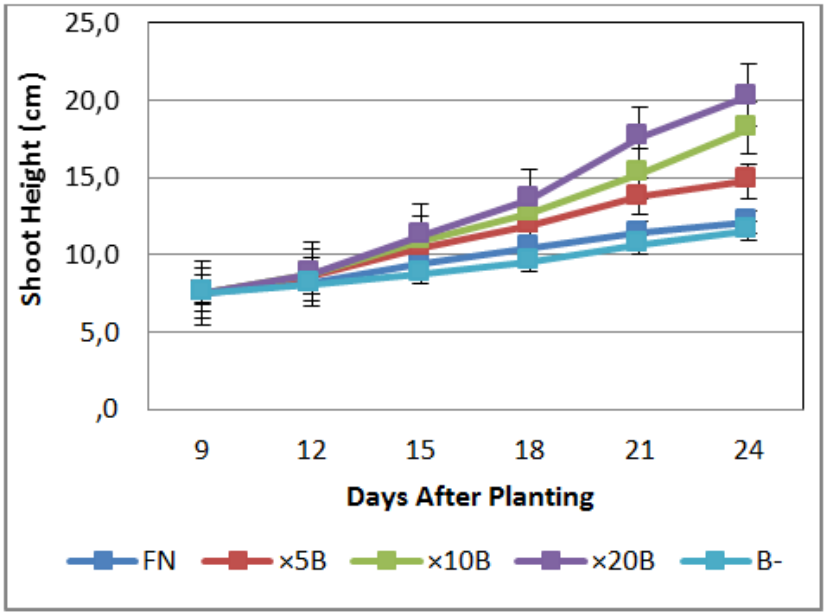


Fig. 1: The Effect of supra-optima concentration and deficiency of boron on the shoot height of Zea mays

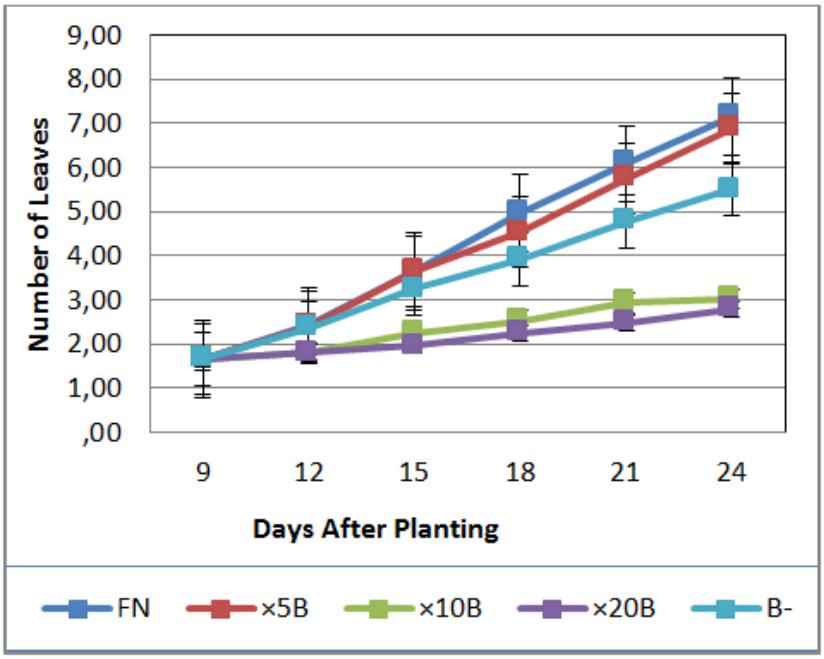


Fig. 2: Variation in the number of leaves on Zea mays seedlings as affected by boron deficiency and toxicity

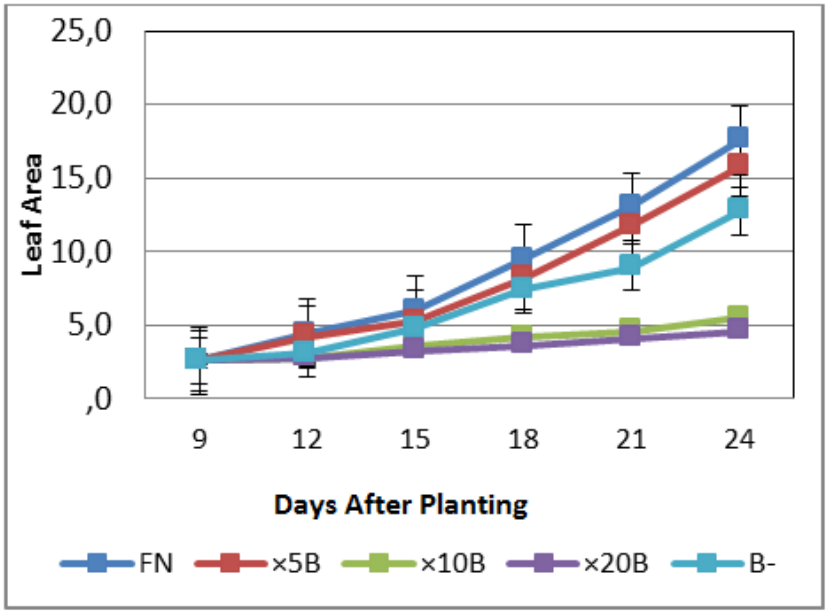


Fig. 3: Leaf area of maize seedlings as affected by the varied doses of boron

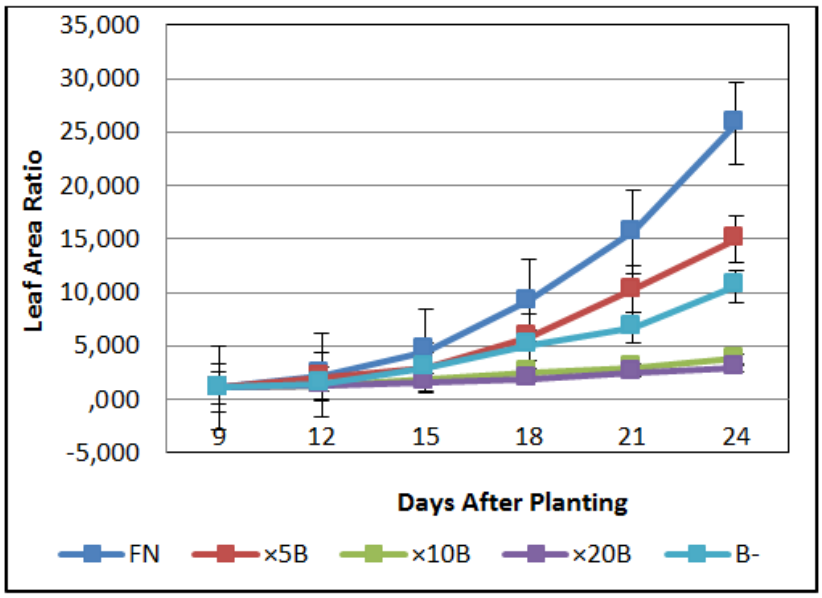


Fig 4: Variation in the leaf area ratio of Zea mays seedlings as affected by boron deficiency and toxicity

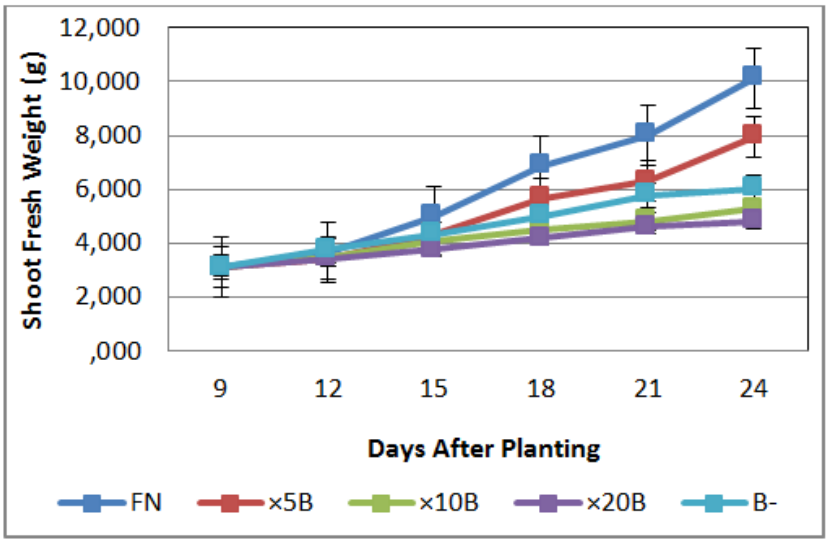


Fig. 5: Time course changes in the shoot fresh weight of Zea mays seedlings subjected to boron nutritional stress

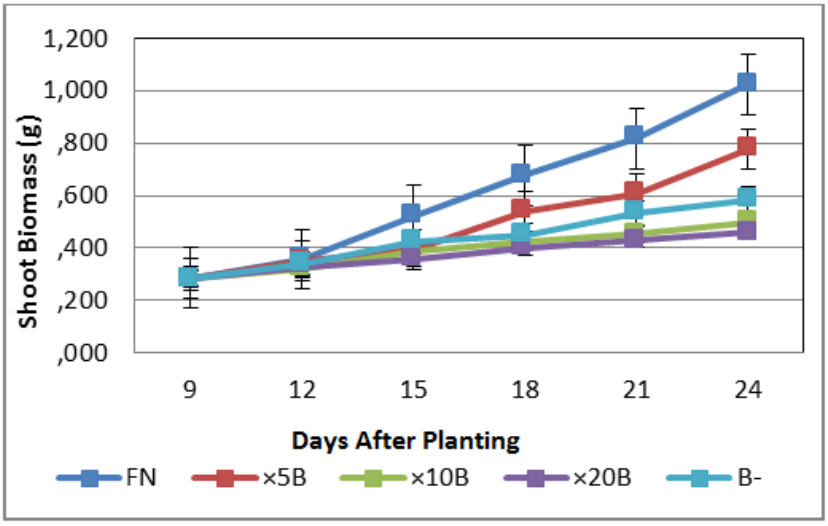


Fig. 6: Time course changes in the shoot biomass of Zea mays seedlings subjected to boron nutritional stress

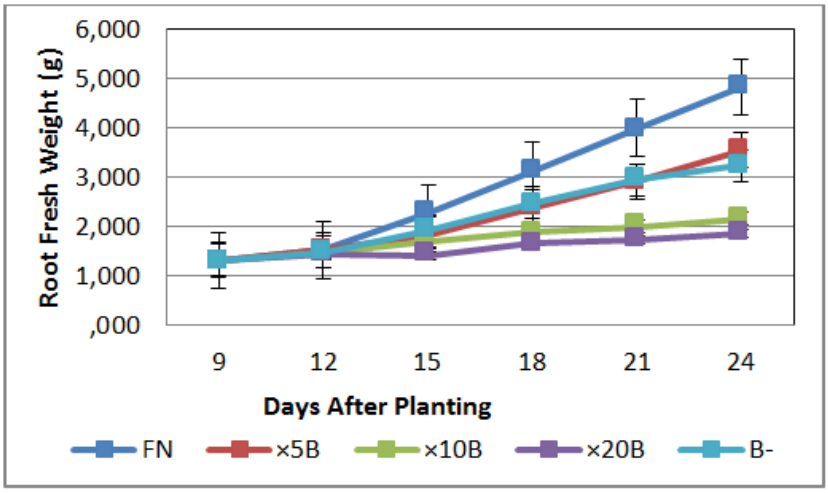


Fig.7: Effect of boron nutritional stress on the root fresh weight of Zea mays seedlings

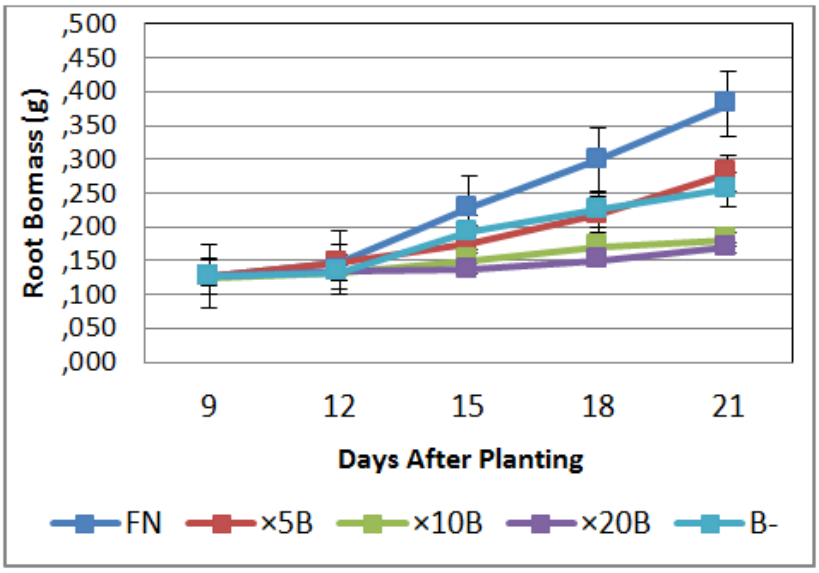


Fig. 8: Effect of boron deficiency and toxicity on the root biomass of Zea mays seedlings

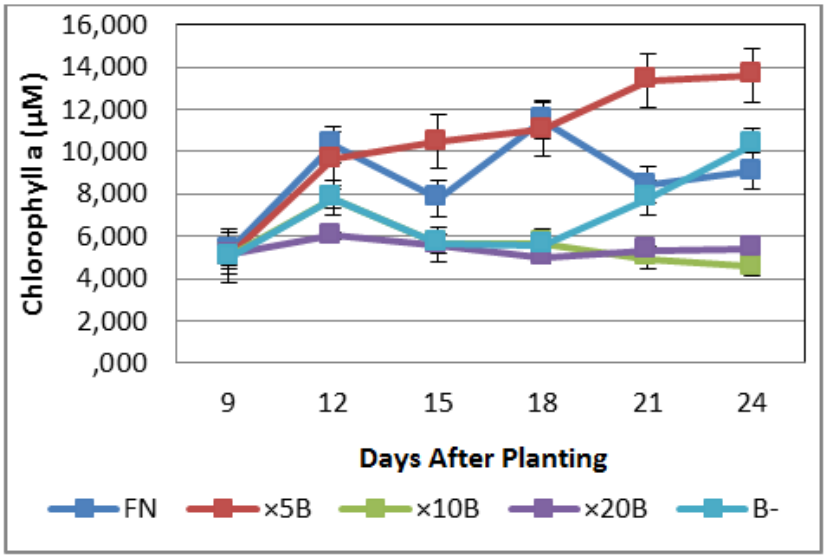


Fig. 9: Time-course accumulation of chlorophyll a in boron nutritional stressed Zea mays

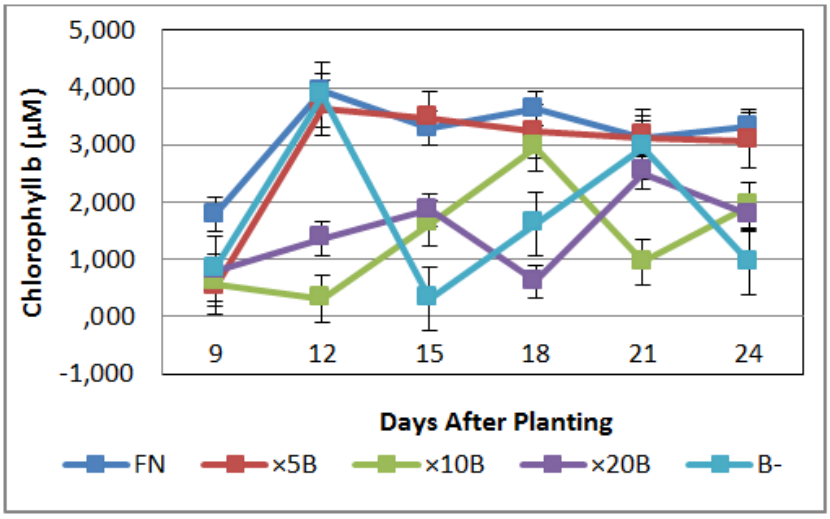


Fig. 10: Time-course accumulation of chlorophyll b in the boron nutritional stressed Zea mays seedlings

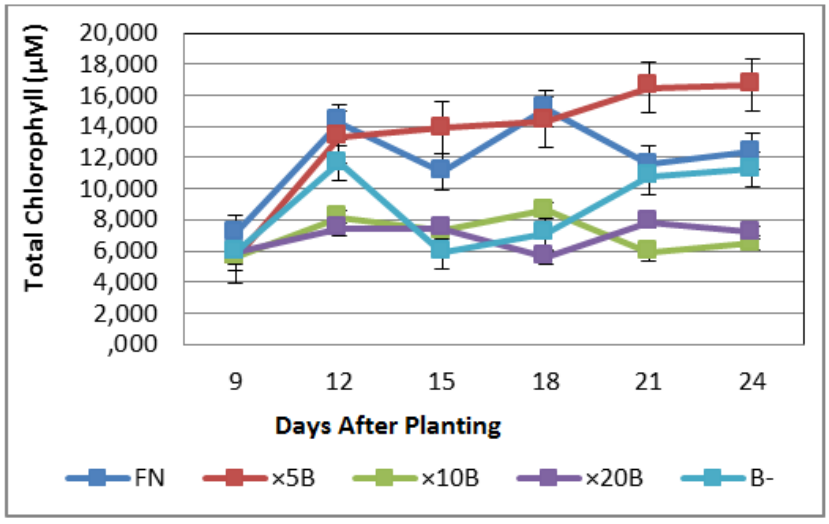


Fig. 11: Time-course accumulation of total chlorophyll in the boron nutritional stressed zea mays seedlings

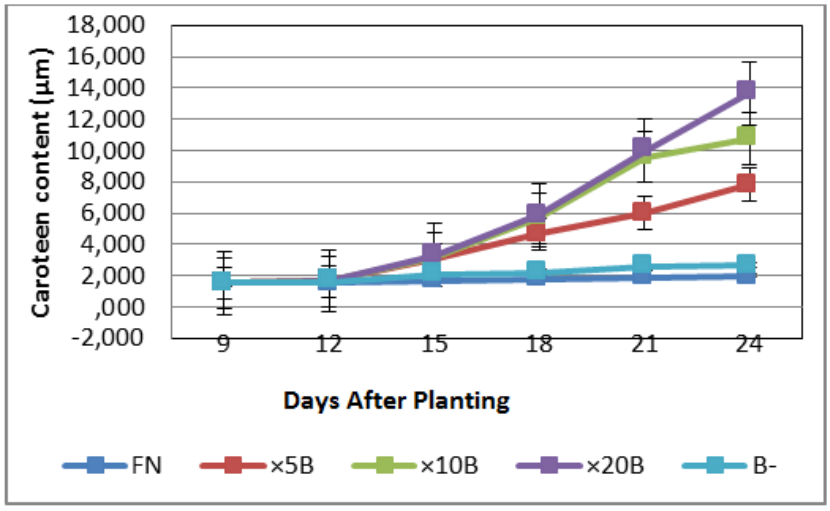


Fig. 12: Variation in the carotene content of Zea mays seedlings as affected by deficiency and toxicity of boron

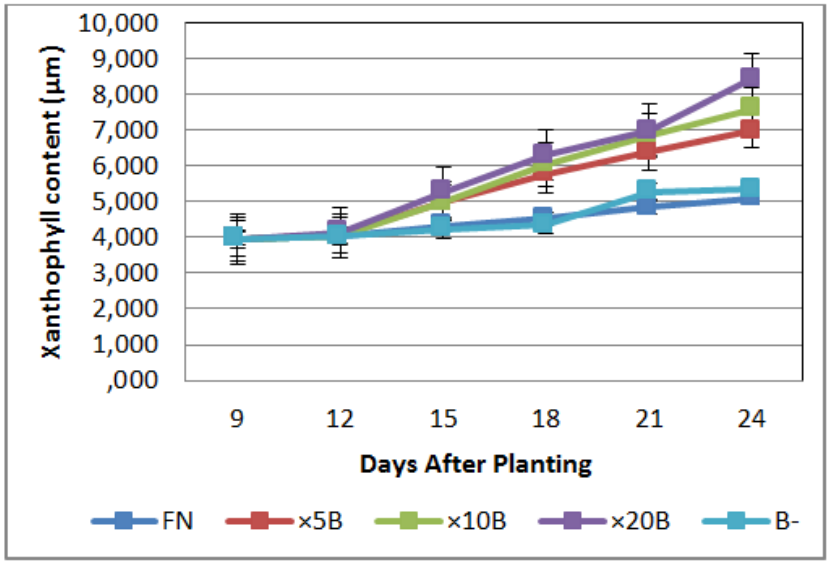


Fig. 13: Variation in the Xanthophylls content of Zea mays seedlings as affected by boron deficiency and toxicity

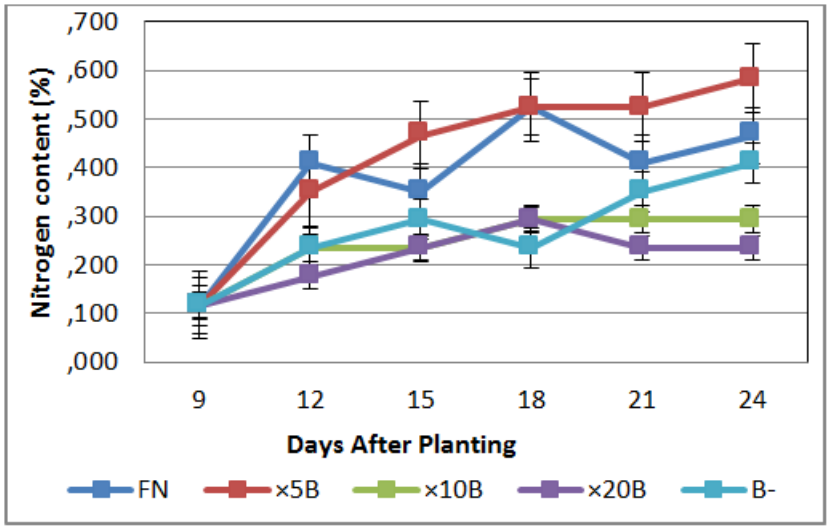


Fig. 14: Effect of deficiency and toxic concentrations of boron on the nitrogen content of Zea mays seedlings

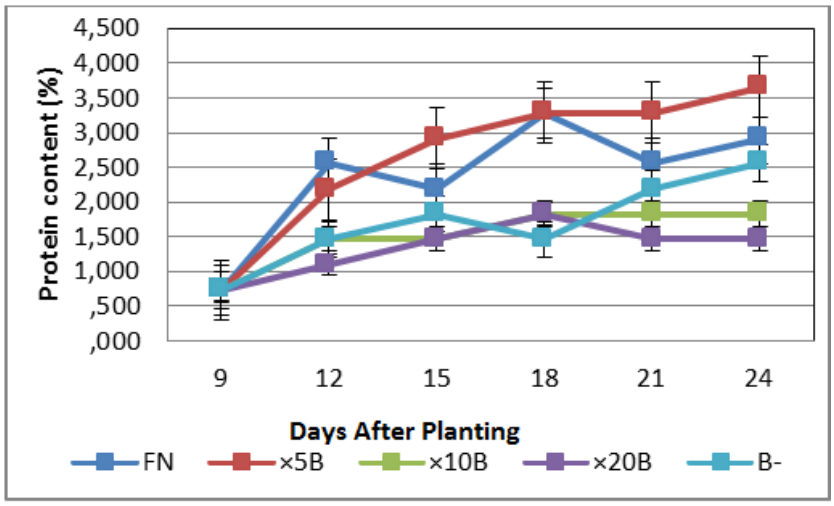


Fig. 15: Time-course accumulation of protein contents in boron nutritional stressed Zea mays

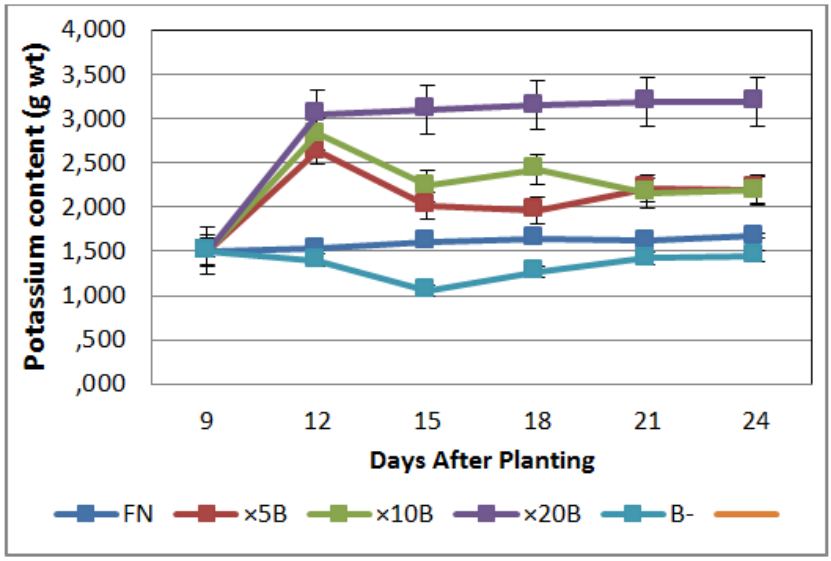


Fig. 16: Variation in the potassium contents of Zea mays seedlings as induced by boron deficiency and toxicity

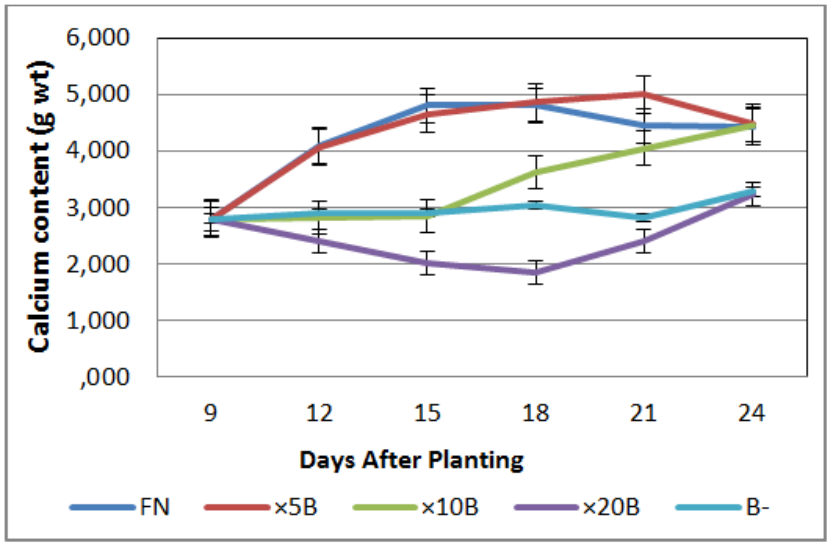


Fig. 17: Effect of boron nutritional stress on the calcium contents of Zea mays seedlings

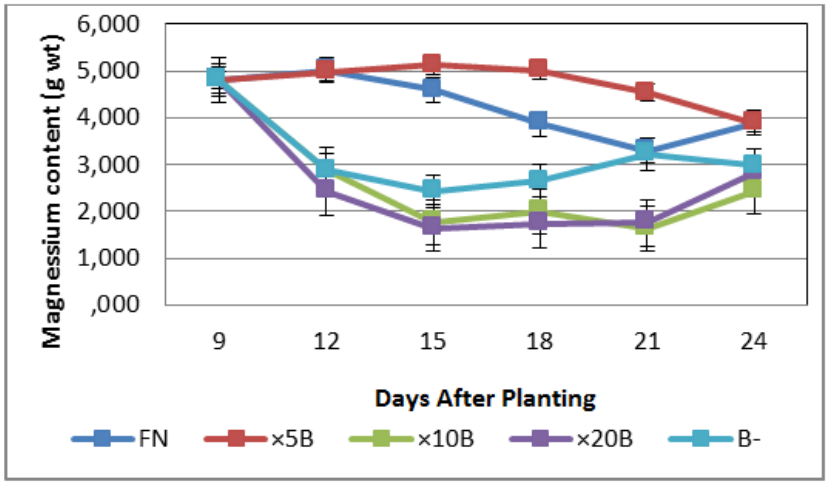


Fig. 18: Effects of varied doses of B on Magnessium concentrations in Zea mays seedlings

5 CONCLUSION

This study had shown that that toxicity of B was more harmful to juvenile maize than its deficiency and presented 3.30 ppm (×10B) concentration of B in the soil as the critical level of toxicity for maize seedlings. The result also showed that B toxicity was more harmful to juvenile maize growth than its deficiency and therefore recommended three different optimal concentrations; 0.33, 1.65 and $\geq$ 3.30 ppm respectively for general growth, chlorophyll and carotenoids synthesis in maize seedlings. The data presented here suggested an under-play physiological role for B in the seedlings leaf formation and development. It also emphasized accumulation of carotenoids and potassium (K) as adaptive mechanisms evolved by the maize seedlings to B-stress tolerance. Further study to validate these hypotheses is therefore recommended.

REFERENCES

[1] Integrated Pest Management, "Crop Nutrient deficiencies and toxicities" Plant Protection Programs, College of Agriculture, Food and Natural Resources. Published by MU Extension, University of Missouri-Columbia. IPM1016, 2002.

[2] R.O. Nable, G.S. Banuelos, J.G. Paull, "Boron toxicity," *Plant Soil*, 198: 181 -198, 1997.

[3] D.G. Blevins and K.M. Lukaszewski, "Boron in plant structure and function" *Annual Revision on Plant Physiology and Plant Molecular Biology,* 49, 481–500.

[4] J.J. Camacho-Cristobal, J. Rexach and A. Gonzalez-Fontes, "Boron in plants: deficiency and toxicity" *Journal of Integrated Plant Biology,* 50:1247–1255, 2008b.

[5] M.A. O'Neill, T. Ishii, P. Albersheim and A.G. Darvill, "Rhamnogalacturonan II structure and function of a borate cross-linked cell wall pectic polysaccharide" *Annual Revision on Plant Biology,* 55, 109–139, 2004.

[6] Y. Li and H. Ling, "Soil boron content and the effects of boron application on yields of maize, soybean, rice, and sugar-beet in Heilonjian Province, P.R. China" In: Bell R.W., Rerkasem B. (eds.) "Boron in Soils and Plants". pp. 17-21, 1997.

[7] M.M. Shaaban and M.M. El-Fouly, "Boron foliar application improves zinc and other nutrient status in cotton plants growth under low or high calcium carbonate level in the soil" Proceedings Of the International Workshop "boron 2001" boron Germany, June, 23-28, 2001.

[8] M. Ardic, A.H. Sekmen, S. Tokur, F. Ozdemir and I. Turkan, "Antioxidant responses of chickpea plants subjected to boron toxicity" *Plant Biology (Stuttg).* 11(3):328-38, 2009.

[9] L.M. Cervilla, B.A. Blasco, J.J. Rios, L. Romero, J.M. Ruiz, "Oxidative stress and antioxidants in tomato (*Solanum lycopersicum*) plants subjected to boron toxicity". *Annals of Botany,* 100, 747–756, 2007.

[10] H. Xuan, J. Streif, H. Pfeffer, F. Dannel, V. Romheld and F. Bangerth, "Effect of pre-harvest boron application on the incidence of CA storage related disorders in 'Conference' pears" *Journal of Horticultural Science and Biotechnology,* 76:133–137, 2001.

[11] R.J. Reid, J.E. Hayes, A. Post, J.C.R. Stangoulis and R.D. Graham, "A critical analysis of the causes of boron toxicity in plants" *Plant Cell Environment,* 25:1405–1414, 2004.

[12] R. Reid "Identification of boron transporter genes likely to be responsible for tolerance to boron toxicity in wheat and barley" *Plant Cell Physiology,* 48:1673-1678, 2007.

[13] K.L. Fitzpatrick and R.J. Reid "The involvement of aquaglyceroporins in transport of boron in barley roots" *Plant Cell Environment,* 32:1357–1365, 2009.

[14] M. Tariq and C.J.B. Mott, "Effect of Boron on the Behavior of Nutrients in Soil-Plant Systems: A Review" *Asian Journal of Plant Science,* 6 (1): 195-202, 2007.

[15] B. Rerkasem, S. Nirantrayagul and S. Jamjod, "Increasing boron efficiency in international bread wheat, durum wheat, triticale and barley germplasm will boost production on soils low in boron" *Field Crops Research* 86:175–184, 2003.

[16] V.M. Shorrocks, "The occurrence and correction of boron deficiency" *Plant Soil,* 193, 121–148, 1997.

[17] W. M. Dugger, *Boron in plant metabolism,* In: Lauchli A., Bieleski R. L., eds. Encyclopedia of plant physiology, inorganic plant nutrition, 15B. New York: Springer Verlag. pp. 626-650.

[18] H. Marschner, *Mineral Nutrition in Higher Plants* Academic Press. London, UK.

[19] A.J. Parr and B.C. Loughman, *Boron and membrane function in plants.* In: D.S. Robb, W.S. Pierpoint (eds.). Metals and Micronutrients, Uptake and Utilisation by Plants, pp. 87–107. Academic Press, New York, 1983.

[20] I. Cakmak and V. Römheld, "Boron deficiency induced impairments of cellular functions in plants" *Plant Soil.* 193, 71–83, (1997).

[21] B. Dell and L. Huang, "Physiological response of plants to low boron" *Plant Soil* 193, 103–120, 1997.

[22] C.J. Li, H. Pfeffer, F. Dannel, V. Romheld and F. Bangerth, "Effects of boron starvation on boron compartmentation and possibly hormone-mediated elongation growth and apical dominance of pea (*Pisum sativum*) plants" *Physiologia Plantarum* 111: 212-219, 2001.

[23] F. El-Shintinawy, "Structural and functional damage caused by boron deficiency in sunflower leaves" *Photosynthetica.* 36(4): 565-573, 1999.

[24] C.D. Tsadilas, In: Bell, R.W., Rerkasem, B. (Eds.), Soil Contamination with Boron due to Irrigation with Treated Municipal Waste Water Boron in Soils and Plants. Kluwer Academic Publishers, Dordrecht, pp. 265–270, 1997.

[25] R.P.S. Chauhan, and S.L. Powar, "Tolerance of wheat and pea to boron in irrigation water" *Plant and Soil,* 50: 145-149, 1978.

[26] M.B. Herrera-Rodrı´guez, A. Gonza´lez-Fontes, J. Rexach, J.J. Camacho-Cristo´bal, J.M. Maldonado and M.T. Navarro-Gochicoa, "Role of boron in vascular plants and response mechanisms to boron stresses" *Plant Stress* 4:115–122, 2010.

[27] J. Takano, K. Miwa and T. Fujiwara, "Boron transport mechanisms; Collaboration of channels and transporters" *Trends in Plant Science* 13: 451-457, 2008.

[28] H.E. Goldbach, "A critical review on current hypotheses concerning the role of boron in higher plants: suggestions for further research and methodological requirements" *Journal of Trace and Microprobe Techniques,* 15: 51-91, 1997.
[29] M.M. Hussein, M.M. Shaaban, A.M. El-Saady, and A.A. El-Sayed, "Growth and Photosynthetic Pigments of Fodder Beet Plants As Affected By Water Regime and Boron Foliar Fertilization" *Nature and Science*, 2011; 9(1), 2011. http://www.sciencepub.net/nature
[30] D. Liu, W. Jiang, L. Zhang and L. Li, "Effects of boron ions on root growth and cell division of broad bean (*Vicia faba* L.)" *Israel Journal of Plant Sciences,* 48: 47-51, 2000.
[31] C.J. Lovett and L.M. Bates, "Early effects of excess boron on photosynthesis and growth of Cucurbita pepo" *Journal of Experimental Botany,* 35, 297–305, 1984.
[32] R.O. Nable and D.B. Moody, *Genotypic Differences in Boron Accumulation in Barley: Relative Susceptibilities to Boron Deficiency and Toxicity* In: Bassam N.E., Dambroth M., Loughman B.C. (Eds), Genetic Aspects of Plant Mineral Nutrition. Kluwer Academic Publishers, Dortrecht: 243–251, 1990.
[33] F. Ghanati, A. Morita and H. Yokota, "Induction of suberin and increase of lignin content by excess boron in tobacco cells" *Soil Science and Plant Nutrition,* 48: 357-364, 2002.
[34] N. Shomron and G. Ast "Boric acid reversibly inhibits the second step of pre-mRNA splicing" *FEBS* 552:219–224, 2003.
[35] E. Karabal, M. Yücel and H.A. Öktem, "Antioxidant responses of tolerant and sensitive barley cultivars to boron toxicity" *Plant Science*, 164, (6); 925-933, 2003.
[36] Y. Keles, I. Öncel and N. Yenice, "Relationship between boron content and antioxidant compounds in *Citrus* leaves taken from field with different water source" *Plant Soil* 265: 345–353, 2004.
[37] P. T. Vasudevan and M. Briggs, "Biodiesel production: current state of the art and challenges" Journal of Indian Microbiology and Technology, 35: 421-430, 2008.
[38] R.N. Mohammad, S. Nassrin and B. Babak, "The effect of microelements spraying on growth, qualitative and quantitative grain in Iran" *International Research Journal OF Applied Basic Sciences,* Vol, 3 (S): 2780-2784, ISSN 2251-838X, 2012.
[39] E.J. Hewitt, "*Sand and water culture methods used in the study of plant nutrition*" Commonw Bur Horts Plantation Crops Great Britain Technology Communication No. 22.
[40] R.W. Pearcy, J.E. Ehleringer, H.A. Monney and P.W. Rundel, *Plant Physiology Ecology, Field Methods and Instrumentation*. Chapman and Hall, New York, pp. 423, 1989.
[41] J.H. Combs, S.I. Long, and J. Scurlock, *Techniques in bio-productivity and photosynthesis*. Pergamon Press. Oxford, New York, Toronto, Sydney, Frankfurt, 1985.
[42] S. Machlis and D. Torrey, *Primary nutrients and plant growth*. In: Essential Plant Nutrients, North Carolina Department of Agriculture, (1956).
[43] A.O.A.C., Official methods of Analysis (17th edition). Association of Official Analytical Chemists, Washington, D. C., 2000.
[44] R. Kluge and W. Podlesak, "Plant critical levels for the evaluation of boron toxicity in spring barley (*Hordeum Vulgare* L.)" *Plant Soil,* 83(3) 381-388, 1985.
[45] R.T. Poole, C.A. Conover and K. Steinkamp, "Symptoms of boron toxicity induced in foliage plants". *Proceedings Fla State Horticultural Scientist Society,* 104: 301-303, 1991.
[46] T.J. Bouma and K.L. Nielsen, "Sample preparation and scanning protocol for computerized analysis of root length and diameter" *Plant and Soil,* 218:185-196, 2000.
[47] K.D. Bonifas, D.T. Walters and J.L. Lindquist, Nitrogen supply affects root: shoot ratio in corn and velvet leaf" *Weed Sci*ence 54:133-137, 2005.
[48] D.G. Blevins and K.M. Lukaszewski, "Proposed Physiologic functions of boron in plants pertinent to animal and human metabolism" *Journal* Series11: 821, 1994.
[49] G. Wang, V. Römheld, C. Li and F. Bangerth, "Involvement of auxin and CKs in boron deficiency induced changes in apical dominance of pea plants (*Pisum sativum* L.)" *Journal of Plant Physiology,* 163, (6), 591-600, 2006.
[50] H.E. Goldbach, D. Hartmannn and T. Rotzer, "Boron is required for the stimulation of the Ferricyanide-induced proton release by auxins in suspension-cultured cells of *Daucus carrota* and *Lycopersicum esculentum*" *Physiology of Plant* 80: 114-118, 1990.
[51] G. Li, H. Zong, H. Wen, Y. Zhang, S. Qu and L. Qiao, "The effect of boron on yield and quality of oriental tobacco" Yunnan Nong Ye Da Xue Xue Bao 20(3), 356-359, 2005.
[52] Q.A. Panhwar, O. Radziah, Y.M. Khanif and U.A. Naher, " Application of boron and zinc in the tropical soils and its effect on maize (Zea mays) growth and soil microbial environment" *Australian Journal of Crop Sciences* 5(12),1649-1654, 2011.
[53] M. Tariq, A. Akbar, H. Lateful and A. Khan, "Comparing Application Methods for Boron Fertilizer on the Yield and Quality of Tobacco (*Nicotiana tabacum L.*)" *Communications in Soil Science and Plant Analysis* 41(13), 1525-1537, 2010.

[54] T. Chatzistathis and L. Therios, "How soil nutrient availability influences plant biomass and how biomass stimulation alleviates heavy metal toxicity in soils: the cases of nutrient use efficient genotypes and phytoremediators, respectively", 2013. http://dx.doi.org/10.5772/53594.

[55] Z. Farooq, A. Rehman, Z.A. Cheema, A. Nawaz and A. Wahid, "Foliage applied boron improves the panicle fertility, yield and bio-fortification of fine grain aromatic rice" *Journal of Soil Science and Plant Nutrition,* 14 (3), 723-733, 2014.

[56] A. Ali, M. Tariq, F. Ali and S. Noor, "Effect of different rates of boron on the yield, quality and micronutrients content of Tobacco (*Nicotiana tabacum* L.). I*nternational Journal of Farming and Allied Sciences,* 3 (11): 1165-1173, 2014.

[57] W.J.H. Peace and P.J. Grubb, "Interaction of light and mineral nutrient supply in the growth of *Impatiens parviflora" New Phytolology* 90(1):127-150, 1982.

[58] W.A. Thompson, G.C. Stocker and P.E. Kriedemann, *Growth and photosynthetic response to light and nutrients of Flindersia brayleyana,* In: Muell F (Ed.). Ecology of Photosynthesis in Sun, a rainforest tree with broad tolerance to sun and shade, 2000.

[59] R. Reid, *Update on boron toxicity and tolerance in plants,* In: Xu, F., Goldbach, H.E., Brown, P.H., Bell, R.W., Fujiwara, T., Hunt, C.D., Goldberg, S., Shi, L. (eds). Advances in plant and animal nutrition. Springer, Dordrecht, pp 83–90, (2007a).

[60] P.H. Brown, N. Bellaloui, M.A. Wimmer, E.S. Bassil, J. Ruiz and H. Hu, "Boron in plant biology" *Plant Biology,* 4: 205-223, 2002.

[61] Muhammad HRS, Tasveer ZB, Uzma Y (2013). Boron irrigation effect on germination and morphological attributes of *Zea mays* cultivars (*Cv*.Afghoee & Cv.Composite). Int. J. Sci. Engi. Res. 4(8):1563-1569.

[62] A. Torun, A. Yazici, H. Erdem and I. Cakmak, "Genotypic variation in tolerance to boron toxicity in 70 durum wheat genotypes" *Turkish Journal of Agriculture,* 30, 49–58, 2006.

[63] L.Y. Akta, M. Gemici, B. TurkyImaz and A. Guven, "The Effects of high boron concentration on growth and protein metabolism in wheat. *Journal of Anatoila Eagean Agricultural Research Institute,* 14 (1): 88-99, 2004.

[64] A. Adiloglu and S. Adiloglu, "The Effect of Boron (B) Application on the Growth and Nutrient Contents of Maize in Zinc (Zn) Deficient Soils" *Research Journal of Agriculture and Biological Science,* 2(1): 1-4, 2006, 2006.

[65] F. Eraslan, A. Inal, A. Gunes, M. Alpaslan. "Boron toxicity alters nitrate reductase activity, proline accumulation, membrane permeability and mineral constituents of tomato and pepper plants," *Scientia Horticulturae,* 30(60): 981-994, 2007a.

[66] C. Kaya, A. L. Tuna, M. Dikilitas, M.A.S. Koskeroglu, M. Guneri Supplementary phosphorus can alleviate boron toxicity in tomato *Scientia Horticulturae* 121 (2009) 284–288

[67] S. Goldberg, P.J. Shouse, S.M. Lesch, C.M. Grieve, J.A. Poss, H.S. Forster, D.L. Suarez, "Effect of high boron application on boron content and growth of melons," *Plant Soil,* 265(2): 403-411, 2003

[68] J.J. Camacho-Cristobal and A. Gozalez-Fontes, "Boron deficiency causes a drastic decrease in nitrate content and nitrate reductase activity and increases the content of carbohydrates in leaves from tobacco plants," *Planta,* 209, 528-536, 1999.

[69] R.O. Carpena, E. Esteban, M. Jose-Sarro, J. Penallosa, A. Garate, J. Lucena and P. Zonosa, "Boron and Calcium distribution in nitrogen fixing pea plants," *Plant Sci.,* 151: 163-170, 2000.

[70] L.Z. Mao, H.F. Lu, Q. Wang, and M.M. Cai, "Comparative photosynthesis: characteristics of *Calycanthus chinensis* and *Chimonanthus praecox," Photosynthetica*, 45, (4), pp 601-605, 2007, 2007.

[71] L.M. Cervilla, M.A. Rosales, M.M. Rubio-Wilhelmi, E. Sánchez-Rodríguez, B. Blasco, J.J. Ríos, L. Romero, and J.M. Ruiz, "Involvement of lignification and membrane permeability in the tomato root response to boron toxicity," *Plant Science,* 176, (4): 545-552, 2009.

[72] S. Kunal and C.A. Naresh, "Effect of boron on the contents of chlorophyll, carotenoid, phenol and soluble leaf protein in mung bean, *Vigna radiata* (L.) Wilczek" Proceedings of the National Academy of Sciences, India Section B: Biological Sciences. Sept. 2014, Vol. 84 (3) pp. 713-719

[73] L.G.R. Pinho, E. Campostrini, P.H. Monnerat, A.T. Netto, A.A. Pires, C.R. Marciano and Y.J.B. Soares, "Boron deficiency affects gas exchange and photochemical efficiency (JPI test parameters) in green dwarf coconut," *Journal of Plant Nutrition.,* 33: 439-451, 2010.

[74] P.N. Sharma and T. Ramachandra, "Water relations and photosynthesis in mustard plants subjected to boron deficiency," *Indian Journal of Plant Physiology,* 33: 150-154, 1990.

[75] P. Wojcik, M. Wojcik and K. Klamkowski, "Response of apple trees to boron fertilization under conditions of low soil boron availability," *Scientia Horticulturae,* 116: 58-64, 2008.

[76] Hans-Walter H. (1997). Plant Biochemistry and Molecular Biology. Oxford University Press, Oxford.

[77] G.E. Bartley and P.A. Scolnik, "Plant Carotenoids: Pigments for photo-protection, visual attraction and human health," *Plant Cell*, 7 (7) pp. 1027-1038, 1995.

[78] A.A.M. Mazher, S.M. Zaghloul and A.A. Yassen, "Impact of boron fertilizer on the growth and chemical constituents of *Taxodium distichum* grown under water regime," *World J. of Agricultural Science,* 2(4): 412-420, 2006.
[79] M. Redondo-Nieto, L. Pulido, M. Reguera, I. Bonilla, and L. Bolanos, "Developmentally regulated membrane glycoproteins sharing antigenicity with rhamnogalacturonan II are not detected in nodulated boron deficient *Pisum sativum," Plant Cell Environment,* 30: 1436–1443, 2007.
[80] J.J. Camacho-Cristobal and A. Gonzalez-Fontes, "Boron deficiency decreases plasmalemma H+ ATPase expression and nitrate uptake, and promotes ammonium assimilation into asparagine in tobacco roots," *Planta,* 226: 443- 451, 2007.
[81] R.W. Krueger, C.J. Lovatt and L.S. Albert, "Metabolism requirement of *Curcubita pepo* for boron," *Plant Physiology,* 83: 254-258, 1987.
[82] D.R. Leece, "Effects of boron on the physiological activity of zinc in maize," *Australian Journal of Agricultural Research,* 29: 739-749, 1978.
[83] L.E. Francois, "Effect of excess boron on tomato yield, fruit size, and vegetative growth," *Journal of America Society of Horticultural Scientist,* 109, 322–324, 1984.
[84] W.J.S. Downton and J.S. Hawker, "Interaction of boron and chloride on growth and mineral composition of cabernet sauvignon vines," *America Journal of Enol. Vitic*, 31: 277-282.
[85] V.M. Shorrocks, "Behavior, function and significance of boron in agriculture," International Workshop Report at St. John's College, Oxford, England. 23-25 July, 1990. Published by Borax Consolidated Limited, London. SW 1P 1H T.
[86] I. Cakmak, H. Kurz, H. Marschner, "Short-term effects of boron, germanium and high light intensity on membrane permeability in boron deficient leaves of sunflower," *Physiology of Plant.* 95, 11–18, 1995.
[87] K.H. Muehling, M. Wimmer and H.E. Goldbach, "Apoplastic and membrane associated Ca^{2+} in leaves and roots as affected by boron deficiency," *Physiology of Plant,* 102: 179-184, 1998.
[88] T. Yamauchi, T. Hara and Y. Sonoda, "Distribution of Ca and B in the pectin fraction of tomato leaf cell wall," *Plant Cell Physiology* 27:727–732, 1986.
[89] M. Tariq and C.J.B. Mott, "Effect of boron supply on the uptake of micronutrients by radish (*Raphanus sativus L*.)," *Journal of Agriculture and Biological Sciences* 1(2): 1-8, (2006).
[90] G. Tolgyesi and A. Kozma, "Investigation on factors affecting boron uptake by grasses," *Agrokemia-es-Talajatan*, 23: 83-98, 1974.
[91] O.P. Yadav and H.R. Manchandra, "Boron tolerance studies in gram and wheat grown on a sierozem sandy soil," *Journal of India Society of Soil Scientist,* 27: 174-180, 1979.

International Journal of Innovation and Scientific Research
ISSN 2351-8014 Vol. 17 No. 2 Aug. 2015, pp. 336-340
© 2015 Innovative Space of Scientific Research Journals
http://www.ijisr.issr-journals.org/

Some characteristics of fluted pumpkin oil extracted at three heating temperatures

B. A. Adejumo and O. O. Oyedeji

Department of Agricultural and Bioresources Engineering, Federal University of Technology, PMB 65, Minna, Nigeria

Copyright © 2015 ISSR Journals. This is an open access article distributed under the ***Creative Commons Attribution License***, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT: The effect of heat treatment on the characteristics and oil yield of fluted pumpkin seeds was investigated. The fluted pumpkin seed samples was divided into four portions A, B, C and D. Samples A, B, C were heated at 100^{o}C, 130^{0} C and 150^{0} C respectively for 30 minutes, while sample D served as the control for the experiment. The oil extraction was done using soxhlet extraction method and the extracted oil was characterized using standard methods. The results showed a percentage oil yield of 40.68% for sample A, 44.32% for sample B, 46.37% for sample C and 36.20% for sample D. The specific gravity and density (kg/m^3) for extracted oil are 0.95, 0.97, 0.96 and 0.93 and 19.95, 27.47, 24.32 and 23.92 for samples A, B, C and D respectively. Saponification (mg/KOH/kg) and iodine (g/100) values are 274.87, 325.31, 375.87, 173.56 and 109.93, 108.98, 107.53, 105.48 for samples A, B, C and D respectively. The acid value (mg/KOH/g) is 2.22 for sample A, 4.46 for sample B, 6.03 for sample C, and 3.02 for sample D while peroxide value(m/mol/kg) for the extracted samples are 2.38 for sample A, 2.38 for sample B, 2.18 for sample C, and 1.18 for sample D. The free fatty acid (mg/KOH/kg) values are 1.10, 2.32, 3.00, 1.66 for samples A, B, C and D respectively for oil samples extracted. It can be concluded that the oil yield, saponification value, free fatty acid, acid value increases with increase in heating temperature while iodine and peroxide values decreases with increase in temperature. However heating temperature has no significant effect on the specific gravity of the oil. It is therefore recommended that further research should be carried out by extracting the oil after heating at a lower temperature range.

KEYWORDS: Acid value, free fatty acid, iodine value, oil yield, saponification value, peroxide value.

1 INTRODUCTION

Fluted pumpkin (*Telfairia Occidentalis)* belongs to the family *Cucurbitaceae* (Hook F). It is a tropical vine grown in West Africa as a leaf vegetable and for its edible seeds. The crop is grown in the southern part of Nigeria across lowland humid tropics and it is also a drought tolerant – perennial crop. Fluted pumpkin is grown primarily for leaf which is popular for use in preparing assorted diet in many West African countries [1] [2]. Fluted pumpkin, also known as *Fluted gourd*, is an important staple vegetable grown in Nigeria. The young shoots and leaves are the main ingredients of a Nigerian soup, *Edikang Ikong a* popular delicacy of the *efiks/ibibios* in Cross River and Akwa Ibom States in Nigeria [3]. The leaves contain vitamins and minerals that the body needs to stay healthy. The leaves are also a good source of iron [4] [1]. Higher potassium content further confirmed that the leaves of this plant can serve as better diets for hypertensive patients. Thus adequate consumption of this leaves may help in preventing adverse effects of dietary deficiencies. The leaf is of high nutritional, medicinal and industrial values.

The seeds can also be eaten whole, ground or fermented into *Ogiri* which serve as condiments for making sauce. The seeds contain about 30.1 and 47% of protein and oil, respectively and the essential amino acid content compare favourably with those of other legumes such as groundnut and soya bean. Fluted pumpkin seed is a good source of Iron, Vitamin A, C, protein, unsaturated fatty acids, which form 61% of the oil and possesses many therapeutic properties [5] [6]. It has been reported that seeds which germinate to female plants are larger in size than those that germinate to male plants. There is also speculation among indigenous farmers that seeds extracted from the head and tail portions of the fluted pumpkin pod develop into male plants, while those extracted from the middle portion develop into female plants [1] [6] [7].

Corresponding Author: B. A. Adejumo

The pod has effect on the sex, growth, and yield of the crop. Fluted pumpkin is dioeciously, having separate male *staminate* plant and female *pistilate* plant. The male plant bears only male flowers, while the female plant bears only female flowers and consequently bears the pod that contains the seeds. This is known as sexual polymorphism. In fluted pumpkin production, preference is on large succulent leaves. The female plants are known to produce large succulent leaves that attract high premium prices in the markets. The male plants, on the other hand, produce small and less attractive leaves [3] [7].

Fluted pumpkin seed oils are important sources of nutritional oils, industrial raw materials and nutraceuticals, its seed is a good source of edible oil. Its fatty acids composition is comparable to that of some conventional oils. The seed contains oil which is used for cooking and manufacturing of margarine [8] [2]. The oily seeds have lactating properties and are widely consumed by the nursing mothers [1]. Fluted pumpkin oil is reddish brown in colour and has a unique flavour (Roberts and Tammy, 2008). Pumpkin seed oil has many health benefits derived from its consumption. It contains essential fatty acids that help maintain healthy blood vessels, nerves and tissues. Pumpkin seed oil is known to alleviate and avert prostrate and bladder problems, it is often prescribed to men over fifty years with prostrate problems [9] [10].

Parameters such as temperature, time, volume of solvent and particle size affect the oil yield of oil bearing seeds. Fluted pumpkin seed oil has the qualities that are suitable for the production of soap, margarine and also for consumption. The oil is semi-drying and it is relatively low in free fatty acid value which is a good attribute for the oil to be used in the food industry as ingredient in food manufacturing. Fluted pumpkin is largely consumed in Nigeria, Ghana and Sierra Leone [1] due to the low labour requirement for production compared to other crops so its seed oil can be a substitute for vegetable oil. There are limited or no information on the processing parameters necessary for the extraction of fluted pumpkin seeds oil. Therefore the knowledge of the appropriate set of parameters for the extraction of fluted pumpkin seed oil will improve the production and quality attributes of fluted pumpkin seed oil. The aim of this study is to evaluate the effects of heating temperature on the oil yield and characteristics of oil from fluted pumpkin seeds.

2 MATERIALS AND METHODS

2.1 SEED SAMPLE COLLECTION AND PREPARATION

Fluted Pumpkin pods were obtained from *Kure* Market in Minna Niger State. The pod was broken to remove the seeds; the seed samples were cleaned thoroughly to remove dirt and spoilt seeds. The cleaned seeds were shelled and the initial moisture content of the kernel was determined using standard procedure with the sample heated for 6h at 1000^{o}C [12] [13] [14]. The seed sample was then divided into samples A, B, C and D of 267.2 g each. Samples A, served as the control, while samples B, C and D were heated for 30 minutes at 100^{0}C, 130^{0}C and 150^{0} C respectively. A laboratory oven was used for heat-treating the fluted pumpkin seed samples through the selected temperatures prior to oil expression.

2.2 OIL EXTRACTION USING SOXHLET METHOD

The Soxhlet method is the most commonly used semi-continuous process for the extraction of lipids from foods [15]. According to Soxhlet procedure, oil and fat from solid material are extracted by repeated washing (percolation) with an organic solvent, usually hexane or petroleum ether. The n-hexane was used for the purpose of this work. The grounded fluted pumpkin seed samples were placed in a porous cellulose thimble. The thimble is then placed in an extraction chamber which is being suspended above a flask containing the solvent and below a condenser. Heat is being applied to the flask and the solvent evaporates and moves to the condenser where it is converted into liquid that trickles into the extraction chamber containing the sample. The extraction chamber is made in such a way that when the solvent surrounding the sample exceeds a certain level it overflows and trickles back down into the boiling flask. The flask containing solvent and lipid is removed at the end of the extraction process. The solvent in the flask is evaporated in an oven and the mass of the lipid remaining is measured. The percentage of the lipid in the initial sample is then calculated.

2.3 DETERMINATION OF PERCENTAGE OIL YIELD AND CHARACTERISATION OF THE EXTRACTED OIL

The extraction of oil using soxhlet extractor was repeated for each of the sample and the oil was recovered by solvent evaporation. It was heated at a temperature higher than that of the solvent until the solvent finally evaporates leaving behind the extracted oil. The procedure was carried out for all samples. The average oil yield on each sample was obtained. The percentage oil yield was calculated as follow;

$$\%\ oil\ yeild = \frac{weight\ before\ extraction - weight\ of\ sample\ after\ extraction}{weight\ of\ sample\ before\ extraction} \times 100$$

2.4 ANALYSIS OF EXTRACTED OIL

Some of the characteristics of the extracted fluted pumpkin seed oil evaluated are oil yield, specific gravity, density, saponification value, acidic value, iodine value, peroxide value and free fatty acid (FFA). The procedures for the determination of these properties of fluted pumpkin oil are as prescribed using standard methods [12]. The data obtained from the above experiment was subjected to data analysis using the software package SPSS 15.0 (statistical package for social science).

3 RESULTS AND DISCUSSION

The results show that the seeds sample A, B, C and D had initial moisture contents of 64.04%, 60.20%, 42.07% and 38.11% respectively before the extraction process. The results of the effect of heating temperature on some characteristics of fluted pumpkin seed oil are as presented in Table 1.

Table 1 Effect of heat treatment on oil yield and quality of fluted pumpkin seeds

Sample	Oil Yield	Specific gravity	Density	Saponification value	Acid value	FFA	Peroxide value	Iodine value
A	36.20^{a}	0.93^{a}	23.92^{b}	173.56^{a}	3.02^{c}	1.66^{c}	1.18^{c}	105.48^{a}
B	40.68^{b}	$O.95^{a}$	19.95^{a}	274.87^{b}	2.22^{d}	1.10^{d}	2.38^{a}	109.93^{a}
C	44.32^{c}	0.97^{a}	27.47^{c}	325.31^{c}	4.46^{b}	2.32^{b}	2.38^{a}	108.98^{b}
D	46.37^{d}	0.96^{a}	24.32^{b}	375.87^{d}	6.03^{a}	3.00^{a}	2.18^{b}	107.53^{c}

3.1 THE EFFECT OF HEATING TEMPERATURE ON THE OIL YIELD OF FLUTED PUMPKIN SEEDS.

The percentage oil yield of fluted pumpkin seeds was compared with the results obtained from the oil yield of some crops within the *cucurbitaceae* family such as "*sesoswane"* (24.8%), "*egusi"* (30.0%), *"wrewre"* (27.5%), "*tsama"* (24.8%) and the desert variety of melon (28.0%) as reported [16]. The physical and chemical properties were compared with the FAO/WHO international standard for edible oil [17]. The oil yields for fluted pumpkin seeds heated at 100℃, 130℃, and 150 ℃ were 40.74%, 44.34% and 46.39% respectively while the unheated seed (control) had an oil yield of 36.55%. The results showed that percentage oil yield increases with the increase in heating temperature. The oil yield for all pre-treated samples were higher than 38-40% oil content for fluted pumpkin seed as reported [16]. It has been reported that any seed containing more than 17% of oil is considered to be an oil seed [18] as such fluted pumpkin seed can be classified as an oil bearing seed, and can be utilized for the industrial vegetable oil processing.

3.2 THE EFFECT OF HEATING TEMPERATURE ON THE SPECIFIC GRAVITY OF FLUTED PUMPKIN SEED OIL

The specific gravity for fluted pumpkin seeds heated at 100℃, 130℃, 150℃ and the unheated seeds (control) are 0.95, 0.97, 0.96, and 0.93 respectively. The values are within the range recommended by FAO/WHO for edible oil which is 0.9-1.16. Statistical analysis showed that heating temperature has no significant effect on the specific gravity of fluted pumpkin oil.

3.3 THE EFFECT HEATING TEMPERATURE ON THE DENSITY OF FLUTED PUMPKIN SEED OIL

The densities for fluted pumpkin seeds heated at100℃, 130℃, 150℃ and the unheated seeds (control) are 19.95, 27.47, 24.32 and 23.92 (kg/m^3) respectively. However, heating temperature had significant effects ($p<0.05$) on densities of the pre-treated samples such that 130℃ have the highest density than the others with 100℃ having the lowest density. The non uniform pattern in the density of the fluted pumpkin oil maybe due to the fact that when oil bearing seeds are being heated, they tend to lose some of their properties such as weight, thereby affecting density drastically [19].

3.4 THE EFFECT HEATING TEMPERATURE ON THE SAPONIFICATION VALUE OF FLUTED PUMPKIN SEED OIL

The saponification values for fluted pumpkin seeds heated at 100℃, 130℃, 150℃, and the unheated seeds (control) are 274.87, 325.31, 375.87 and 173.56 (mg/g) respectively. The values shows a deviation from the range recommended by FAO/WHO international standard for edible oil which is 181±260 .The saponification value increases significantly with increase in heating temperature, such that samples heated at 150℃ resulted in the highest value and the control the least. The oil has saponification value that is beyond the range for most oils of plants origin and less than that of palm oil, meaning that the oil has larger molecular weight than the common oils [20].

3.5 THE EFFECT HEATING TEMPERATURE ON THE ACID VALUE OF FLUTED PUMPKIN SEED OIL

The acid value of fluted pumpkin seeds heated at 100℃, 130℃, 150℃ and the unheated seeds (control) are 2.22, 4.46, 6.03 and 3.02 (mg/KOH/g) respectively. These are within the range specified for edible oil as recommended by FAO/WHO which is 4mg/KOH/g. The acid value increases significantly with increase in heating temperature, such that samples heated at 150℃ resulted in the highest amount of acid. Thus seed oil of *Telfaria occidentalis* could be suitable for cooking [21]. Its low acid value also indicates that the oil is edible [2].

3.6 THE EFFECT HEATING TEMPERATURE ON THE FREE FATTY ACID VALUE OF FLUTED PUMPKIN SEED OIL

The free fatty acid value for fluted pumpkin seeds heated at 100℃, 130℃, 150℃, the unheated seeds (control) are 1.10, 2.32, 3.00 and 1.66 (mg/KOH/g) respectively. Free Fatty Acid increased significantly with increase in temperature, such that 150℃ had the highest value (4.6). These shows a deviation from the standard specified for edible oil as given by FAO/WHO which is 5.78-7.28 [17]. Thus the seed oil could be suitable for deep frying purpose.

3.7 THE EFFECT HEATING TEMPERATURE ON THE PEROXIDE VALUE OF FLUTED PUMPKIN SEED OIL

The peroxide value of fluted pumpkin seeds heated at 100℃, 130℃, 150℃, and the unheated seeds (control) are 2.38, 2.38, 2.18, and 1.18 (m/mol/kg) respectively. These are within the range specified by F.A.O/W.H.O for fresh edible oil which is below 10mEq/kg. Low peroxide value indicates resistance of the oil to peroxidation during storage. The peroxide value of fluted pumpkin seed oil is low compared to the maximum acceptable value of 10mEq/kg. The oil is thus stable and would not easily go rancid [22]. The peroxide value increased significantly with increase in heating temperature, as compared to the control sample. There were no significant differences within the peroxide values of the oil extracted after heating at 100℃ *and* 130℃. The lowest peroxide value was obtained in the control sample.

3.8 THE EFFECT HEATING TEMPERATURE ON THE IODINE VALUE OF FLUTED PUMPKIN SEED OIL

The iodine value (100/g) of samples heated at 100℃, 130℃, 150℃ , and the unheated seed (control) are 109.93, 109.98, 107.53, 105.48 (g/100g). This shows a deviation from the standard specified by FAO/WHO for edible oil which is 80-106. The unheated seed (control) has the lowest value, which falls within the FAO/WHO standard. The iodine value is high and this reflects the presence of high percentage of unsaturated fatty acids. The iodine value is the measure of the degree of unsaturation in oils and could be used to qualify the amount of double bonds present in the oil which reflects the susceptibility of the oil to oxidation [23]. Iodine value increases with heating of the seeds, however iodine value was significantly higher at 100°C. It also has high iodine value compared to palm oil, indicating that it has high content of unsaturated fatty acids relative to palm oil [21].

4 CONCLUSION

It can be concluded that fluted pumpkin seed oil yield increases with increase in heating temperature. Heating temperature has no significant effect on the specific gravity of fluted pumpkin oil, but it however increases the saponification value, free fatty acid, acid value, peroxide value and iodine value. Heating fluted pumpkin seed at 150℃ for 30 minutes gave the highest oil yield.

REFERENCES

[1] Ajibade, S.R., M.O. Balogun, O.O. Afolabi and M.D. Kupolati, (2006). Sex differences in the biochemical contents of *Telfairia occidentalis Hook f. Journal of Food Agriculture and Environment* 4: 155-156.

[2] Agatemor, C. (2006). Studies of selected phytochemical properties of fluted pumpkin (*Telferia occidentalis hook*F.) seed oil and tropical Almond (*terminalis catappia*l) seed oil. *Pakistan Journal of Nutrition* 5: 306-330.

[3] Aletor, 0.J, A.A. Oshodi and K. Ipinmoroti, (2002), Chemical composition of leafy vegetables and properties of their leaf protein concentrates. *Food chemical* 78: 63-68.

[4] Telfairia Occidentalis, 2009, Wikipedia, the free encyclope-dia, retrieved on 4th July, *http://en.Wikipedia.Org/Wiki/ Telfairia Occidentalis*.

[5] Akwaowo, E.U., B.A. Ndon and E.U. Etuk, (2000). Minerals and antinutrients in fluted pumpkin(*Telfaria occidentalis Hook F.). Food Chemistry*, 70: 235-240.

[6] Akoroda, M.O. and M.A. Adejoro, (1990). Patterns of vegetative and sexual developmen of (*Telfairia occidentalis) Hook F. Tropical Agriculture*., 67: 243-247.

[7] Nwangwa, E.K., J. Mordi, O.A. Ebeye and A.E. Ojieh, 2007. Testicular regenerative effects induced by the extracts of *Telfairia occidentalis* in rats. Caderno de Pesquisa, *Serie Biology*, 19: 27-35.

[8] Horsfall, M. Jr. And Spiff, I.A, (2005). Equilibrium SorptionStudy of AI3+, Co2+ and Ag+ in Aqueous solutions by fluted pumpkin (*Telfairia Occidentalis HOOK f).WasteBiomass Acta Chimica Slovenica*, 52: 174-181.

[9] Odoemena, C.S. and Onyeneke, E.C, (1998). *Lipids of fluted pumpkin (Telfairia occidentalis) seeds*. *Proceedings of the 1st African Conference on Biochemistry of Lipids*, (ACBL'98), Ambik Press, Benin City, Nigeria, 2: 147-151.

[10] Oboh, G. Nwanna, E.E. and Elusiyan, C.A. (2006). Antioxidant and Antimicrobial Properties of *Telfairia occidentalis* (Fluted pumpkin) Leaf Extracts. *Journal of Pharmacology and Toxicology*, 1: 167-175.

[11] Nkang, D. Omokaro, A. Egbe, G. Amanke, (2003). "Variations in fatty acid proportions during dessication of (*Telfairia occidentalis*) seeds harvested at physiological and agronomic maturity". *African Journal Biotechnology*, 2(2), 33-39.

[12] AOAC (Association of Official Analytical Chemist), (1990). *Official Methods of Analysis* (*18th edition). AOAC: Washington DC* .

[13] Young, J. H., Whitaker, T. B., Blankenshy, P. D., Drusewitz, G. H., and Steele, J. C, (1998). Effect of Oven-drying Time on Peanut Moisture Content Determination. *Trans American*

[14] Tunde-Akintunde, T. Y., Akintunde, B. O., and Igbeka, J. C. (2001). Effects of Processing Factors on Yield and Quality of Mechanically Expressed Soybean Oil. *Journal of Engineering Technology.* 1(9):39-45.

[15] Obikili, C. M. (2010): Evaluation Of The Effect of Methods of Oil Extraction On Physico Chemical Properties of Oil From African Breadfruit Seeds, (*Treculia africana*) and Cashew Nuts *(Anarcardium Occidentale). Unpublished Undergraduate Project. Department Of Agricultural And Bioresources Engineering, Federal University Of Technology, Minna, Niger State*. Pg 12-18.

[16] Mabaleha, M.B., Mitel, Y.C., and Yeboah, (2008)"A comparative study of the properties of selected melon seed oils as potential for development into commercial edible vegetable oils". *Journal of American oil chemists society,* 84: 31-36.

[17] F.A.O/W.H.O, (1993) "*Composition and selected uses of fats and oils in food*", in Report of the Joint F.A.O/W.H.O Expert Consultation on Fats and Oils in Human Nutrition, Rome, 5-27.

[18] Akinoso, R. and Raji, A.O., (2010). "Optimization of Oil Extraction from Locust Beans using Response Surface Methodology". *European Journal of Lipid science and Technology* 113(2), 245-252.

[19] Eromosele, C.O and Pascal, N.H., (2003). "Characterization and viscosity parameters of seed oils from wild plants"*Journal of.Bioresoures Technology* 86,203-205.

[20] Dosumu, M.I. and Ochu, C. (1995): Physicochemical properties and fatty acid composition of lipids extracted from some Nigerian fruits and seeds. *Global Journal of Pure & Applied Science*, 1: 45-47.

[21] Oderinde, R.A., Ajayi,I.A., Adewuyi, A., (2009) "Characterization of seed and seed oil of Hura crepitans and the kinetics of degradation of the oil during heating". *Journal of Environment and Agriculture and Food Chemistry*, 8(3), 201-208.

[22] Arouri, A. and Mouritsen, O.G, (2013) Membrane-perturbing effect of fatty acids and lysolipids. *Programme Lipid Res*earch, 52: 130-140

[23] Mohammed, M.I., and Hamza, Z.U, (2008) "Physicochemical Properties of Oil Extracts from Sesamum indicum L Seeds Grown in Jigawa State- Nigeria". *A Journal of Application Science Environment Management,* 12 (2): 99-101.

International Journal of Innovation and Scientific Research
ISSN 2351-8014 Vol. 17 No. 2 Aug. 2015, pp. 341-351
© 2015 Innovative Space of Scientific Research Journals
http://www.ijisr.issr-journals.org/

CFD ANALYSIS OVER A SEAMLESS CONTACT TRAILING EDGE FLAP SYSTEM

BANDARU SWETHA[1] and GUTTAPALLI SAVARNI MAHARSHI[2]

[1]B.Tech Aeronautical Engg., (M.Tech) Thermal Engg. in Andhra university, India

[2]B.Tech Aeronautical Engg, India

Copyright © 2015 ISSR Journals. This is an open access article distributed under the ***Creative Commons Attribution License***, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT: This project serves to develop a new flap design concept entitled "seamless contact trailing edge flap (SCTEF)" and analyze it on a regional airliner model. It covers a wide range of engineering work processes and due to the realistic nature and wide scope of the project, it can be made comparable to real life engineering projects, which engineers deal with in their course of work. CAD models are developed in CATIA V5 R19 software.
Computational Fluid Dynamics (CFD) study will be conducted to explore the effect of new flap concept entitled "seamless contact trailing edge flap (SCTEF)" on lift and drag of the regional airliner during takeoff. In this work ANSYS FLUENT 14.5 was used as Computational Fluid Dynamics (CFD) software. The working condition of simulation was considers at the aircraft takeoff just before the rotation speed 'V_1'. Two configurations (i.e. wing with deflected flap & deflected seamless contact flap) were considered along with an unmodified (no flap deflection) wing as the baseline case. Comparison of lift and drag corresponding to these configurations with baseline configuration (retracted flaps) will be expected to show a definite trend in the results.
CFD analysis has shown that new flap design SCTEF concept improves lift and decreases drag which is nothing but more fuel efficient flights and low noise when taking off.

KEYWORDS: Flaps, Vortices, Computational Fluid Dynamics, ANSYS FLUENT, CATIA.

INTRODUCTION

The aircraft industry has been responding to the need for energy-efficient aircraft by redesigning airframes to be aerodynamically efficient, employing light-weight materials for aircraft structures and incorporating more efficient aircraft engines. Reducing airframe operational empty weight (OEW) using advanced composite materials is one of the major considerations for improving energy efficiency. A NASA study entitled "Elastically Shape Future Air Vehicle Concept" was conducted to examine new concepts that can enable active control of wing aero elasticity to achieve drag reduction. This study showed that highly flexible wing aerodynamic surfaces can be elastically shaped in-flight by active control of wing twist and vertical bending to improve aerodynamic efficiency through drag reduction during cruise and enhanced lift performance during take-off and landing. This theory shows that active aero elastic wing shaping control can have a potential drag reduction benefit. But Conventional flap and slat devices inherently generate drag as they increase lift. The study also shows that conventional flap and slat systems are not aerodynamically efficient for use in active aero elastic wing shaping control for drag reduction. A new flap concept, referred to as seamless trailing edge flap system (SCTEF) was developed to explore the effect on a regional airliner model.

TIP VORTICES

Vortices form because of the difference in pressure between the upper and lower surfaces of a wing that is operating at a positive lift. Since pressure is a continuous function, the pressures must become equal at the tips. The tendency is for

particles of air to move from the lower wing surface around the tip to the upper surface (from the region of high pressure to the region of low pressure) so that the pressure becomes equal above and below the wing. The same theory can be assumed for a deflected flap as it has tips on either side. So there will be a tendency for air particles to generate tip vortices.

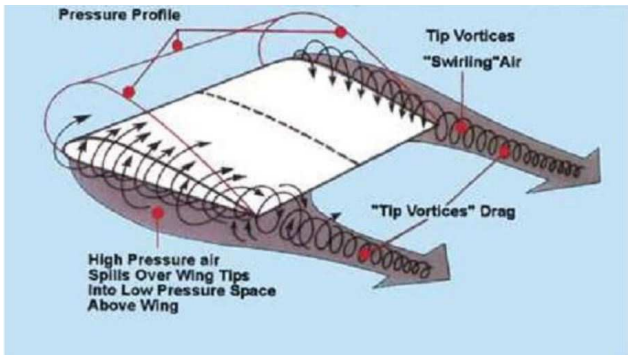


Fig.1: Origin of tip vortices

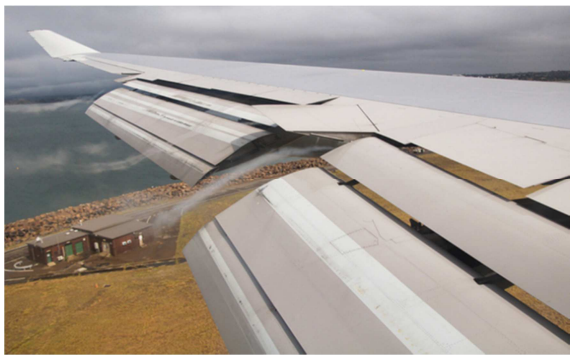


Fig.2: conventional flaps and gap between them

AIRCRAFT MODELS

CATIA (Computer Aided Three-dimensional Interactive Application) is a multi-platform CAD/CAM/CAE commercial software suite developed by the French Aeronautics company Dassault Systems. Written in the C++ programming language.

Airfoil was imported from "UIUC Airfoil Data site[12]"named "NASA/LANGLEY MS (1)-0317" and other design parameters are obtained from regional aircraft preliminary design cases. By these design drivers CAD models are developed in CATIA software. The basic aircraft model shown in Fig.3

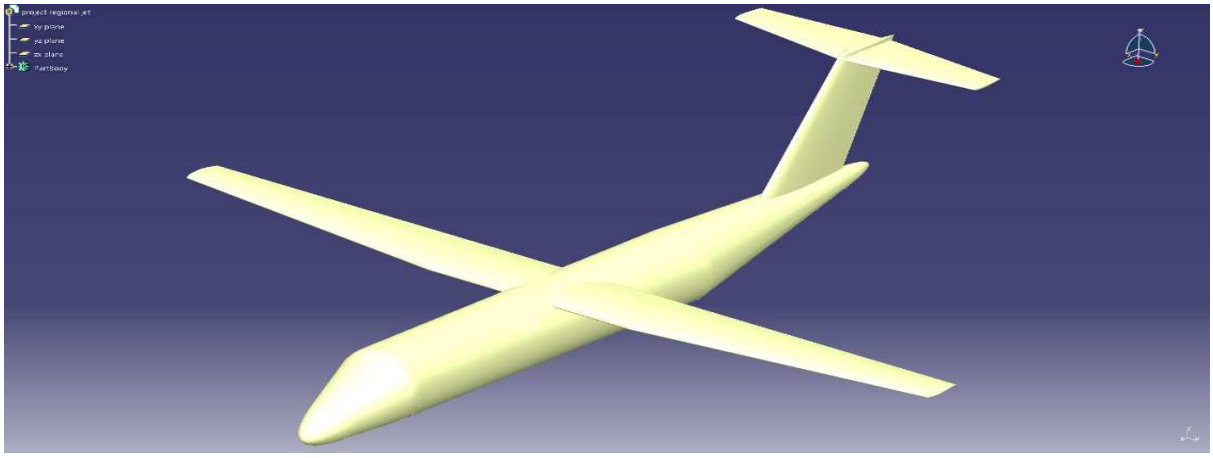


Fig.3: Basic Aircraft model in CATIA software

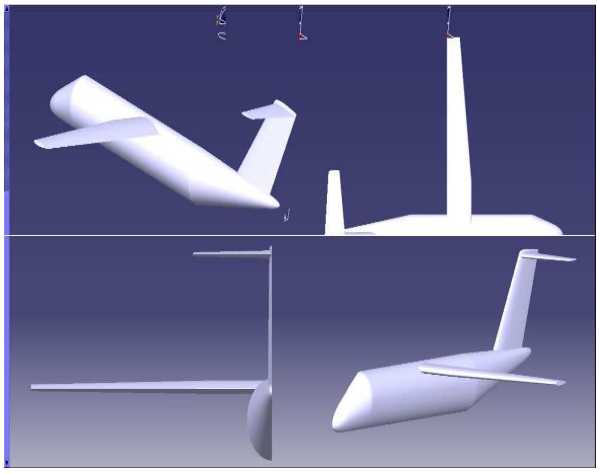


Fig.4: Aircraft without flap

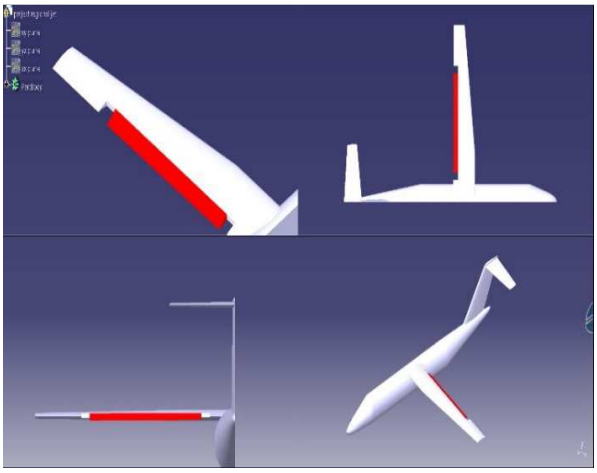


Fig.5: Aircraft with deflected plain flap

Wing section was altered with deflected plain flap is shown in Fig. 5 and seam less contact trailing edge flap (SCTEF) as shown in Fig. 6.

Design	Area	Length
Aircraft with no flap	0.000192556m^2	28.14mm
Aircraft with deflected flap	0.000191634m^2	28.14mm
Aircraft with deflected SCTEF system	0.000192666m^2	28.14mm

Table 1: Design parameters of CAD models

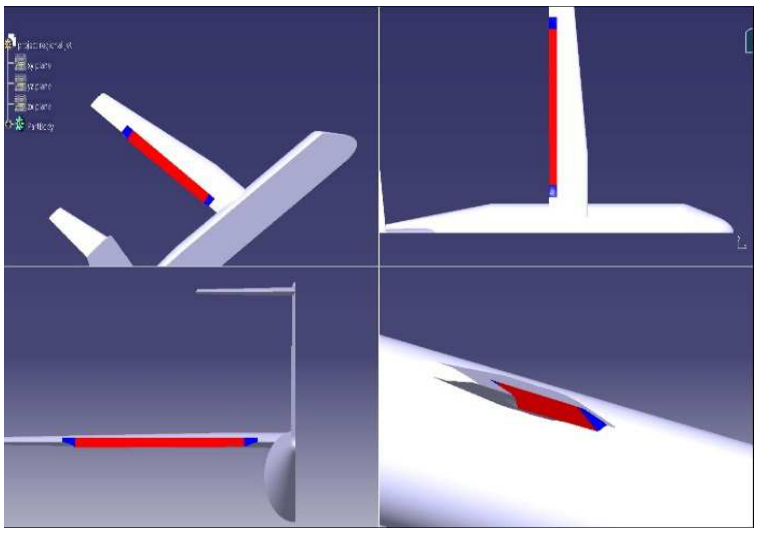


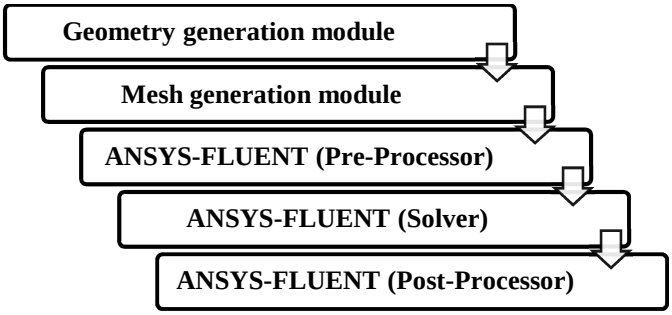
Fig.6: Aircraft with deflected SCTEF system

COMPUTATIONAL FLUID DYNAMICS (CFD)

Computational fluid dynamics, usually abbreviated as CFD, is a branch of fluid mechanics that uses numerical methods and algorithms to solve and analyze problems that involve fluid flows. CFD involves fluid flow, heat transfer and associated

phenomena such as chemical reactions by means of computer based simulation. The technique is very powerful and spans a wide range of industrial and non-industrial application areas.

STRUCTURE OF ANSYS FLUENT



STEPS INVOLVED IN CFD ANALYSIS

Meshing the Continuum

The meshing of the aircraft is done using ANSYS MESH14.5. Here continuum is divided into different named sections like inlet, outlet, symmetry, wall and aircraft as shown in Fig.7 and the required meshing conditions are applied and the continuum is meshed. The aircraft is given a fine mesh size of 0.001mm since it is of most importance and of complex geometry and the rest of the continuum is given a mesh size of 0.01mm. The difference between the elements sizes can be seen in Fig.8.

Design\Mesh statistics	No. of nodes	No. of elements
Aircraft with plain wing	147022	824195
Aircraft wing with deflected flap	215028	1213860
Aircraft wing with deflected SCTEF system	216706	1222607

Table 2: CAD Models Mesh Statistics

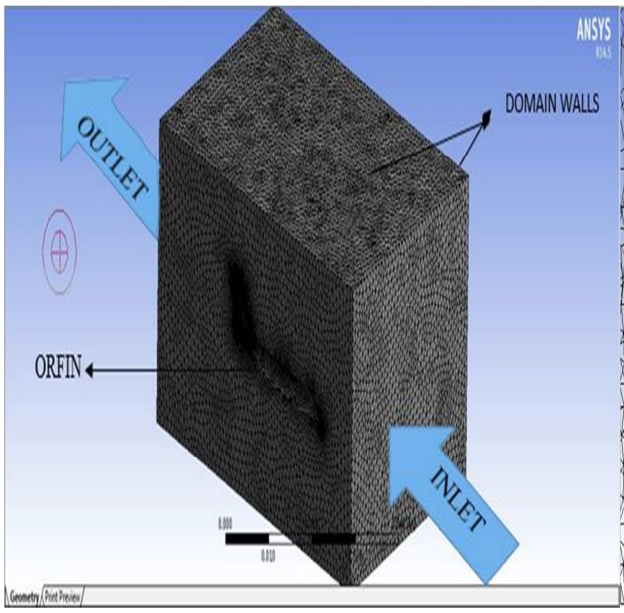


Fig.7: Domain configuration

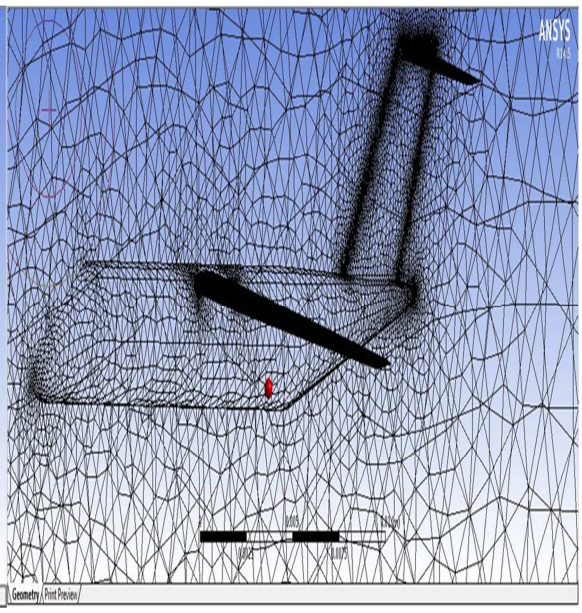


Fig.8: Finely meshed aircraft (ORFN)

SIMULATION OF THE CONTINUUM

The simulation of this continuum is done in ANSYS Fluent 14. In this initially the meshing of the continuum is checked and once the software approves it, the models, materials and boundary conditions are set.

1. Model

The model used for this kind of simulation is the spalart-allmaras (SA) model. This is a single equation model which is consider mostly for boundary layer problems like aerospace, automobile etc. This model is coupled with viscous heating option in our simulation.

2. Materials

The working fluid in this simulation is air at 27^0c and is considered to act on the aircraft at normal atmospheric conditions. The properties of air at 27^0c were given in table 3.

3. Boundary Conditions

The important boundary conditions in an External Flow Analysis are Mach number or velocity at inlet of the continuum and pressure at the outlet of the continuum. As per the data regarding the range of 'V1' speed at takeoff for regional class of aircrafts the inlet boundary condition for the continuum is given as 75 m/s. The outlet boundary condition is given as gauge pressure and its value is given as 0 Pa. the symmetry plane (YZ plane) is mentioned as symmetry. The rest of the faces of the continuum are mentioned as wall which means that these faces are under free-slip condition i.e. there is no considerable boundary layer effect on these faces.

4. Monitors

In order to predict the lift force and drag force generating on the aircraft, monitors of lift and drag are engaged along with the residual plots. These monitors needs the data like length, area, flow parameters to calculate the center of gravity (C.G), Aerodynamic center (A.C) of the aircraft. By these calculations it shows the forces acting in the aircraft.

5. *Solution*

Once the boundary conditions are set, the solution methods and controls are set for this simulation. The solution method set for this is the coupled solver. And as for the solution controls the courant number is set to 0.25 and the under relaxation factors for momentum and pressure are set as 0.75 and for the turbulent kinetic energy, turbulent dissipation rate and turbulent viscosity is set to 0.8.

PROPERTIES OF AIR AT 27^0C	VALUES
Density ρ (kg/m^3)	1.1765
Thermal conductivity k (W/m.k)	0.026118
Dynamic viscosity μ (kg/m.s)	1.8538e-05
Specific heat c_p (j/kg.k)	1.0063e+03

Table 3: Properties of air at 27^0c

SECTION	BOUNDARYCONDITIONS	
INLET	Velocity=75 m/s	Temperature=300 k
OUTLET	Pressure outlet=0 pa	Temperature=300 k
AIRCRAFT (ORFN)	Wall-no slip(considering BL effects)	
DOMAIN WALLS	Wall-free slip	

Table 4: Design parameters of CAD models

RESULTS

Pressure counters:

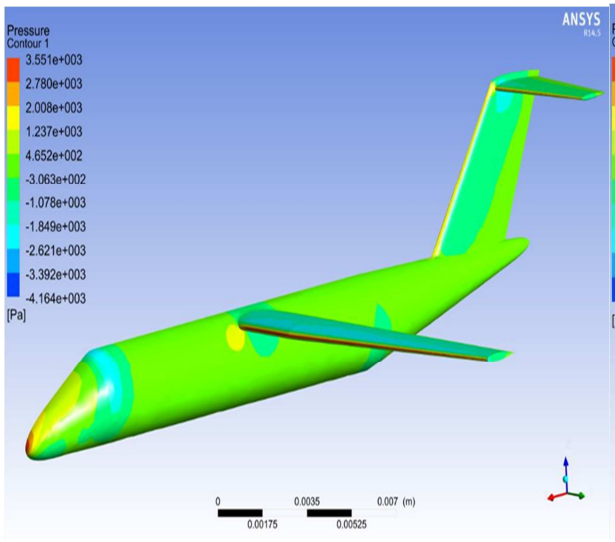


Fig.9: Aircraft without flaps

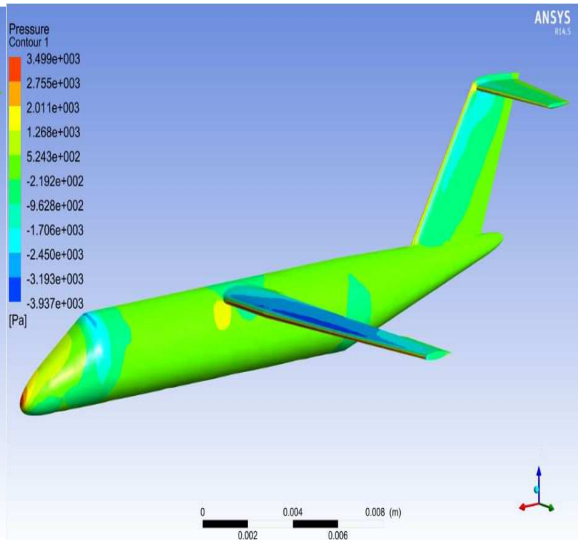


Fig.10: Aircraft with deflected plain flap

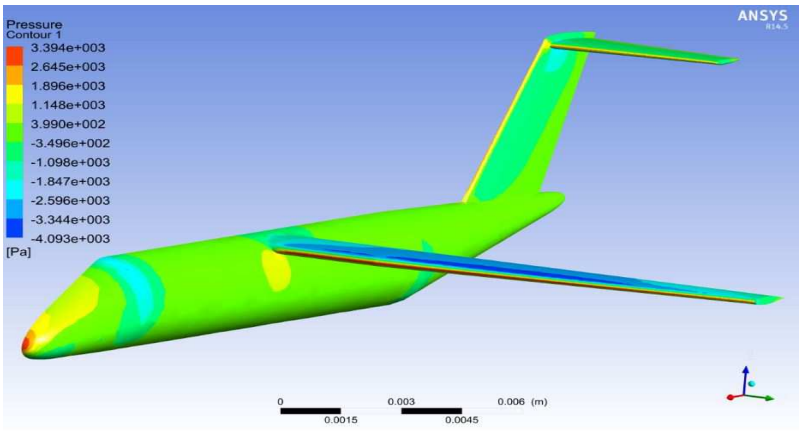
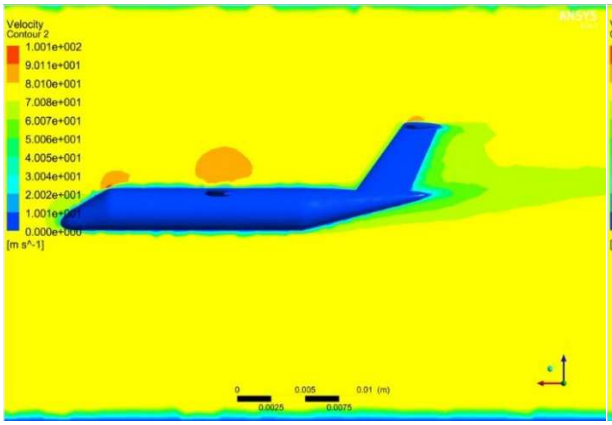


Fig.11: Aircraft with SCTEF configuration

Velocity Magnitude Counters:



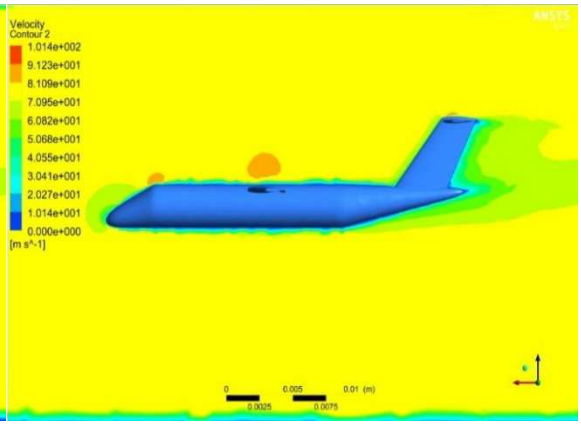
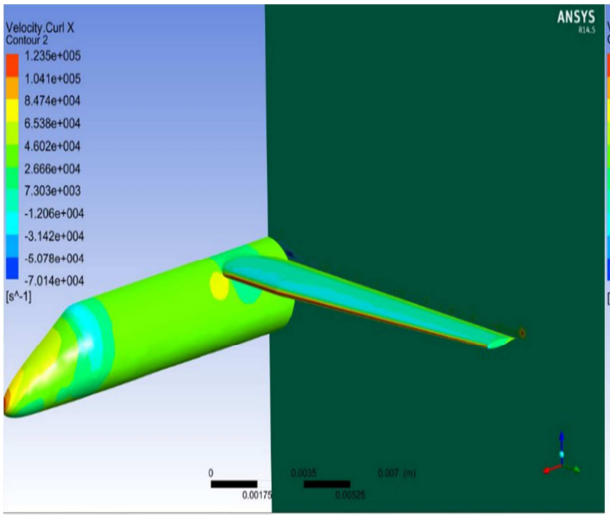


Fig.12: Aircraft with plain flap ***Fig.13: Aircraft with SCTEFzz***

Velocity Curls:

Velocity curl in X direction is monitored among three models on a plane created just behind the wing shown as green wall in the figures.



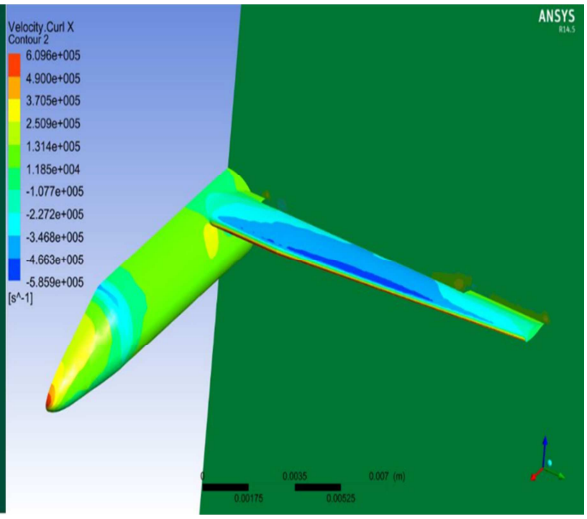


Fig.14: Velocity curl on aircraft without flaps ***Fig.15: Velocity curl on aircraft with plain flap***

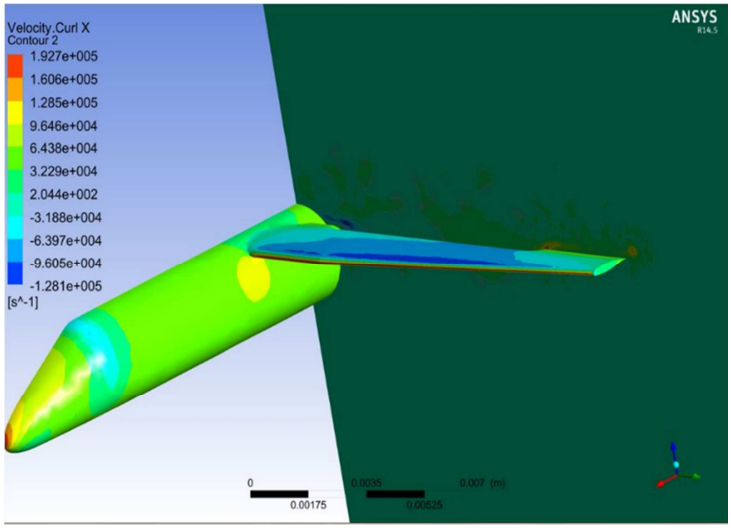


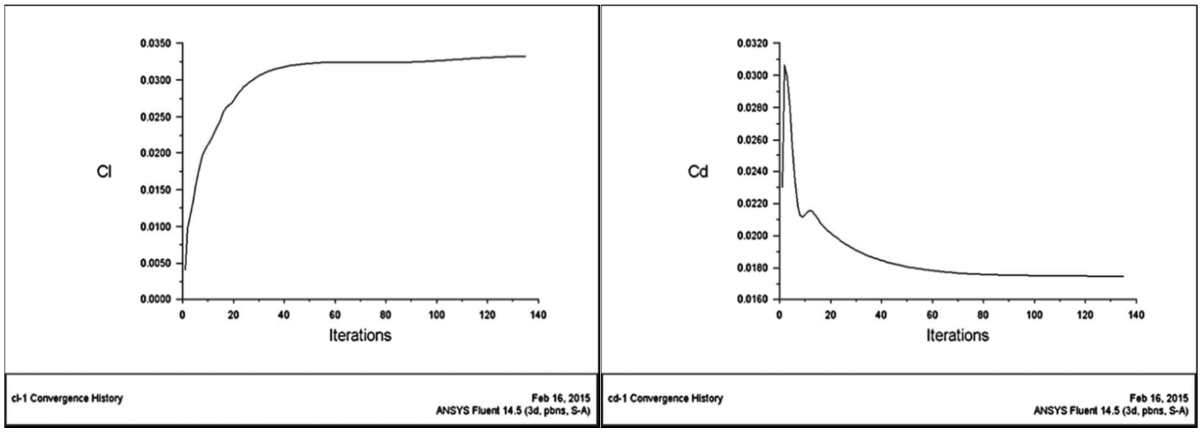
Fig.16: velocity curl on aircraft with SCTEF

From the velocity curls we can observe that aircraft with deflected SCTEF has less vortices when compared with the aircraft with plain flap deflection. Aircraft without flap has even less curl vector than aircraft with deflected SCTEF because it doesn't have any deflections to disturb the air flow pattern. The maximum and minimum values of velocity curls are compared among three models in table 5.

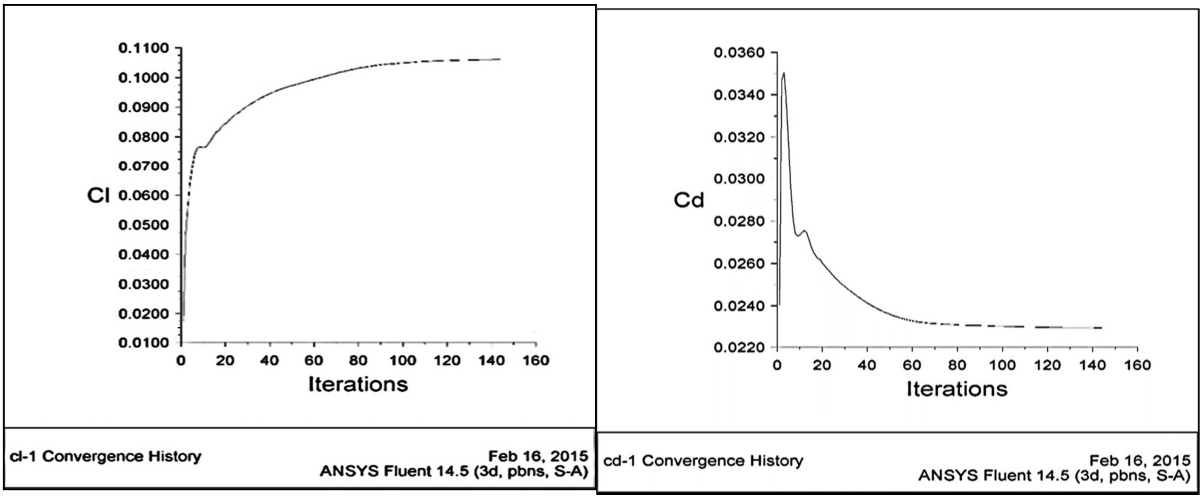
Velocity curl(s^{-1}) \ Model	Aircraft without flaps	Aircraft with plain flap	Aircraft with SCTEF
Maximum	$1.235*10^{005}$	$6.096*10^{005}$	$1.927*10^{005}$
Minimum	$-7.014*10^{004}$	$-5.895*10^{005}$	$-1.281*10^{005}$

Table 5: velocity curl among three models

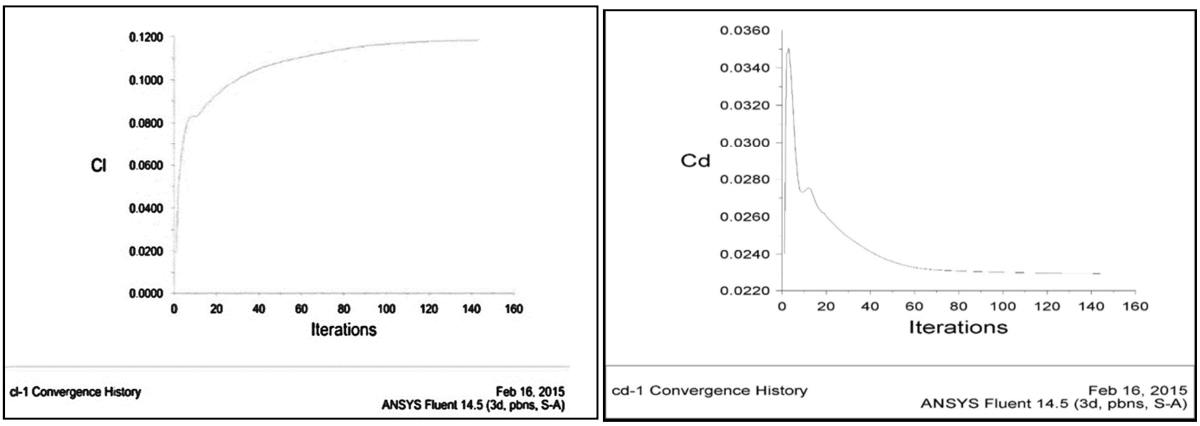
LIFT AND DRAG MONITORS



Graph 1: C_L & C_D monitors of aircraft without flap deflection



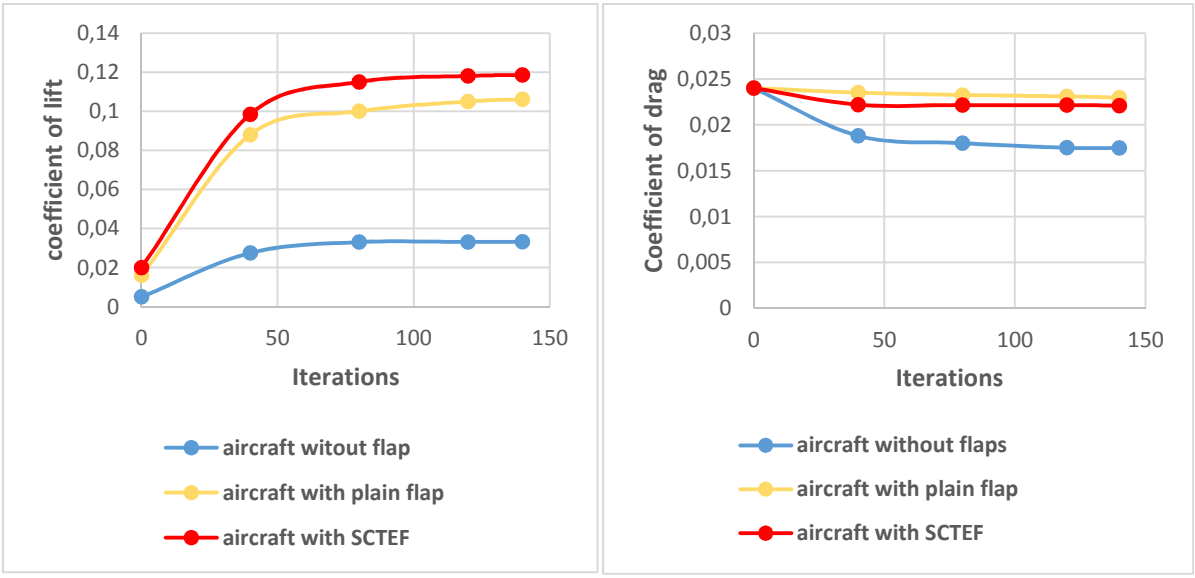
Graph 2: C_L & C_D monitors of aircraft with plain flap deflection



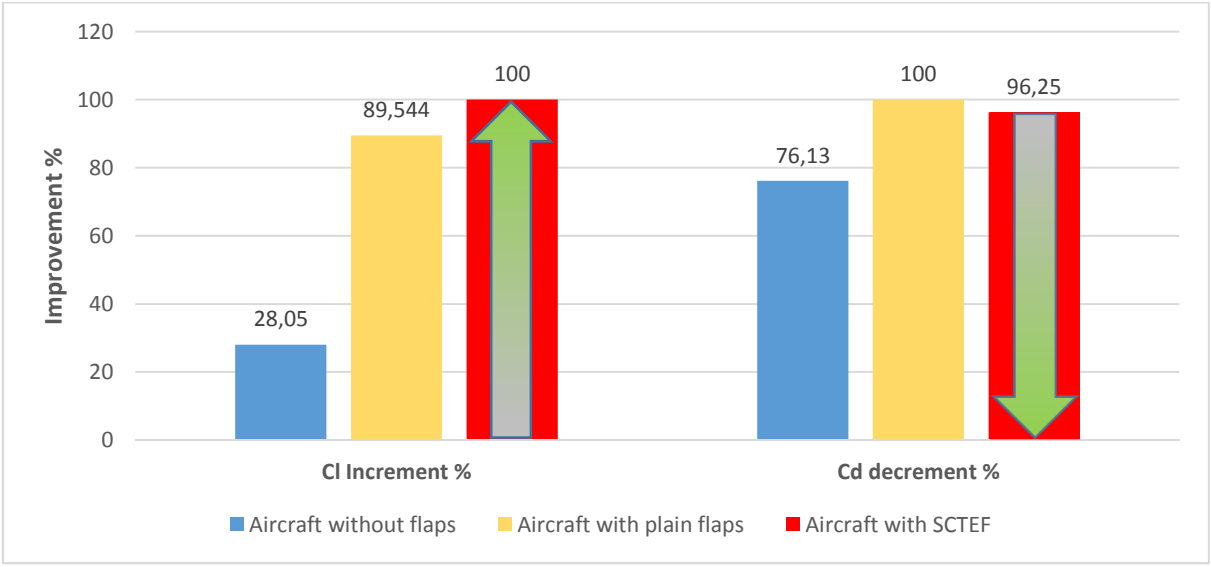
Graph 3: C_L & C_D monitors of aircraft with deflected SCTEF

MODEL	Lift force(N)	Drag force(N)	C_L	C_D	C_L/ C_D
Aircraft without flaps	0.021179N	0.0111384N	0.033241	0.017482	1.90
Aircraft with plain flap	0.0672842N	0.01456N	0.10611	0.022962	4.62
Aircraft with SCTEF	0.075546N	0.0140903N	0.1185	0.022102	5.36

Table 6: CFD analysis results comparison



Graph 4: C_L& C_D comparison among three models



Graph 5: Lift and Drag improvement percentage

From the improvement graph, it is clear that aircraft with SCTEF flap lift has increased 10.456 % & 3.75 % drag has decreased when compared with aircraft with plain flap deflection.

CONCLUSION

Computational fluid dynamics (CFD) analysis was done on three configurations to explore the effect of seamless contact trailing edge flap (SCTEF) with comparison among the other two models. When conventional flaps are lowered, gaps exist between the forward edge and sides of the flaps and the wing surface. By using flexible composite materials flaps will be gapless, forming a seamless transition region with the wing while remaining attached at the forward edge and sides. The improved flap eliminated a major source of airframe noise generation and also improves aerodynamic efficiency.

- Computational fluid analysis on the aircraft model with new concept has shown definite trends in comparison among the other
- Analysis shown that SCTEF flap has improved the lift production by 10.456% and decrease in drag by 3.75% when compared with the plain flap.

- Pressures velocity magnitude and velocity curls are well within the limits with respect to the boundary conditions.

Hence CFD analysis has shown that SCTEF concept improves lift and decreases drag which is nothing but more fuel efficient flights and low noise when taking off. This new concept can be incorporated with the aircraft flap actuation system that makes pilot to engage the system whenever it is needed.

REFERENCES

[1] "National Advisory Committee for Aeronautics (NACA) airfoil results data"
[2] "National Aeronautics and Space Administration (NASA) Glen Research Institute"
[3] "Aircraft design: a conceptual approach" Daniel. P. Raymer AIAA Educational series
[4] "Drag Optimization Study of Variable Camber Continuous Trailing Edge Flap (VCCTEF) using OVERFLOW" Upender K. Kaul and Nhan T. Nguyen NASA Ames Research Centre, USA.
[5] "Fundamentals of aerodynamics" Dr. J .D. Anderson Jr.
[6] "Flow analysis over an F-16 aircraft using CFD" Manish Sharma, T.Ratna reddy, ch indirapriya
[7] "CFD analysis over an aircraft" Basil Oscar Reberio.
[8] "NASA Flexfoil, advanced shape morphing concept for aircrafts" Glen research Centre, U.S.A
[9] "Aircraft wing design" Mohammad sadraey Daniel

International Journal of Innovation and Scientific Research
ISSN 2351-8014 Vol. 17 No. 2 Aug. 2015, pp. 352-358
© 2015 Innovative Space of Scientific Research Journals
http://www.ijisr.issr-journals.org/

TREMBLEMENT DE TERRE DANS LA PROVINCE DU SUD-KIVU DU 03/02/2008 ET SES CONSÉQUENCES SUR LA VILLE DE BUKAVU

John Kashinzwe Kibekenge[1], Richard Birindwa Cubwe[1], and Sylvain Kulimushi Matabaro[2]

[1]Département de Géographie et Gestion de l'Environnement, ISP Walungu, R.D. Congo

[2]Institut Supérieur Pédagogique de Bukavu, I.S.P Bukavu, R.D. Congo

Copyright © 2015 ISSR Journals. This is an open access article distributed under the ***Creative Commons Attribution License***, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT: The shaking of the earth's crust at any point causes vibrations that are transmitted across the globe. This movement has the effect of inducing in the soil and in the works of rapidly varying inertial forces over time. Its action is exerted essentially dynamic way, but it takes on different aspects in structures, soil. Is recorded structural damage equipment and manpower.

South Kivu province, mainly the city of Bukavu and the neighboring countries were shaken by a violent earthquake, among the rarest recorded in the region, to Sunday 03/02/2008 9:34 local time (7:34 'GMT) . The 6.3 magnitude earthquake on the scale of RICTHER had its epicenter, according to the seismological observatories NSRF / Lwiro, around Birava in the same province, 20 km north of Bukavu, whose home was 33 km deep, according to still the same source (shallow earthquake: less than 60Km). It lasted about 20 seconds. This tectonic phenomenon has generated much of the damage as well geomorphological, material as humans.

KEYWORDS: Earthquake, tectonic phenomenon.

RESUME: L'ébranlement de la croûte terrestre en un point quelconque provoque des vibrations qui se transmettent à travers le globe. Ce mouvement a pour effet d'induire dans le sol et dans les ouvrages des forces d'inertie rapidement variables dans le temps. Son action s'exerce donc de façon essentiellement dynamique, mais elle revêt des aspects différents dans les structures, dans le sol. On enregistre des dégâts structuraux matériels et humains. La province du Sud-Kivu, principalement la ville de Bukavu et les contrées voisines ont été secouées par un violent séisme, parmi les plus rares enregistrés dans la région, le dimanche 03/02/2008 à 09h34' heure locale (7h34' GMT). Ce séisme de magnitude 6,3 sur l'échelle de Richter avait comme épicentre, selon les observatoires séismologiques du Centre de Recherche en Sciences Naturelles de Lwiro, C.R.S.N/Lwiro en sigle, aux environs de Birava dans la même province à 20 Km au nord de la ville de Bukavu et dont le foyer se situait à 33 Km de profondeur, selon toujours la même source (séisme superficiel: inférieur à 60Km). Il a duré environs 20 secondes. Ce phénomène tectonique a engendré bien des dégâts aussi bien géomorphologiques, matériels qu'humains.

MOTS-CLEFS: Tremblement de terre, Echelle de Richter, Séisme, Catastrophe, Ebranlement.

1 INTRODUCTION

De toutes les manifestations de la dynamique planétaire, les tremblements de terre ou séisme sont, sans doute ceux qui ont le plus marqué la conscience populaire(1). Ce phénomène a également attiré notre attention surtout de par son originalité. En effet, le séisme qui a secoué la ville de Bukavu le 03 Février 2008 est égal à lui-même dans l'histoire de cette province tant sur sa nature que sur les dégâts perpétrés sur tous les plans. Ainsi, dans ce travail nous voulons étudier les causes de ce séisme dans cette région, la dynamique de la nature des dégâts perpétrés à travers la ville et ses causes, la dynamique de ses répliques dans le temps et dans l'espace, l'avenir de la région par rapport à sa structure tectonique, des

préventions contre la catastrophe et bien d'autres questions auxquelles nous aurons à répondre et à fournir des explications par rapport à cette catastrophe naturelle dans la ville.

2 APPROCHE METHODOLOGIQUE ET TECHNIQUES

Pour aborder cette étude, **n**ous avons d'abord observé les différents dégâts causés par le séisme du 03 février 2008 dans les quartiers de la ville de Bukavu. Les données recueillies ont été comparées aux activités sismiques observées dans la région du lac Kivu et dans d'autres parties du monde en termes de puissance du séisme sur l'échelle de Richter et d'intensité observée en terme des dégâts occasionnés (destruction des immeubles, nombre des morts et des blessés, etc.).

Par ailleurs, trois types de démarches ont été particulièrement empruntés pour collecter et analyser les informations. Il s'agit de la consultation des ouvrages, des rapports, des mémoires et d'autres documents sur les séismes. Nous avons également consulté les données recueillies par les séismographes du Centre de Recherche en Sciences Naturelles, en sigle CRSN/Lwiro notamment celles du séisme du 03 février 2008 et ses répliques. Enfin, pour compléter nos observations sur terrain, nous avons eu des entretiens sous forme d'interview avec les chercheurs du CRSN/Lwiro au département de géophysique sur le phénomène sismique du moment, avec des populations sinistrées, les autorités municipales et provinciales. Ces éléments ont permis de retracer l'historique et l'évolution d'activités sismiques dans la région à partir des données recueillies jusqu'à présent et de comprendre le phénomène actuel à Bukavu avec un passé sismique bien marqué.

3 PRESENTATION DES DONNEES

3.1 LOCALISATION

« Là où la terre a tremblé, elle tremblera …. »[(2)]. Ce séisme de magnitude 6,3 sur l'échelle de Richter avait comme épicentre, selon les observatoires séismologiques du CRSN/Lwiro, aux environs de Birava dans la même province à 20 Km au nord de la ville de Bukavu et dont le foyer se situait à 33 Km de profondeur, selon toujours la même source (séisme superficiel: inférieur à 60Km).

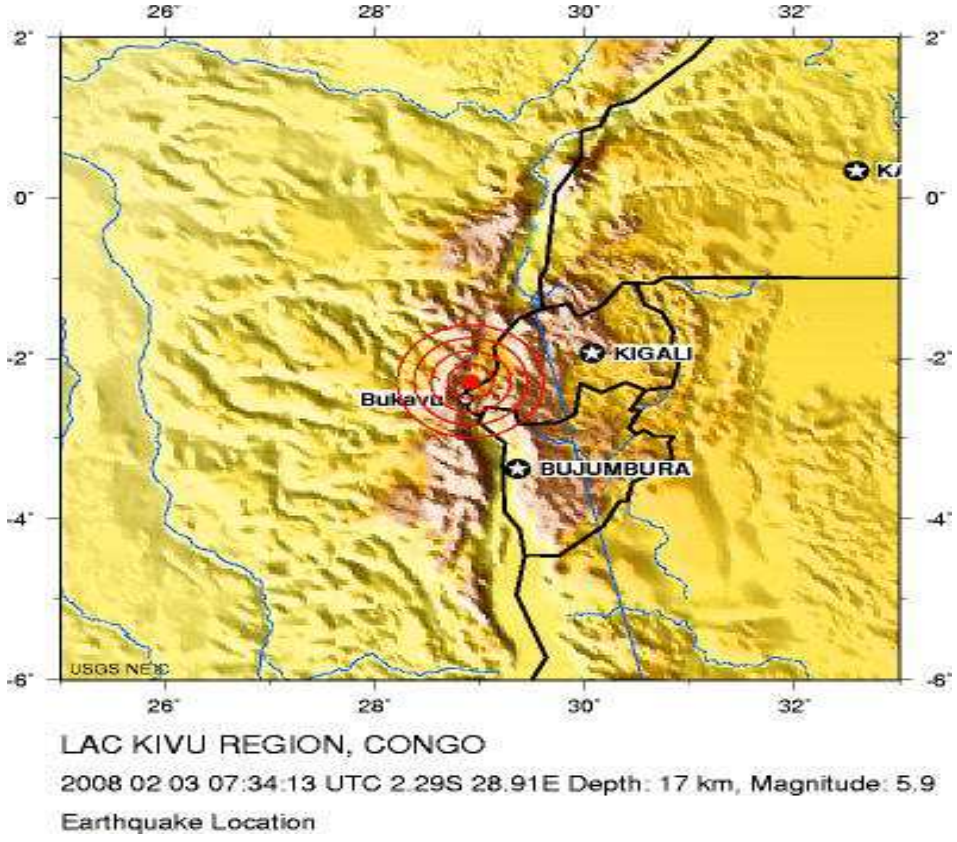


Figure N^{0}1. Localisation du séisme du 03Fév.2008

3.2 CAUSES ET ORIGINES

Les séismes résultent de la rupture des roches résistantes provoquées par le brusque glissement de deux compartiments terrestres le long d'un plan de faille. Contrairement à l'opinion publique qui a crue à l'entrée en éruption des volcans Kahuzi et Biega qui étaient éteints depuis près d'un demi-siècle, dont le tremblement de terre du 03/02/2008 ne serait qu'un signe précurseur, des études et des analyses scientifiques ont prouvées jusqu'aujourd'hui qu'il n'en est pas question. En effet, se fondant sur sa localisation, l'état actuelle des volcans précités, sa nature et son ampleur, son intensité et sa puissance ; tous ces éléments réunis n'ont pas permis d'adhérer à l'opinion publique. Le tremblement de terre précité dans la province du Sud-Kivu est d'origine tectonique lié aux mouvements de failles intra plaques continentales, vu la localisation de son épicentre et ses caractéristiques. En effet nous savons qu'une zone sismique s'étend le long de l'Afrique de l'Est jusqu'en Syrie (Moyen Orient), en passant par la mer rouge. Elle correspond à une grande cassure continentale long de 9500 Km, large de 40Km et profonde des quelques milliers des mètres. On parle actuellement dans cette structure, des rifts Albertin, Ruzizien et Tanganyikien. Nous sommes donc dans une zone de subduction intra-plaque réputée d'une activité sismique depuis la formation du rift au début du Miocène mais n'a jamais intéressé la masse populaire comme il en est le cas aujourd'hui ; les ancêtres pensaient tout simplement à la colère divine. La carte ci-dessous montre les cas enregistrés depuis 1990 à nos jours.

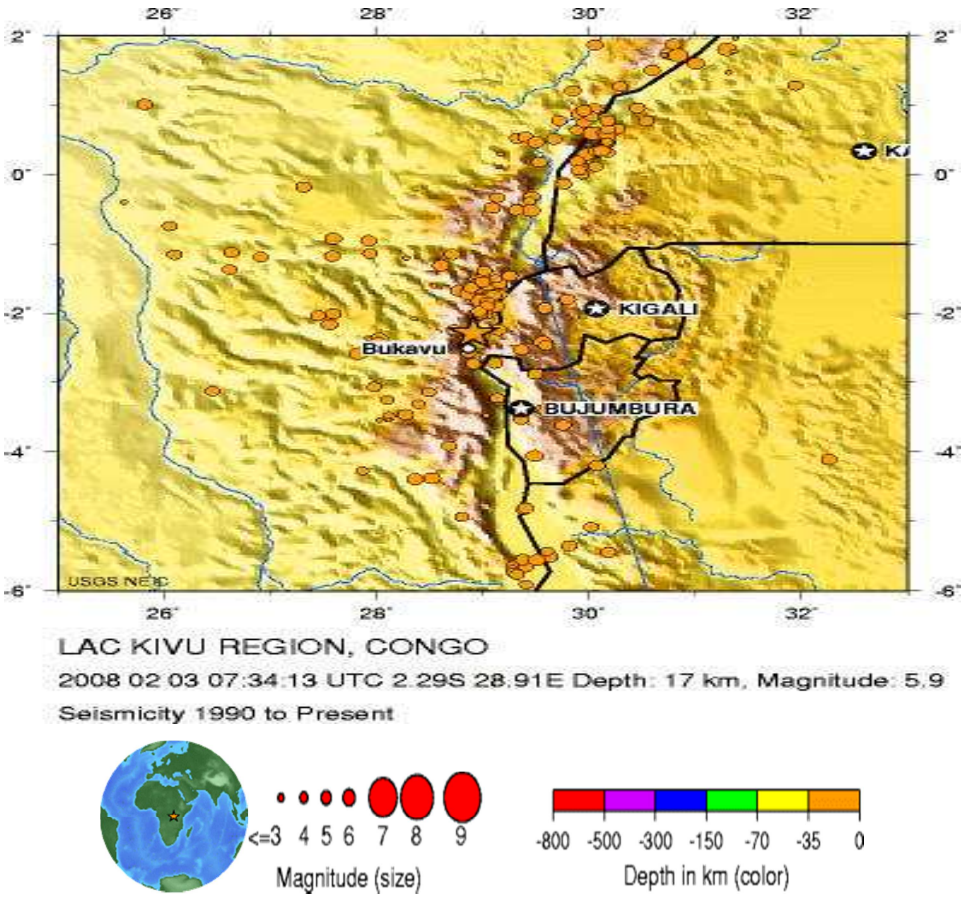


Fig N^{0}2. Historique sismique de 1990 à nos jours

3.3 ENREGISTREMENT SISMOGRAPHIQUE

Le passage des ondes sismiques lors d'un tremblement de terre est enregistré par les sismographes sous forme des sismogrammes. Le séisme de Bukavu du dimanche 03/02/2008 a été enregistré par les séismographes de la station du CRSN/Lwiro situé à 17 Km au nord de son hypocentre et à une latitude de 2,30° Sud, sa longitude étant de 28,90 Est. La description que nous avons faite de ce séisme découle de l'analyse de ces enregistrements. En voici le sismogramme caractéristique.

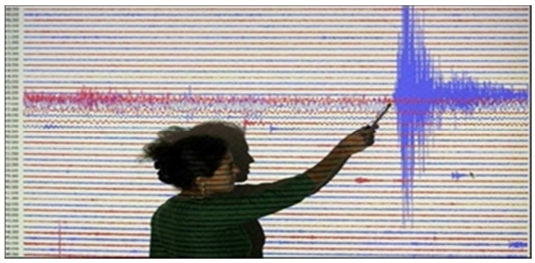


Fig n^{0}3. Sismogramme du séisme du 03/02/2008 de magnitude 6,3 dans la province du sud-kivu

3.4 EXTENSION

La carte ci-dessous montre clairement les différentes contrées affectées par ce séisme ainsi que leur degré d'affectation (voir légende) à partir de l'épicentre. Ainsi nous avons successivement la zone I (Kavumu, Cifuma, Kabare, le Sud-Sud d'Idjwi, Cangugu, Nord de Bukavu), zone II (Bukavu, Mumosho, Mule, Mushenyi, Idjwi). Il ressort également cette carte que ce séisme s'est étalé généralement sur trois pays dont la RDC, le Rwanda et le Burundi.

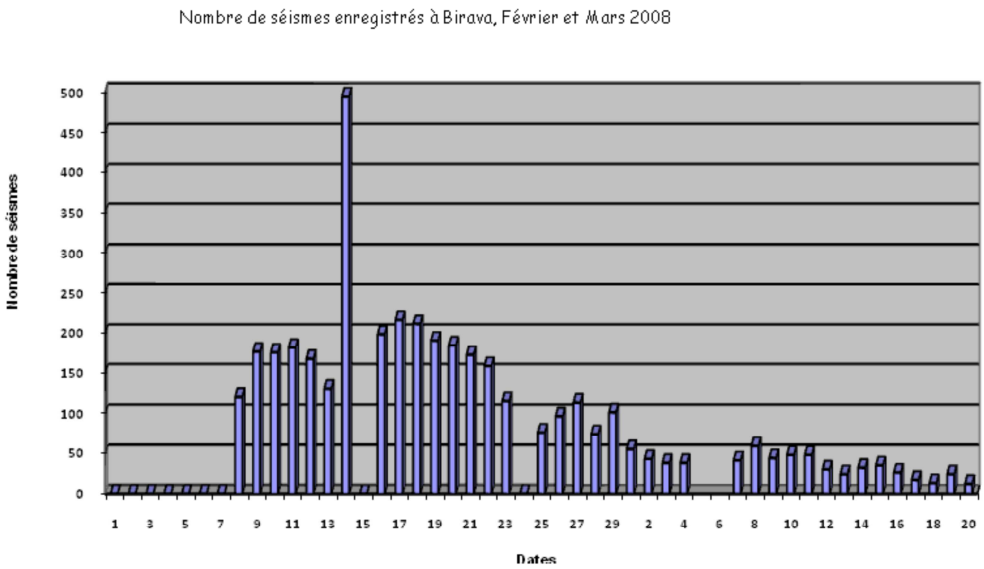
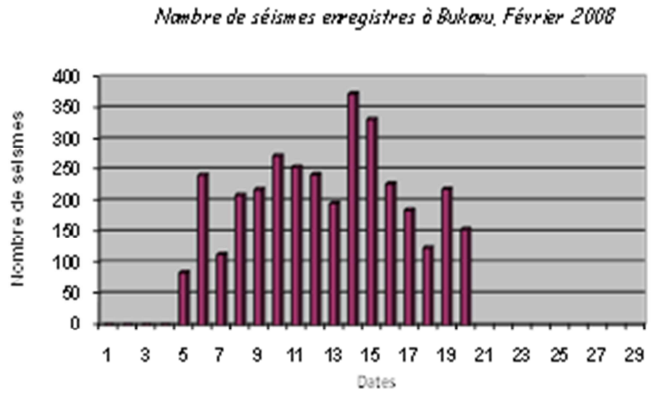
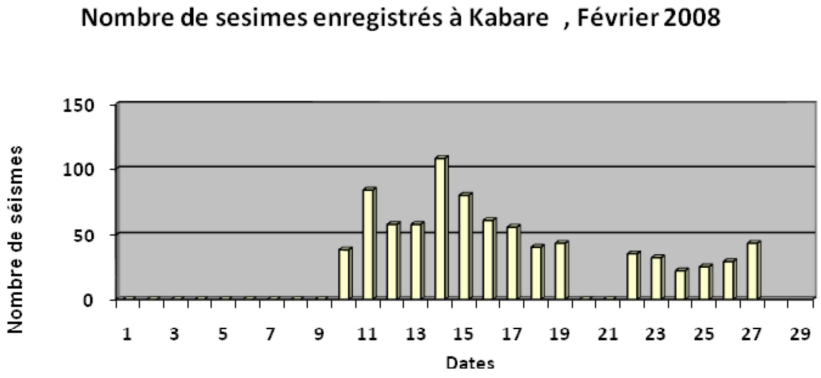


Figure n°4. Régions affectées par le séisme du 03/02/2008 (affected eathquake area)

3.5 LES RÉPLIQUES

Le plus souvent, un séisme se compose d'une ou plusieurs secousses principales brèves suivies par d'autres secousses secondaires qui surviennent au cours des heures et des jours suivants appelées « ***répliques*** »[(2)]. Le séisme de Bukavu n'a pas fait exception. Les répliques du séisme de Bukavu ont été enregistrées également à la station de Lwiro dont voici les graphiques qui expliquent leur intensité et leur fréquence dans le temps et dans l'espace.





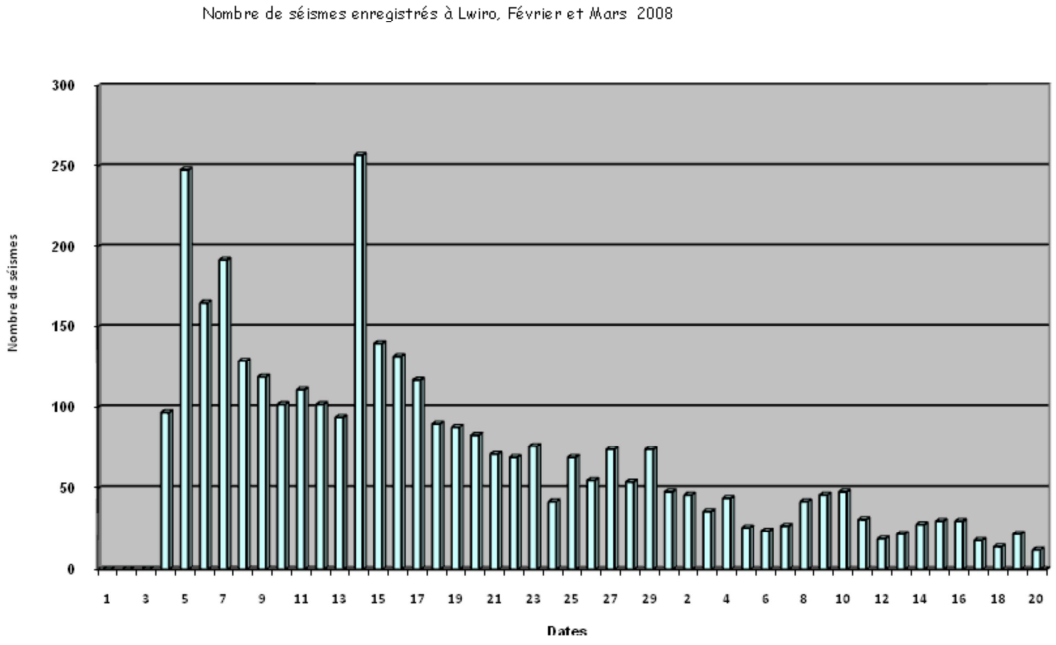


Figure n°5. Les Répliques du séisme du 03/02/2008 dans la région du kivu

Il a été démontré par les instruments de mesure (sismographes) que chaque jour se produisait en moyenne plus de 200 répliques, la majorité étant de faible intensité (inférieur à 3 de magnitude) et par conséquent non ressenties par l'homme. Néanmoins, si le principe est tel que les répliques vont en diminuant jusqu'au réajustement des compartiments fracturés, un phénomène nous a intrigué quant aux répliques de ce séisme, la réplique du 14 février 2008 à 4 h 07' locales est allée jusqu' à 5,5 magnitude sur l'échelle de Richter. Les chercheurs ont eu tendance à l'individualiser jusqu'à localiser même son épicentre.

3.6 LES CONSÉQUENCES DE CE SÉISME

Ce séisme de magnitude 6.3 sur l'échelle de RICHTER et qui a duré moins d'une minute a causé beaucoup de dégâts humains, matériels et géomorphologiques. Ces dégâts ne sont pas forcément fonction de la puissance de ce tremblement de terre. Nous avons mis en cause bien d'autres facteurs ou paramètres pouvant les alourdir dans cette contrée bien précise notamment : « l'effet de site » c'est-à-dire les caractéristiques géologiques ou géotechniques de la ville, sa géomorphologie et sa pédologie, l'occupation du sol et l'architecture de la ville etc.

Suivant l'échelle de Mecalli, il n'est pas fait référence au nombre des victimes c'est-à-dire que celui-ci n'est pas structurelle en rapport avec l'intensité du séisme et dépend souvent des circonstances fortuites telles qu'une incendie, le hasard d'un regroupement de la population dans les immeubles à haut risque (fragiles) au moment du tremblement de terre telle qu'à l'église, à l'école, au marché, au stade. Le nombre de victimes est toujours plus élevé la nuit que le jour, pendant la saison des pluies qu'en saison sèche[(3)].

3.6.1 LES CONSÉQUENCES HUMAINES ET MATÉRIELLES

Les conséquences humaines (victimes) et matérielles de ce séisme devraient dépendre normalement de la vulnérabilité de l'aléa de la ville qui dépend du nombre des personnes exposées (densité de la population) et de l'environnement (caractéristique régionale du lac, de la montagne, de mode de construction, de la qualité des matériaux etc.).En effet, dans les régions touchées par les séismes violents, le niveau de dégâts et des pertes humaines est lié directement à l'importance des implantations humaines et à la qualité de l'urbanisation[(4)]. Pour le cas précis de la ville de Bukavu, les pertes en vies humaines ont été fonction d'autres facteurs que ceux qui sont censés les conditionner. Ces facteurs sont l'heure et le jour du séisme. En effet, le bilan serait plus déplorable si cet événement se passait un jour ouvrable et/ou la nuit. Et ici, le phénomène s'est produit un dimanche à 09 h 34' à l'heure où le gros de la population était dans les lieux des cultes (église, temple, mosquée, etc.).

Les dégâts matériels (destruction d'immeubles) ont été dus à des secousses verticales et horizontales (ondes P) et à des mouvements cisaillants (ondes S) ou même rotatoires et dont l'ampleur a été fonction de la nature des constructions. Ces dégâts se sont alourdis avec la fréquence des répliques parfois importantes comme celle du 14/02/2008 (5,5 de magnitude) qui a plus affecté la commune de Bagira.

3.6.2 LES CONSÉQUENCES GÉOMORPHOLOGIQUES

Les ruptures des surfaces telles que les escarpements des failles ou les décalages horizontaux, s'il s'agit d'un décrochement, ne sont possibles que pour des événements majeurs (M_w = 6 et plus). D'autres effets de surface peuvent apparaître pour des séismes de magnitudes plus faibles, mais il s'agit souvent d'effets secondaires comme des glissements des terrains s'accompagnant des fissures[(2)]. La ville de Bukavu n'est pas loin de cette réalité car le séisme du 03/02/2008 a fort joué sur sa géomorphologie en provoquant des glissements de terrains et des fissures surtout dans des sites réputés, au plan géomorphologique, instables et sur le rivage des côtes du Lac Kivu où l'action anthropique prévaut avec la poussée des eaux de ce lac par l'homme en quête des terrains de construction. Ainsi la ville de Bukavu est située sur le trajet d'une région tectoniquement réputée active et faillée avec toutes ses conséquences géomorphologiques telles que l'on peut l'observer à travers la ville. Les principaux sites affectés par le séisme du 03/02/2008 dans la ville de Bukavu sont Nyakavogo à Bagira, Kasheke à Kadutu, Funu 1er à Kadutu, le versant de l'ITFM (Institut Technique Fundi Maendeleo), le versant de l'Elacat à Ibanda et les rivages du Lac Kivu.

Ces sites sont réputés instables et caractérisés surtout par des glissements de terrains (mouvements de masse) [(5)]. Ces mouvements étant liés à la natures, soit géologique soit pédologique (structure et texture), du terrain accentué par les eaux pluviales provoquent soit l'érosion superficielle soit l'érosion souterraine. De toute évidence, ces vastes glissements de terrains se cantonnent principalement sur les versants raides des hautes montagnes. Comme les éboulements, ils sont activés par le sapement des ***écoulements torrentiels*** et ***les séismes***, [(6)]. La ville de Bukavu, avec son terrain, meuble et alluvial,

dans un climat de montagne pluvieux et dont les actions anti-érosives sont moins importantes ; s'est retrouvé dans cette situation.

4 DISCUSSION ET CONCLUSION

A l'issue de l'étude de cette étude, nous sommes arrivé aux résultats et analyses suivants: La ville de Bukavu a subi le choc d'un séisme de 6,3 sur l'échelle de Richter d'origine tectonique lié au mouvement de rifting intra plaque du rift valley Est africain et donc pas d'origine volcanique comme on pouvait le croire.

Ce mouvement s'est produit le dimanche 03 février 2008 à 9h34' heure locale soit 7 h 34' TU (GMT) et dont l'épicentre a été localisé à Birava à 20 km au nord de la ville de Bukavu avec un foyer à 33 km de profondeur. Ce séisme s'est accompagné de plusieurs répliques parfois importantes mais qui n'ont jamais égalées le choc initial.

Des dégâts importants tant humains, matériels que géomorphologiques, mêmes économiques, ont été enregistrés dans la ville et sa périphérie. Pour les dégâts humains, au total 9 morts inventoriés dans les hôpitaux de Bukavu et de Kabare, 375 blessés à des degrés divers.

Pour les dégâts matériels, des nombreux édifices se sont écroulés ou sont sérieusement endommagés à Bukavu : 1065 maisons d'habitation totalement endommagées, 366 maisons d'habitation fissurées et 163 bâtiments publics endommagés. A noter que les grands immeubles publics, cinquantenaires, même sexagénaires pour certains, véritable fierté de Bukavu en terme de monuments historiques ont subi des coups violents avec des fissures plus ou moins importantes, victimes du poids de l'âge. Par contre, pour certains autres bâtiments, le séisme est venu mettre à nu l'irresponsabilité ou l'incompétence de certains architectes vrais ou autoproclamés pour leurs prétendus chef-d'œuvre tombés littéralement comme des châteaux de carte .

Pour les dégâts géomorphologiques, ils se sont observés dans des sites réputés instables dans la ville à cause de la nature des sols et de la géologie du rift valley oriental.

Nous avons trouvé que ces dégâts ont été fonction de bien des paramètres entre autres l'architecture de la ville, la localisation de la ville par rapport à l'épicentre, la nature géomorphologique de la ville avec ses failles panaméennes ; **bref « l'effet de site ».**

On le dira à jamais, Bukavu est dans une région à risque sismique et pour la sauver, il s'avère impérieux de diligenter une étude multidisciplinaire qui déterminera de nouveaux sites appropriés, sur lesquels la ville de Bukavu devra être érigée. Une analyse d'images satellitaires et des photos aériennes sera au centre de cette étude. La source d'énergie et d'eau potable sera déterminée en considérant les nouvelles technologies, la gestion durable des ressources naturelles et le réchauffement climatique seront considérés. C'est seulement après avoir délocalisé la population qu'un nouveau plan d'aménagement de Bukavu comme ville moderne pouvait se faire [(7)]

On devrait également , dans cette ville, faire attention à la façon de construire les maisons, notamment en respectant la quantité dans le mélange ciment-sable, en prévoyant de linteaux avec béton armé, avoir des fondations solides faisant recours aux techniques de chaînage, et si la nécessité l'oblige, détruire certaines maisons de Bukavu affectées par le séisme pour en reconstruire d'autres plus solides et plus stables, ou tout simplement délocaliser la ville.

REFERENCES

[1] MAURY Autenu., 1995. Encyclopedia universalis S.A., T20 (RHEOLOGIE-SILICATES).
[2] BELLAIR P, POMEROL C., 1965. Eléments de géologie, Armand Colin.
[3] KATIA K, KRAFT M, HAAS R., 1976. volcanisme et tremblements de Terre, édition de deux logs d'or, Paris.
[4] POMEROL C, LAGABRIELLE Y et RENARD M., 2003. Éléments de Géologie, Dunod, 12e édition, Paris.
[5] CHAMAA S et All., 1981. Atlas de la Ville de Bukavu CERUK, Bukavu.
[6] COQUE R., 1977. Géomorphologie, Armand Collin.
[7] KATCHO Karume., 2008. Rapport du CRSN/Lwiro sur le séisme du 03-février-2008 dans la région des grands –lacs.

International Journal of Innovation and Scientific Research
ISSN 2351-8014 Vol. 17 No. 2 Aug. 2015, pp. 359-361
© 2015 Innovative Space of Scientific Research Journals
http://www.ijisr.issr-journals.org/

STUDY ON ANTIFUNGAL ACTIVITY OF HONEY

Tasiu Mahmud[1], Ibrahim A. Sabo[1], Mukhtar Muhammad Dauda[2], Musbahu Shehu Aminu[3], Hassan Muhammad Ibrahim[3], and Naziru Dahiru[3]

[1]Department of Biotechnology School of Engineering and Technology, Greater Noida, Guatam Budha Nagar, India

[2]Department of Microbiology, Faculty of Science, Bayero University Kano, Nigeria

[3]Department of Biotechnology School of Engineering and Technology, Greater Noida, Guatam Budha Nagar, India

Copyright © 2015 ISSR Journals. This is an open access article distributed under the ***Creative Commons Attribution License***, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT: Studies on antifungal activity of honey with the objectives of determining the susceptibility of fungal isolate at different dilution of honey was carried out, medically important samples of fungi were collected and isolated from hospital and used in the bioassay following a modified Kirby-bauer technique. The aim of the research was to determine the current level of effectiveness of honey on some humans and animal dermatophyte. The honey was collected from its hunters and vendors in Kano state northern part of Nigeria. Result showed that the higher the concentration of honey the higher the zone diameter of inhibition. Surprisingly, the zones diameter of inhibition at dilution of 20%v/v and 30% v/v induce and increase susceptibility of fungal isolate tested. The finding showed that honey can be used to treat skin infection associated with Trichophyton tonsurans, Microsporum canis and Aspergillus species through topical application.

KEYWORDS: Dermatophyte, *Trichopyton tonsurans, Microsporum canis,* susceptivility, Kirby bauer.

INTRODUCTION

Honey has been used for the treatment of infection of wounds more than hundred years ago even before the discovery of bacteria as a causative agent of infection [1, 12]. It has been used as a medicine since ancient time on many cultures, even then further scientific study on the efficacy of the honey on fungal pathogen are steal recommended[1,2,7]. The increase in the resistance of anti-fungal drugs in use has attracted the attention of the scientific community. Its known that only few specie of fungi have been tested against honey for its activity for example *Candida albicans* (*C. albicans*) is a dimorphic organism that commonly inhabit in oral and vaginal mucosa and gastro- intestinal tract of human beings as one of the commensal organism[3,4,11]. In recent years, there has been an increasing search for new antifungal compound due to the lack of efficacy, side effect and or resistance associated with some of the existing drugs [10] .Most types of honey generate hydrogen peroxide when diluted because of the activation of the enzyme glucose oxidase which oxidizes glucose to glucoronic acid and hydrogen peroxide [7]. Hydrogen peroxidase is the major contributor to the antimicrobial activity of honey, and the different honeys result in their varying antifungal effect [7,9].

AIMS AND OBJECTIVES

The main aim of this research is to study the antifungal activities of honey, with the objective of determining the susceptibility of fungal isolate at different concentration of honey.

Corresponding Author: Tasiu Mahmud

MATERIAL AND METHODS

SAMPLE COLLECTION OF THE TEST ORGANISM

Skin samples were obtained from patient attending Yada kunya leprosy and dermatophyte hospital in Kano state. The affected area were clean each with 70 % ethanol, and then skin scales were collected by scraping the surface of the margin of the lesion using a sterile blunt razor blade[9,2].

HONEY SAMPLE

Honey sample were collected from its vendors and hunters around Kano state of Nigeria. These honey samples were aseptically collected in sterile bottles and kept in a cool and dry place[2,5].

PREPARATION OF HONEY SOLUTION

Honey solution were prepared immediate prior to its testing by diluting with sterile distilled water to the required concentration.

IDENTIFICATION OF FUNGAL ISOLATE

The specimens collected were culture aseptically on the surface of Sabouraud Glucose Agar (SGA) that was prepared according to the manufacture's guide and incubate appropriately at room temperature (25°C) for 1-3- weeks to identify the species of fungi[3]. Each of the interested fungal colonies was identified by observing the colonial morphology and their mycelia macroscopically [8].

ANTIFUNGAL BIOASSAY

The agar well diffusion method was employed. The honey sample was first inoculated separately on standard nutrient media with no test organism so as to evaluate and test for their possible contamination. Thereafter, solidified nutrient agar plate were separately flooded with the liquid inoculums of the different test organism using the spread or plate method[6,8].The plate were drained and allowed to dry at 37°C for 25 minutes. Afterward, six equidistant wells of 5 mm in diametre were punched using sterile cork borer at different side on the plate. About 60 µL of the different concentration (0%, 10%, 15%, 20%, 25% and 30%) v/v of the diluted honey sample were separately placed on the different punched well with 1mL sterile syringe. The plate was allowed to stay for 15 minutes, for pre-diffusion to take place followed by an overnight incubation that lasted for 24- 72 hours at room temperature. The zone diameter of inhibition, including the diameter of the well, was recorded [9].

RESULTS

The result for the investigation is shown in table 3.1 It can be seen that; the growth of all four species of fungi tested was completely inhibited by the concentration of 30%v/v, similarly the result showed a concentration dependent increase in susceptibility of the various dilution of honey. *Aspergillus niger* and *Candida albican* has the highest diameter zones of inhibition of 14mm both at 30% V/V and least being 8.0mm

Table 3.1: Zones diameter of inhibition (mm) at different dilution of honey

Fungal isolate	0%	10%	15%	20%	25%	30%
Trichophyton tonsurans	0.0	0.0	3.0	5.0	10.0	12.0
Microsporum canis	0.0	5.0	5.0	6.0	9.0	11.0
Aspergillus niger	0.0	8.0	9.0	11.0	12.0	14.0
Candida albican	0.0	8.0	10.0	12.0	12.5	14.0

DISCUSSION

T. tonsurans and *M. canis* are all important group of fungi which regularly infect humans [3]. Cutaneous or superficial mycoses cause through host infection by these fungi is one of the most common diseases of humans [11].

The yeast *Candida albican* may live harmlessly among the normal flora of the skin but in some people it invades the deep layers of the skin and subcutaneous tissue, and hence causes candidal skin infection, *aspergillus niger* the most common spoiler of food and other organic compound, normally produces mycotoxins, if this toxin is ingested it can damage the liver, perhaps leading to cancer [10].

The result of this investigation showed that the higher the concentration of honey, the higher the diameter zones of inhibition. The antifungal activity of honey has been attributed to its osmotic pressure, the activity which is very low, for example the water activity of a ripened honey has been reported from 0.562 to 0.62 which is too low to support the growth of any species [9]. Honey is characteristically acidic, its pH being between 3.2 and 4.5 which is enough to be inhibitory to many animal and fungal pathogens [7].

Another major factor that account for inhibition of these specie has been found to be due to hydrogen peroxide produced enzymatically in the honey [4,9]. It is observed that certain activity in honey has been attributed to the phytochemical factors and seven tetracycline derivatives [12].

In a marked departure from the intuitive use of honey as an effective remedy; many reports have associates the effectiveness of honey with its high antimicrobial activity.

Similarly, the results of the investigation were consistently with many reports of researchers for example Jeddar and Molan, 1985 and 1988 respectively. Several chemical with antifungal activity has been identified in honey by various researchers. These include pinocembrin, terpenes, benzyl alcohol, 3, 4-dimethoxy-4-hydroxybenzoic acid (syringic acid) [5,12]

CONCLUSION

This study showed that honey exhibit high antifungal activity against the four pathogenic fungal strains, isolated and tested.

RECOMMENDATION

It is recommended that honey can be used for the treatment of dermatophytic infection.

REFERENCES

[1] Allen K.L Hutchinson G, Molan P.C. The potential for using honey to Treat wounds.Infected with MRSA and VRE. First world Healing Congress, 2000; Melbourne, Australia. 2000

[2] Brady N/F, Molan P.C Harfiot CG.The sensitivity of dermatophytes to the antimicrobial activity of manuka honey and other honey. Pharm sci 1997. 2: 1-3. 1997.

[3] Brooks, Geo F, Butel, Janets and Morse, Staphen. A. Medical Microbiology.23rd edition. Pp 628-632, 2004.

[4] Bulma M.W. Honey as a surgical dressing. Midlesen. Hosp. J.55, 188-189, 1995.

[5 Jeddar A., Kharsary .A. Ramsaroop UG, Bhamjee A, Haffee I.E, Moosa A.The antibacterial action of honey an. In –vitro study. S. Afr J: 67 257-258, 1985.

[6] Kirby-Buer.Antimicrobial sensitivity testing by agar diffusion method. Africaan Journal of Clinical pathology 44:493 published by Febiger Henry Kingdom. London, 1996.

[7] Molan P.C, Russel K,M.Non- peroxide antibacterial activity in some New Zealand honey. J APL Res 27 :62-67, 1988.

[8] Monica Cheesbrough.District Laboratory practice in tropical countries, part II, University Press London. PP. 233-238, 2000.

[9] National Honey Board.Carbohydrate and Sweetness of honey, 2007.

[10] Nester, Anderson, Robert, Parsall and Nester. A human perspective. 4th edition. Published by MC-Graw Hills, pp.256, 286-291 preliminary observation. Surgey 113 (22): 200-4, 2004.

[11] Rademaker. M.Superficial Dermatophyte infection N.Z. Med.j. pp.106, 14-16, 1993.

[12] Radians', EI –Essawy, A, Sarhan M.M.Experimental evidence for the occurrence in honey of specific substance against microorganisms.pp. 256,286-291, 1984.

International Journal of Innovation and Scientific Research
ISSN 2351-8014 Vol. 17 No. 2 Aug. 2015, pp. 362-369
© 2015 Innovative Space of Scientific Research Journals
http://www.ijisr.issr-journals.org/

DETERMINATION OF OPTIMUM HOLLOWNESS IN TAPERED ROLLER BEARING USING FINITE ELEMENT ANALYSIS TO INCREASE THE FATIGUE LIFE

G. D. Bassan[1] and D. P. Vakharia[2]

[1]Mechanical Engineering Department, Faculty of Technology, Dharmsinh Desai University, Nadiad-387001, Gujarat, India

[2]Mechanical Engineering Department, Sardar Vallabhbhai National Institute of Technology, Surat-395007, Gujarat, India

Copyright © 2015 ISSR Journals. This is an open access article distributed under the ***Creative Commons Attribution License***, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT: An attempt has been made to obtain the optimum hollowness in the rollers to increase the fatigue life by decreasing contact stress in the tapered roller bearing. In the present analysis it has been proposed that under the applied load hollow rollers deflects more than a solid roller of the same size. By making the balls hollow which are flexible enough, the stress concentration can be reduced to increase the fatigue life of ball bearings. Finite Element Analysis has been used to investigate the contact pressure, contact stress and deformation as available theoretical method is applied only to solid tapper roller bearing. Using FEA package ANSYS the analysis has been carried out considering the equivalent cylindrical roller of actual tapered roller of the test bearing. Analysis have been made for different hollowness percentage ranging from 0% to 90% of the outer diameter of the equivalent cylindrical roller of actual tapered roller in the ANSYS to find the optimum hollowness for bearing's life period point of view. It is noticed that the approximately 65 % hollowness gives the lowest contact stress which finally increases the fatigue life of the bearing.

KEYWORDS: Hollow tapered roller bearing, Finite element analysis; Hertz contact stress, Contact pressure, Fatigue life.

1 INTRODUCTION

In railway wagons, mainly, the tapered roller bearings are used for carrying heavy loads but the failure ratio of the bearing is very high in spite of the regular maintenance. Hence, present research work is mainly based upon increasing the life of the bearings. Hertz [1] first investigated the problem of two elastic bodies subjected to pure normal loading. He used the Newtonian potential function to study the distribution of the stresses in the contact body and to study the distribution of the load over the contact area. The solution was verified by experimental results. Good results for the stresses in the contact region, called Hertzian contact stress were obtained. In the roll supports of sheet, billet, tube-rolling mills and gear housing four-row tapper roller bearing is widely used. Smith and Liu [2] modified and elaborated the work of Hertz by including the tangential component and assuming the Hertzian distribution of the normal and tangential loads over the area of contact. The resulting stresses of applying the normal and tangential loads were represented by a closed form and used as verification for the numerical solution obtained in this work. Goncharov et. al. [3] developed a new bearing design of four-row tapered bearing. The test results of new bearing design showed that their life was 2 to 2.5 times the life of a normal bearing. It deferred from the existing one in the fact that the support collars on the inner rings were movable in the axial direction. Kletzli et. al. [4] analyzed a thermally-induced failure in railroad tapered roller bearings operating at relatively high speeds. It was shown that this failure was caused by an unstable thermal expansion and internal bearing load feedback. It was also found through simulation that at axle rotational speeds equivalent to a train speed of 100 mph , a combination of grease starvation and heat flux from the contact seals caused high rib temperature and subsequent unstable load growth which would lead to failure. Grigorescu and Gafitanu [5] dealt with optimization criteria to increase ball bearing service life. The analytical and experimental results presented in this paper established the correlation between bearing service life and housing stiffness. It was concluded that for each housing shape, an optimum position of the supporting points determined a maximum service life. Further, proper design of housing wall thickness and initial value of gap between the housing and

outer ring assured the highest value of the bearing service life. Ferreira, Balthazar and Araujo [6] carried out a performance analysis of double self-aligning roller bearings used in railway ore transportation wagon. Two different methodologies were used to access the bearing nominal life L_{10s}. It was shown that the methodology suggested by the author for estimating the lives L_{10s} was more flexible as it allows the control of the parameters directly involved in the bearing failure phenomenon than methodology proposed by the bearing manufacturer. Gerdun et. al. [7] presented a research article dealt with two cases of failure in freight wagon cylindrical roller bearings and axles. Based on the analysis, it was accomplished that the failure can be prevented through a more frequent replacement of the inner rings of bearings. Further, the axle broke faster than it would if the cages were made of some other material rather than the Brass. Wisam [8] studied a relative fatigue life estimation of cylindrical hollow rollers in general pure rolling contact. Investigators used the finite element package ABAQUS to find the stress distribution and the resulting deformations in the bodies of the rollers. Four main different hollowness percentages were studied namely 20, 40, 60 and 80%. It was found that the hollow rollers have longer fatigue life than solid rollers when subjected to a combination of normal and tangential loading. Also, the fatigue life was improved as the hollowness percentage increased up to 60% and improvement in fatigue life were decreased when the percentage of hollowness was 80% as the bending stress started to affect the stresses in the contact zone significantly, by decreasing the shearing stress value there. Darji and Vakharia [9] dealt with the determination of optimum hollowness for hollow cylindrical rolling element bearing. Different hollowness percentage from 30 to 80% was analyzed in FEA package to find the optimum percentage hollowness for increasing fatigue life of the bearing. It was concluded in this article that 67% hollowness was the most desirable to impart sufficient roller flexibility and load carrying capacity. Tiwari, Sunil kumar and Reddy [10] described an optimum design methodology of tapered roller bearing using genetic algorithms. This investigation proposed an optimum design methodology which could be considered as a basic step towards a more advance design requirement of the tapered roller bearing.

Here, it has been proposed to determine optimum hollowness in tapered roller bearing using finite element analysis to increase the fatigue life as less work has been carried out performing to this aspect.

2 DEFINITION OF PROBLEM

Tapered roller bearing under consideration

Bearing No: 32212

Internal diameter of bearing: 60 mm.

Outside diameter of bearing: 110 mm

Average outer diameter of inner ring: 76.09 mm

Average inner diameter of outer ring: 96.65 mm

Average roller diameter: 12.96 mm.

Length of roller : 19.96 mm

Number of rollers: 19

Applied load on bearing (F): 30 kN

Modulus of elasticity: 2.058×10^5 N/mm^2

Poisson's ratio: 0.3

3 FINITE ELEMENT ANALYSIS OF TAPERED ROLLER BEARING

A Major limitation of rolling-element bearing is that they are subjected to very high alternating stresses at the rolling contacts, which leads to a limited fatigue life. In fact, pre-stressing and centrifugal forces at high speed operation significantly increase the contact stresses and further reduce the fatigue life. If stresses are low, fatigue life can be practically unlimited.

In the present analysis, it has been proposed that the contact stresses can be significantly reduced by making the rollers hollow. The contact stresses in solid rollers can be obtained using Hertz equation [10]. The same Hertz equation cannot be applied to obtain the contact stresses in the case of hollow rollers due to some assumptions taken by Hertz. In the past, Finite Element analysis was successfully applied by various researchers to study the contact interaction between the rollers

[11-12]. Thus, Finite Element analysis approach has been carried out to determine the optimum hollowness in the tapered roller bearing.

Analysis has been carried out considering equivalent cylindrical roller of tapered roller taking average diameter of the tapered roller in the finite element package ANSYS. Different cylindrical hollowness percentages ranging from 10 to 90% have been analyzed to obtain the contact stress developed in the heavily loaded roller.

Fig. 1. 3-D model of tapered roller bearing

The configuration of the bearing which is under investigation is presented in figure 1. Considering applied load of 30 kN on the bearing, the load on the heavily loaded roller has been obtained [10]. The Finite Element Analysis has been carried on the heavily stressed equivalent cylindrical roller for the actual tapered roller by applying the external normal load of heavily loaded roller as shown in figure 2.

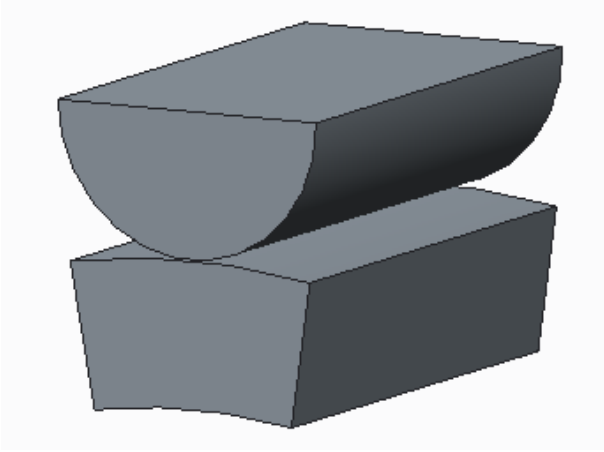


Fig. 2 Single contact of heavily stressed equivalent cylindrical roller bearing between roller and inner race

4 RESULTS AND DISCUSSION

Fig: 3 and 6 show the total deformation of the solid and hollow rollers in contact respectively. It is seen from Fig: 3 and 6 that the total deformation is more in case of hollow rollers as compared to the solid rollers. Fig: 4 and 7 represent the contact pressure generated at the contact point between two heavily loaded solid and hollow rollers respectively. It is noticed that the contact pressure remains considerably less in case of hollow tapered roller bearing as compared to the solid taper roller bearing. Finally, from Fig:5 and 8 it is established that the contact stress is significantly less in the hollow tapered roller bearing as compared to solid tapered roller bearing. FEA results for different hollowness has been presented in the tabular form as well as graphically as shown in the Table:1 and Fig: 9 respectively.

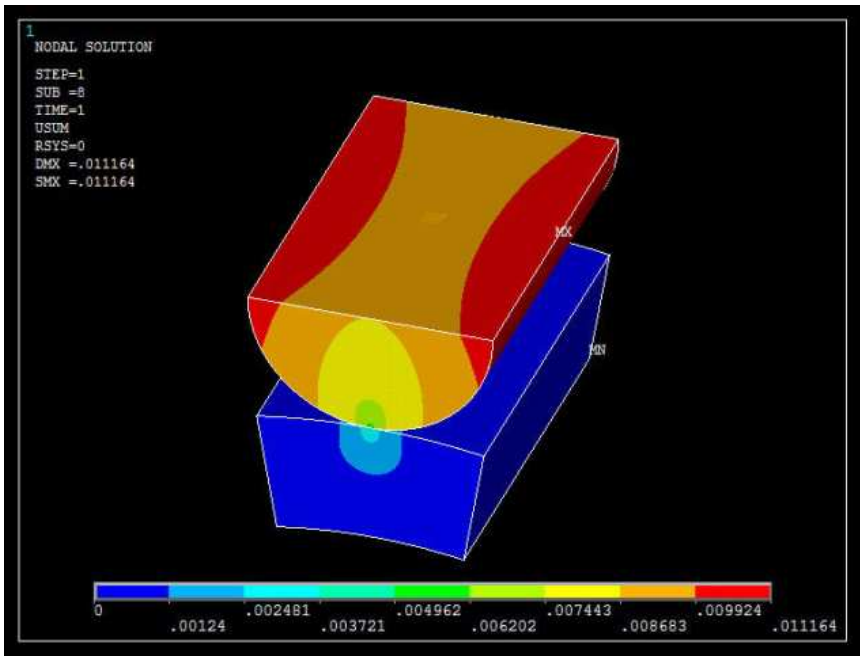


Fig. 3. Total displacement of solid rollers

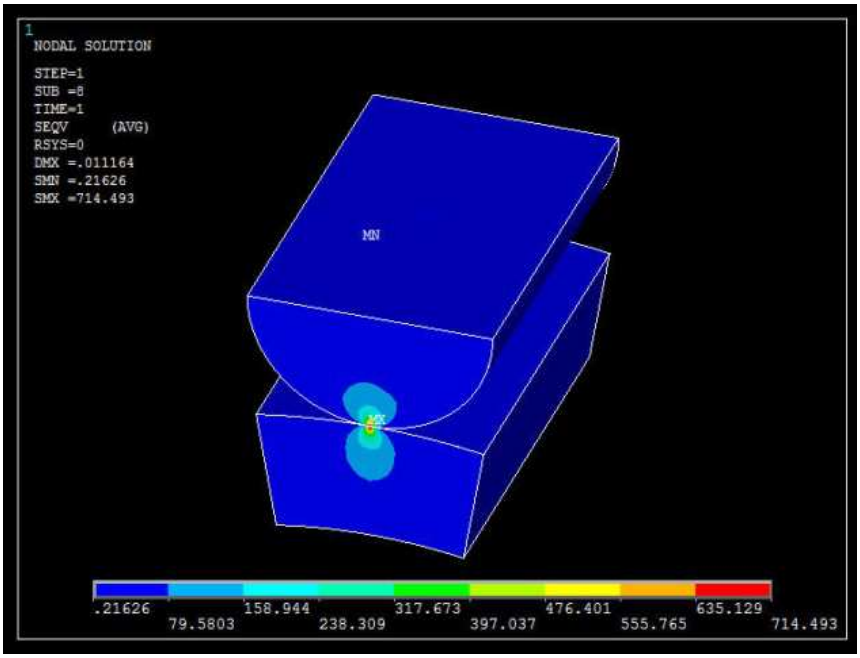


Fig. 4. Von mises stress distribution in solid rollers

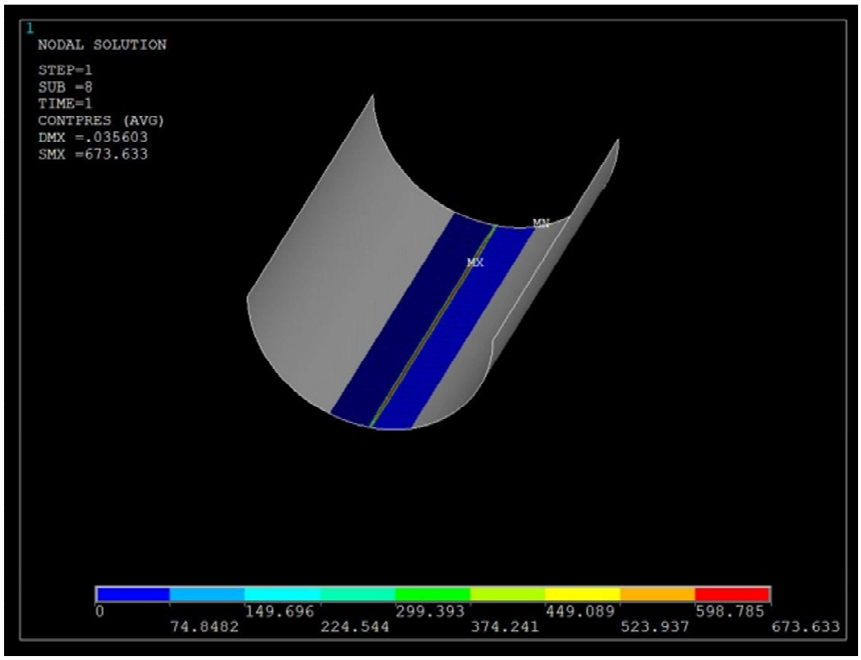


Fig. 5. Contact pressure in the solid rollers

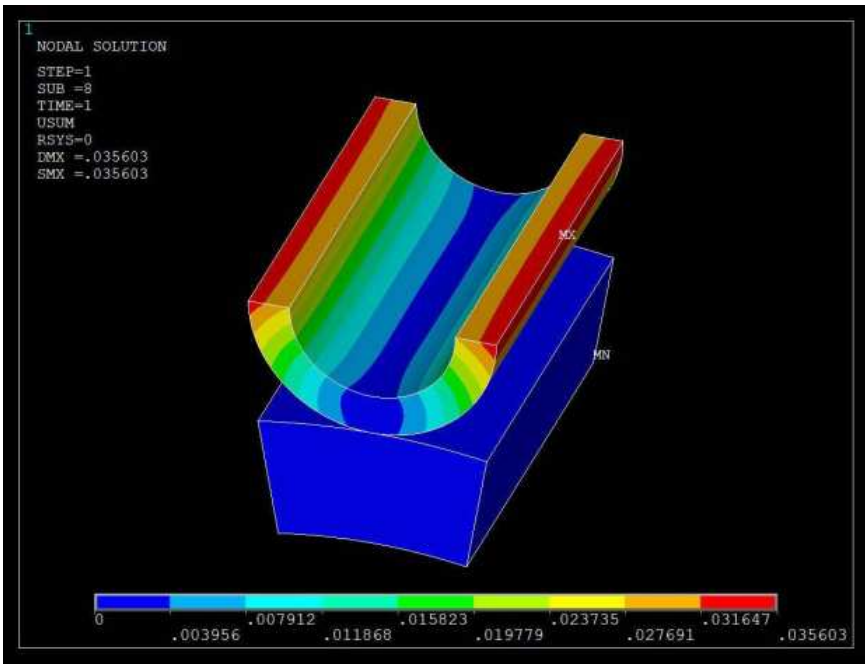


Fig. 6 Total deformations of hollow rollers (67% hollowness)

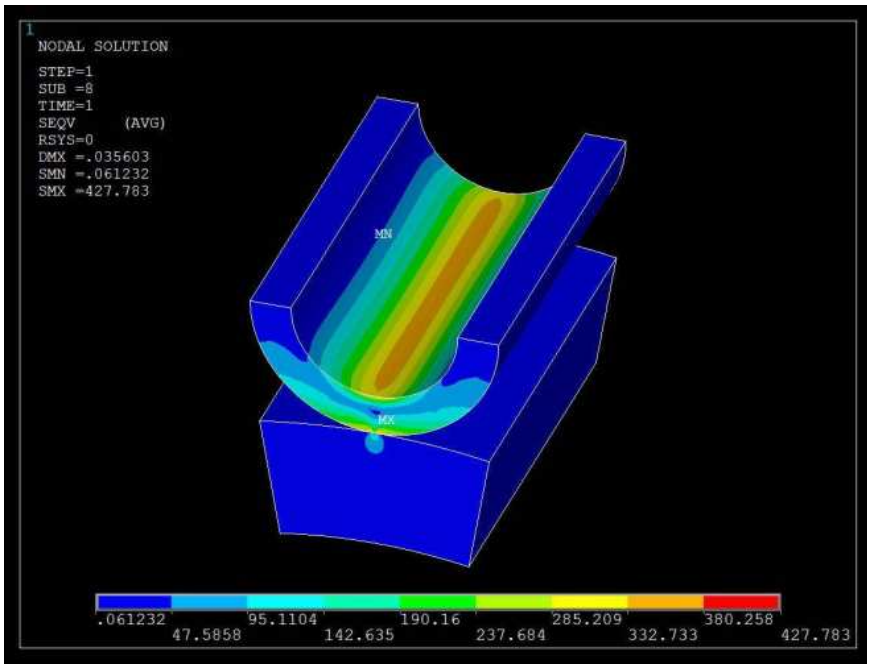


Fig. 7. Von mises stress distribution in hollow rollers (67% hollowness)

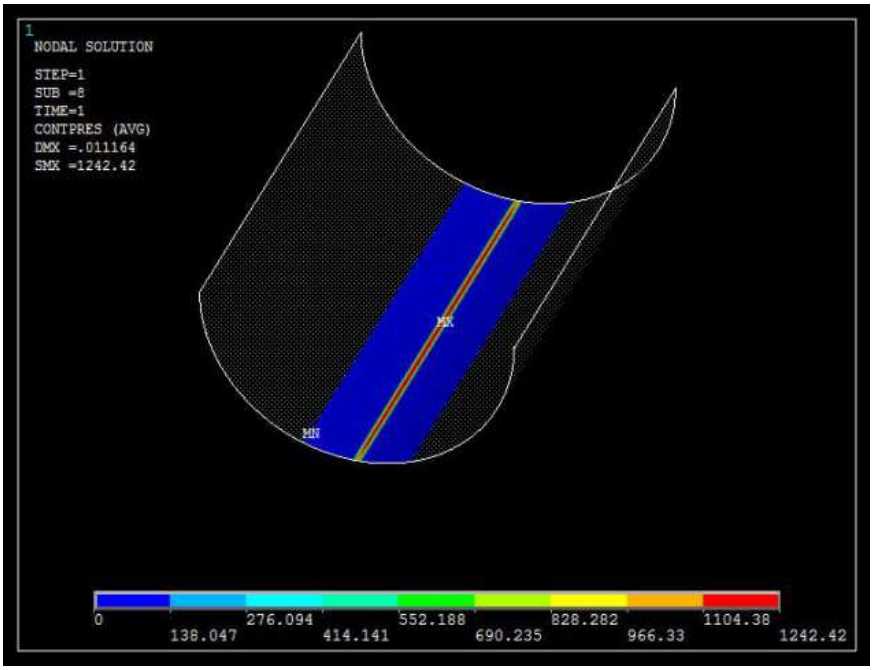


Fig. 8. Contact pressure in hollow rollers (67% hollowness)

Table 1. FEA Results for Different Percentage of Hollowness

% Hollowness	Max Deflection (mm)	Max Von mises stress (Mpa)	Max Contact Pressure (Mpa)
0	0.011164	714.493	1242.420
10	0.010723	660.971	1158.780
20	0.010684	621.961	1094.870
30	0.011212	575.491	1016.970
40	0.012711	523.920	933.628
50	0.016263	469.081	848.029
60	0.024016	433.314	743.757
61	0.025162	437.371	734.877
62	0.026535	425.521	721.416
63	0.028042	423.221	715.340
64	0.029668	433.678	706.251
65	0.031335	420.793	693.420
66	0.033267	429.578	684.732
67	0.035603	427.783	673.633
68	0.037816	428.070	664.612
69	0.040524	432.862	657.624
70	0.043082	434.435	643.924
80	0.102706	572.492	542.375

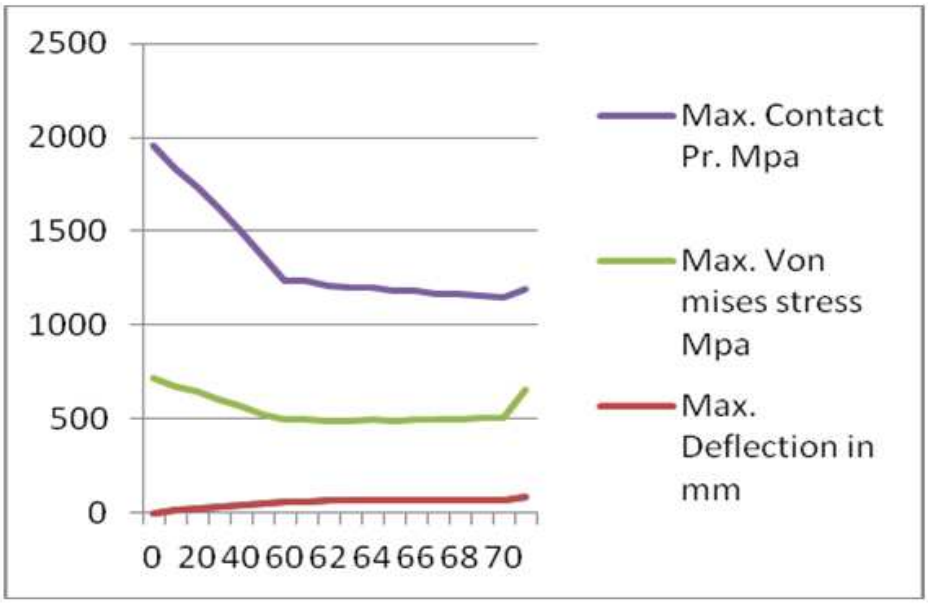


Fig. 9. Graphical representation for FEA results of Different Percentage of Hollowness

5 CONCLUSION

This type of bearing system becomes more favorable in the industry as the hollowness provides more fatigue life due to the decrease in contact stress for almost all geometrical configurations. It has been noticed that the contact stress is minimum for the hollowness between 60% and 70% of the average diameter of tapered roller bearing. More precisely, at 65% hollowness contact stress is found to be lowest that gives optimum hollowness for maximum fatigue life.

REFERENCES

[1] Hertz H.,Gesammelte Werke, Vol.1: Leipzig, Germany, 1895: English translation in Miscellaneous Papers, 1896.

[2] J.O. Smith, and C.K. Liu, "Stress due to tangential and normal load on an elastic solid with application to some contact stress problems", *J. Appl. Mech*, vol. 20, pp. 201-11, 2010.

[3] I.P. Goncharov, V.I. Ivanov, Yu. D. Nosibov, and I.A. Utin, "New four row taper roller bearings", *Translated from Metallurgy*,vol. 10, pp. 38-39, 1974.

[4] D.B. Kletzli, C. Cusano, and T.F. Corny, "Thermally-induced failure in railroad tapered roller bearing", *Tribology transactions*, vol. 42,no. 4, pp. 824-832, 1999.

[5] R. Grigorescu, and M.D. Gafitanu, "Constructive optimization criteria to increase bearing service life", *Tribology letters*, vol. 8,pp. 57-62, 2000.

[6] J.L.A. Ferreira, B.C. Balthazar, A.P.N. Araujo, " An investigation of rail bearing reliability under real conditions of use" *Engineering Failure Analysis*,vol. 10 ,pp. 745-758, 2003.

[7] Victor Gerdun, Tomaz Sedmak, Viktor Sinkovec, Igor Kovse, and Bojan Cene," Failure of bearings and axle in railway freight wagons" *Engineering Failure Analysis*, vol. 14,pp. 884-894,2007.

[8] Wisam M. Abu Jadayil, "Relative fatigue life estimation of cylindrical hollow rollers in general pure rolling contact", *Tribotest*,vol. 14,pp. 27-42, 2008.

[9] P.H. Darji, D.P. Vakharia, "Determination of optimum hollowness for hollow cylindrical rolling element bearing", *ASME International Mechanical Engineering Congress and Exposition*, USA, 2008.

[10] A. T. Harris, *Rolling bearing analysis, Fourth edition*, John Wiley & Sons.

[11] Aleksander Sladkowski, Marek Sitarz, "Analysis of wheel-rail interaction using FE software", *Elseveir, Wear,*vol. 258,pp. 1217-1233,2005.

[12] P.H. Darji, D.P. Vakharia, "Numerical and finite element analysis of rolling element bearing", *International conference on ETAETS*, 2008.

International Journal of Innovation and Scientific Research
ISSN 2351-8014 Vol. 17 No. 2 Aug. 2015, pp. 370-380
© 2015 Innovative Space of Scientific Research Journals
http://www.ijisr.issr-journals.org/

Modeling Selection Criteria for Reinforcement Steel Bars with Stochastic Carbon Equivalent distribution

C. Christopher Senfuka[1], Paul Kizito[1], J.B. John Kirabira[2], and J.K. Joseph Byaruhanga[2]

[1]Dept. of Mechanical & Production Engineering,
Kyambogo University,
Kampala, Uganda

[2]Dept. of Mechanical Engineering,
Makerere University,
Kampala, Uganda

Copyright © 2015 ISSR Journals. This is an open access article distributed under the ***Creative Commons Attribution License***, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT: Deciding the functional suitability of recycled steel using carbon equivalent (CE) and strength can be misleading since the formulae used to determine CE do not capture many of the elements that play a decisive role in establishing steel values. In this study, a mathematical model is developed to optimize the selection decision from a steel manufacturer considering a stochastic CE distribution. In the given model, a building/fabrication contractor intends to select one of two manufacturers of recycled steel bars basing on CE as determined by the IIW formula and strength values selected in equal monthly intervals. A Markov decision process approach is adopted where three states of a Markov chain represent possible states of CE of steel bars. The ultimate strength, σ_u, of steel is maximized for minimum CE where the decision to select the best steel is made using dynamic programming over a finite period planning horizon. A numerical example demonstrates the existence of an optimal state-dependent selection decision and strength of steel over the planning horizon.

KEYWORDS: Carbon equivalent, recycled steel, modeling, strength of steel, stochastic.

1 INTRODUCTION

Plain carbon steel is mainly an alloy of iron and carbon. The carbon content of steel is responsible for not only its strength, but also its ductility and many application based properties like weldability and hardenability. Reinforcement bars, projected to improve on the ductility of concrete, are principally made from plain carbon steel and derive much of their efficiency from its properties.

The nature of the influence of carbon on steel, however, is affected by other alloying elements which, present as impurities, modify the effect of carbon although some of them exercise a direct effect on steel properties. These alloying elements have individual effects that are additive and increase with particular alloying element content [15]. The total effect of these elements has been expressed by the carbon equivalent (CE) value with a view to convert the percentage of alloying elements other than carbon to an equivalent carbon percentage because the iron-carbon phases are better understood than other iron-alloy phases [8]. The widespread use of CE value in making important decisions in welding, casting, rolling and heat treatment of steel has made it an indispensible component of all steel standards world over [11].

The CE value tends to denote the susceptibility of steel to weld cracking, the machinability of castings, the hardenability of steel and cast iron during heat treatment [20] and the eligibility in concrete reinforcement use where the low CE values for high strength values is an optimum combination for high strength steel bar of high ductility, weldability and formability [13]. These features underlie the structural integrity of the steel-concrete composite in the event of cracking and enable the steel bars to reliably be joined and bent into small radii during their placement [1]. The same features result essential for fatigue

performance so as to enable the structure to endure cyclic loading [2, 21] rife in the event of wind and earthquake laden conditions [12] and influence the performance of the steel bars even when subjected to static bending moments which in the presence of ribs on their surfaces, increase their susceptibility to stress concentration [23].

When the weldability and other properties of steel are specified in terms of the chemical composition and in particular the CE however, only a limited number of alloying elements is taken into account. These elements are however, only a small fraction of the chemical content when it comes to recycled steel, the major resource for concrete reinforcing bars. Because of this, when the strength of steel is found sufficient and the accompanying CE assessed equally suitable for a specific purpose, chances are high that the CE value of the steel is under estimated in view of the fact that many of the tramp elements not captured in the CE formula have substantial influence on its real value and ultimately on vital functional steel properties. A salient example of such elements is Boron which, being a common tramp element in recycled steel, will all other factors being constant, increase the hardenability of steel by up to 1.5 times when present in less than 0.003% by weight [6]. The globally prevalent thermo-mechanically treated (TMT) high strength reinforcement bars owe their properties to heat treatment which relies on steel hardenability.

The fact that the tramp element content of steel cannot be economically decreased in industrial manufacturing and that the dwindling availability of steel scrap has caused a decisive and continually growing reduction in the quality of the scrap input over the years [17] makes it necessary that a method be devised to predict the steel with a CE value that corresponds to the lowest effect of the un captured tramp element content for the maximum acceptable tensile strength.

Research has shown that the occurrence of the tramp elements in recycled steel exhibits a random (stochastic) incidence [16]. The purpose of this paper therefore, is to resource a probabilistic approach adept at attaching the real value of the CE corresponding to the ultimate strength of a selected consignment of steel bars through a Markov decision process approach using dynamic programming for optimality tests.

2 LITERATURE REVIEW

Carbon equivalent (CE) formulae were first developed to provide a numerical value for a steel composition that would give an indication of a carbon content which would cause an equivalent level of hardenability as that of the steel in question [4]. These formulae were later extended to represent the contribution of the composition to the hydrogen cracking tendency of steel in welding operations and are now also linked to other properties that may be related to hardness, such as toughness and strength [9]. Their aim was to convert the percentage of alloying elements other than carbon to an equivalent carbon percentage. The resulting figure is important in the decision making that lays precursor to casting, welding, heat treatment and many other mechanical engineering manufacturing projects.

In physical terms, while in welding, CE is used to understand how the different alloying elements affect the hardness of the steel being welded ; a feature which is directly related to hydrogen-induced cold cracking [14], in the foundry practice, the CE concept is used to understand how alloying elements will affect casting behavior and as a predictor of the strength of cast irons. This is achieved by giving an approximation of the austenite and graphite contents in the final structure and features related to critical cooling time as indicator of how easily a steel or a cast iron undergoes martensitic transformation [18]. It also provides an idea of the cooling temperature range and graphitization or carbide forming potential [7]. In the heat treatment of steel, the CE expresses the critical cooling time required for a steel to change into 100% martensite which then has a direct relation with the ideal critical diameter [20].

Determining the carbon equivalent of steel is therefore an issue of substantial importance. In the past several equations have been used to determine the CE value basing on their chemical composition. These have taken many forms.

In earlier times, Dearden and O'Neill first proposed a formula for steel strength, hardenability and HAZ hardness which took a simplified version used by the International Institute for Welding (IIW) as:

$$C_{eq} = C + \frac{Mn}{6} + \frac{(Cr + V + Mo)}{5} + \frac{(Cu + Ni)}{15} \dots\dots\dots\dots\dots i)$$

and has generally been used to measure weldability [8].

Ito and Bessyo [10] developed another formula based on a wider range of steels than the IIW formula

$$P_{cm} = C + \frac{Si}{30} + \frac{Mn + Cu + Cr}{20} + \frac{Ni}{60} + \frac{Mo}{15} + \frac{V}{10} + 5B \dots\dots ii)$$

While Düren [9] came up with a similar version

$$C_{Eq} = C + \frac{Si}{25} + \frac{Mn + Cu}{16} + \frac{Ni}{40} + \frac{Cr}{10} + \frac{Mo}{15} + \frac{V}{10} \dots\dots\dots\dots\dots iii)$$

also for low alloy steel.

The Yurioka [22] formula:

$$CEN = C + A(C) \times \left(\frac{Si}{24} + \frac{Mn}{6} + \frac{Cu}{15} + \frac{Ni}{60} + \frac{Cr + Mo + Nb + V}{5} + 5B\right) \dots iv)$$

where $$A(C) = 0.75 + 0.25tanh\{20 \times (C - 0.12)\}$$

also came up for a still wider variety of steel, including low-alloy and carbon structural steels.

Cotrell [7] later originated the relation;

$$CE_w = C + \frac{Mn}{14} + \frac{Ni}{30} + \frac{Cr}{10} + \frac{Mo}{10} + \frac{V}{6} + \frac{Nb}{2.5} + \frac{Cu}{30} + 3N + 20B \dots\dots\dots\dots\dots v)$$

to improve on the prediction of weld cracking.

It can be noted that equation *i)*, the most widely used CE, does not capture many of the elements that form part of the composition of steel bars made from recycled steel. A major concern is the case of Boron which is known to be introduced into induction furnace steel by their scrap origin and the boric acid binder often used in induction furnace ramming mass [17].

Formula ii) due to Ito and Bessyo [5] and formula iv) by Yurioka [22] both indicate the significance of the Boron content while the Cotrell formula (v), [7] captures Nitrogen, an interstitial element effective in minute inclusion levels with high strengthening capacity.

The use of formula *i)* therefore leaves out a large measure of elemental influence and used for recycled steel, it could be substantially inaccurate in many circumstances.

For a given bunch of steel bars, the steel strengths corresponding to calculated CE values of selected bars can be optimized so that only certain CE value levels match pre-decided steel bar strengths using probabilistic projections to minimize the inclusion of bars with the unwanted residual element effect. Ideally, this would mean low CE values to correspond to high ultimate strength inside the standardized strength bracket. For a maximum carbon content of 0.27%C for thermo-mechanically treated bars [5], the CE value of not exceeding 0.3% would correspond to the ultimate strength (σ_u) range whose upper limit would be 710Mpa.

3 MODEL FORMULATION

3.1 NOTATION AND ASSUMPTIONS

i,j	=	States of demand
H	=	High state
A	=	Average state
L	=	Low state
n,N	=	Stages
Z	=	Selection decision
N^z_{ij}	=	Number of transitions
C^z	=	Transition matrix for carbon equivalence
C^z_{ij}	=	Carbon equivalence transition probability
S^z	=	Matrix for strength of steel
S^z_{ij}	=	Strength of steel due to carbon equivalence transition
e^z_i	=	Expected strength of steel
a^z_i	=	Accumulated strength of steel
m	=	Manufacturer

i,j ε {H,A,L} m ε {1,2} Z ε {1,2} n=1,2,……N

Consider a production system consisting of two manufacturing plants producing recycled steel bars in batches for a designated number of customers. The CE of steel bars during each time period over a fixed planning horizon is classified as *High* (denoted by state H), *Average*, (denoted by state A) or *Low* (denoted by state L). The transition probabilities for carbon equivalence over the planning horizon from one state to another may be described by means of a Markov chain. Suppose one is interested in determining an optimal course of action, namely to select bars from manufacturer 1(a decision denoted by Z=1) or to select bars from manufacturer 2 (a decision denoted by Z=2) during each time period over the planning horizon. Optimality is defined such that the expected strength of steel is accumulated at the end of N consecutive time periods spanning the planning horizon under consideration. In this paper, a two-period (N=2) planning horizon is considered.

3.2 FINITE - PERIOD DYNAMIC PROGRAMMING PROBLEM FORMULATION

Recalling that CE can be in state H, state A, or in state L, the problem of finding an optimal selection decision among the manufacturers may be expressed as a finite period dynamic programming model.

Let $T_n(i)$ denote the optimal expected strength of steel accumulated during the periods *n,n+1,……,**N*** given that the state of the system at the beginning of period *n* is *i*ϵ{ H,A,L }.The recursive equation relating T_n and T_{n+1} is:

$$T_n(i) = max_Z[C^Z_{iH}(m)S^Z_{iH}(m)+S_{n+1}(H), C^Z_{iA}(m)S^Z_{iA}(m)+S_{n+1}(A), C^Z_{iL}(m)S^Z_{iL}(m)+ S_{n+1}(L)] \quad (1)$$

i.e. **{**H,A,L **}**, m={1,2}, n= 1,2,…….. N

together with the final conditions

$T_{N+1}(H) = T_{N+1}(A) = T_{N+1}(L) = 0$

This recursive relationship may be justified by noting that the cumulative strength of steel $S^Z_{ij}(m)+ S_{N+1}(j)$

resulting from reaching state j ϵ{ H,A,L } at the start of period n+1 from state i.e. { H,A,L } at the start of period *n* occurs with probability $C^Z_{ij}(m)$.

Clearly, $e^Z(m) = [C^Z_{ij}(m)]\ [S^Z_{ij}(m)]^T$, Z ϵ{1,2} , m ϵ{1,2} (2)

where 'T' denotes matrix transposition, and hence the dynamic programming recursive equations

$$T_N(i) = max_Z[e^Z_i(m)+C^Z_{iH}(m)T_{N+1}(H)+C^Z_{iA}(m)T_{N+1}(A)+C^Z_{iL}(m)T_{N+1}(L)] \quad (3)$$

$$T_N(i,m) = max_Z[e^Z_i(m)] \quad (4)$$

result where (4) represents the Markov chain stable state.

3.2.1 COMPUTING $C^Z(M)$

The transition probability for CE from state i.e. { H,A,L } to state j ϵ{ H,A,L }, given selection decision Z ϵ{ 1,2 } may be taken as the number of state transitions observed at manufacturing plant m with CE initially in state i and later with CE changing to state j, divided by the sum of transitions over all states. That is,

$$C^Z_{ij}(m) = N^Z_{ij}(m)/[N^Z_{iH}(m) + N^Z_{iA}(m) + N^Z_{iL}(m)]$$

i.e. **{**H, A, L**}**, Z ϵ{1, 2} , m= {1, 2} (5)

4 OPTIMIZATION

The optimal selection decision and strength of steel are found in this section for each period separately.

4.1 OPTIMIZATION DURING PERIOD 1

When CE is High (i.e. in state H), the optimal selection decision during period 1 is

$$Z = \begin{cases} 1 & if \quad e_H^1(m) > e_H^2(m) \\ 2 & if \quad e_H^1(m) \leq e_H^2(m) \end{cases}$$

The associated strength of steel is then:

$$T_1(H,m) = \begin{cases} e_H^1(m) & if \quad Z = 1 \\ e_H^2(m) & if \quad Z = 2 \end{cases}$$

Similarly, when CE is Average (i.e. in state A), the optimal selection decision during period 1 is

$$Z = \begin{cases} 1 & if \quad e_A^1(m) > e_A^2(m) \\ 2 & if \quad e_A^1(m) \leq e_A^2(m) \end{cases}$$

The associated strength of steel is then:

$$T_1(A,m) = \begin{cases} e_A^1(m) & if \quad Z = 1 \\ e_A^2(m) & if \quad Z = 2 \end{cases}$$

When CE is low (i.e. in state L), the optimal selection decision during period 1 is:

$$Z = \begin{cases} 1 & if \quad e_L^1(m) > e_L^2(m) \\ 2 & if \quad e_L^1(m) \leq e_L^2(m) \end{cases}$$

The associated strength of steel is then:

$$T_1(L,m) = \begin{cases} e_L^1(m) & if \quad Z = 1 \\ e_L^2(m) & if \quad Z = 2 \end{cases}$$

4.2 OPTIMIZATION DURING PERIOD 2

Using dynamic programming recursive equation (1) and recalling that $a^Z_i(m,2)$ denotes the already accumulated strength of steel at the end of period 1 as a result of decisions made during that period, when CE is High (i.e. in state H), the optimal selection decision during period 2 is:

$$Z = \begin{cases} 1 & if \quad a_H^1(m,2) > a_H^2(m,2) \\ 2 & if \quad a_H^1(m,2) \leq a_H^2(m,2) \end{cases}$$

while the associated strength of steel is:

$$T_2(H,m) = \begin{cases} a_H^1(m,2) & if \quad Z = 1 \\ a_H^2(m,2) & if \quad Z = 2 \end{cases}$$

Similarly, when CE is Average (i.e. in state A), the optimal selection decision during period 2 is:

$$Z = \begin{cases} 1 & if \quad a_A^1(m,2) > a_A^2(m,2) \\ 2 & if \quad a_A^1(m,2) \leq a_A^2(m,2) \end{cases}$$

while the associated strength of steel is:

$$T_2(A,m) = \begin{cases} a_A^1(m,2) & if \quad Z = 1 \\ a_A^2(m,2) & if \quad Z = 2 \end{cases}$$

When carbon equivalence is Low (i.e. in state L), the optimal selection decision during period 2 is:

$$Z = \begin{cases} 1 & if \quad a_L^1(m,2) > a_L^2(m,2) \\ 2 & if \quad a_L^1(m,2) \leq a_L^2(m,2) \end{cases}$$

and the associated strength of steel is:

$$T_2(L,m) = \begin{cases} a_L^1(m,2) & if \quad Z = 1 \\ a_L^2(m,2) & if \quad Z = 2 \end{cases}$$

5 CASE STUDY

In order to demonstrate use of the model in sections 3 to 4, real case applications from rolling mills 1 and 2 in Uganda are presented in this section. Steel bars are manufactured for fabrication shops and the degree of CE varies for the two manufacturers. The fabrication shop wants to avoid poor strength of steel when the state of CE is High (state H) or Average (state A) in order to utilize steel at lower levels of CE. Hence, decision support is sought for the fabrication shop in terms of an optimal selection decision and the associated strength of steel in a two-month planning period for the two competing manufacturers.

5.1 DATA COLLECTION

Past data revealed the following patterns of CE and strength of steel (σ_u) over 30 days.

Table 1: Manufacturer 1

Days	CE, $C^1_{ij}(1)$	σ_u , $S^1_{ij}(1)$	Days	CE, $C^1_{ij}(1)$	σ_u , $S^1_{ij}(1)$
1	0.431	673	16	0.406	710
2	0.424	664	17	0.434	677
3	0.394	665	18	0.444	623
4	0.440	651	19	0.362	632
5	0.348	670	20	0.361	646
6	0.390	638	21	0.371	641
7	0.348	670	22	0.399	621
8	0.390	638	23	0.330	606
9	0.430	683	24	0.384	610
10	0.395	668	25	0.376	619
11	0.359	680	26	0.380	656
12	0.368	656	27	0.531	702
13	0.361	686	28	0.518	683
14	0.396	686	29	0.415	718
15	0.521	702	30	0.341	669

Table 2: Manufacturer 2

Days	CE, $C^2_{ij}(2)$	σ_u , $S^2_{ij}(2)$	Days	CE, $C^2_{ij}(2)$	σ_u , $S^2_{ij}(2)$
1	0.335	665	16	0.326	632
2	0.351	631	17	0.373	675
3	0.442	680	18	0.303	676
4	0.448	710	19	0.322	675
5	0.348	657	20	0.385	629
6	0.369	648	21	0.271	682
7	0.515	702	22	0.501	708
8	0.365	622	23	0.341	640
9	0.486	701	24	0.441	710
10	0.328	575	25	0.341	638
11	0.387	626	26	0.277	658
12	0.358	684	27	0.334	634
13	0.387	673	28	0.315	645
14	0.323	656	29	0.315	634
15	0.381	660	30	0.518	669

5.2 DETERMINING $C^z(M)$ AND $S^Z(M)$

5.2.1 ESTIMATING ELEMENTS OF $C^1(1)$ AND $S^1(1)$

Table 3: Average state

State Transition	No. of Transitions	CE	σ_u	Transition Probability, CE	σ_u Due to state transition
AA	7	0.424 0.394 0.440 0.430 0.394 0.434 0.444	664 665 651 683 668 677 629	$\frac{7}{13} = 0.5385$	$\frac{4637}{7} = 662.4$
AL	5	0.348 0.348 0.359 0.362 0.341	670 670 680 632 669	$\frac{5}{13} = 0.3846$	$\frac{3321}{5} = 664.2$
AH	1	0.521	702	$\frac{1}{13} = 0.0769$	$\frac{702}{1} = 702$
TOTALS	**13**			**1**	

Table 4: Low state

State Transition	No. of Transitions	CE	σ_u	Transition Probability, CE	σ_u Due to state transition
LA	3	0.390 0.390 0.306	638 638 686	$\frac{3}{13} = 0.2308$	$\frac{1962}{3} = 654$
LH	1	0.531	702	$\frac{1}{3} = 0.0769$	$\frac{702}{1} = 702$
LL	9	0.368 0.361 0.361 0.371 0.399 0.330 0.381 0.376 0.380	658 686 646 641 621 606 610 619 658	$\frac{9}{13} = 0.6923$	$\frac{5743}{9} = 638$
TOTALS	**13**			**1**	

Table 5: High state

State Transition	No. of Transitions	CE	σ_u	Transition Probability, CE	σ_u Due to state transition
HA	2	0.406 0.415	710 718	$\frac{2}{3} = 0.6667$	$\frac{1428}{2} = 714$
HL	0	0	0	0	0
HH	1	0.518	683	$\frac{1}{3} = 0.3333$	$\frac{683}{1} = 683$
TOTALS	**3**			**1**	

State Transition	No. of Transitions	CE	σ_u	Transition Probability, CE	σ_u Due to state transition
HA	0	0	0	0	0
HL	2	0.365 0.341	622 640	$\frac{2}{2} = 1$	$\frac{1262}{2} = 631$
HH	0	0	0	0	0
TOTALS	**2**			**1**	

5.2.2 ESTIMATING ELEMENTS OF $C^2(2)$ AND $S^2(2)$

Table 6: Low state

State Transition	No. of Transitions	CE	σ_u	Transition Probability, CE	σ_u Due to state transition
LA	3	0.442 0.486 0.441	710 701 710	$\frac{3}{23} = 0.1304$	$\frac{2{,}121}{3} = 707$
LL	17	0.351 0.369 0.387 0.358 0.387 0.323 0.381 0.326 0.373 0.303 0.322 0.385 0.271 0.277 0.334 0.315 0.315	631 648 626 684 673 656 660 632 675 676 675 629 682 658 634 645 634	$\frac{17}{23} = 0.7391$	$\frac{11{,}118}{17} = 654$
LH	3	0.515 0.501 0.518	702 708 669	$\frac{3}{23} = 0.1304$	$\frac{2{,}079}{3} = 693$
TOTALS	**23**			**1**	

Manufacturer 1:

$$S^1(1) = \begin{bmatrix} 662.4 & 664.2 & 702 \\ 654 & 702 & 638 \\ 714 & 0 & 683 \end{bmatrix}$$

$$C^1(1) = \begin{bmatrix} 0.5385 & 0.3846 & 0.0769 \\ 0.2308 & 0.0769 & 0.6923 \\ 0.6667 & 0 & 0.3333 \end{bmatrix}$$

Manufacturer 2:

$$S^2(2) = \begin{bmatrix} 710 & 623 & 0 \\ 707 & 654 & 694 \\ 0 & 631 & 0 \end{bmatrix}$$

$$C^2(2) = \begin{bmatrix} 0.2500 & 0.7500 & 0 \\ 0.1304 & 0.7391 & 0.1304 \\ 0 & 1 & 0 \end{bmatrix}$$

5.3 CALCULATING $E_i^Z(M)$ AND $A_i^Z(M)$

When steel bars are selected from manufacturer 1(m=1, Z=1), the matrices $C^1(1)$ and $S^1(1)$ yield the following strength;

$$e_H^1(1) = (0.5385)(662.4) + (0.3846)(614.2) + (0.0769)(702) = 646.91$$

$$e_A^1(1) = (0.2308)(654) + (0.0769)(702) + (0.6923)(638) = 646.61$$

$$e_L^1(1) = (0.6667)(714) + (0)(0) + (0.3333)(683) = 703.67$$

When steel bars are selected from manufacturer 2(m=2, Z=2), the matrices $C^2(2)$ and $S^2(2)$ yield the following strength:

$$e_H^2(2) = (0.2500)(710) + (0.7500)(623) + (0)(0) = 644.25$$
$$e_A^2(2) = (0.1304)(707) + (0.7391)(654) + (0.1304)(694) = 666.06$$
$$e_L^2(2) = (0)(0) + (1)(631) + (0)(0) = 631$$

5.4 THE OPTIMAL DECISION FOR STEEL SELECTION

Month 1:

Since 646.91>644.25, it follows that Z=1 is an optimal decision for steel selection in month 1 with associated total strength of 646.91 when CE is High. Since 666.06>646.61, it follows that Z=2 is an optimal decision for steel selection in month 1 with associated total strength of 666.06 when CE is Average.

Since 703.67 > 631, it follows that Z=1 is an optimal decision for steel selection in month 1 with associated total strength of 703.67 when CE is Low. Hence, optimality calls for selection of manufacturer 1 when CE is High or Low. Manufacturer 2 can be selected when CE is Average.

The accumulated strength of steel is computed for manufacturer 1 when CE is High, Average or Low and the following results are obtained:

$$a_H^1(1) = 646.91 + (0.5385)(646.91) + (0.3846)(646.61) + (0)(631) = 1243.96$$
$$a_A^1(1) = 646.61 + (0.2308)(646.91) + (0.0769)(646.91) + (0.6923)(631) = 1282.46$$
$$a_L^1(1) = 703.67 + (0.6667)(646.91) + (0)(646.61) + (0.3333)(631) = 1345.28$$

Similarly, the accumulated strength of steel is computed for manufacturer 2 when CE is High, Average or Low and the following results are obtained as;

$$a_H^2(2) = 644.25 + (0.2500)(646.91) + (0.7500)(646.61) + (0)(631) = 1290.94$$
$$a_A^2(2) = 666.06 + (0.1304)(646.91) + (0.7391)(646.61) + (0.1304)(631) = 1310.61$$
$$a_L^2(2) = 631 + (0)(646.91) + (1)(646.61) + (0)(631) = 1277.61$$

Month 2:

Since 1290.94 > 1243.96, it follows that Z=2 is an optimal decision for steel selection in month 2 with associated accumulated strength of 1290.94 when CE is High. Since 1310.61 > 1282.46, it follows that Z=2 is an optimal decision for steel selection in month 2 with associated accumulated strength of 1310.61 when CE is Average.

Since 1345.28 > 1277.61, it follows that Z=1 is an optimal decision for steel selection in month 2 with associated accumulated strength of 1345.28 when CE is Low. Hence in month 2, the optimal selection criterion is in favor of manufacturer 2 when CE is High or Average. Manufacturer 1 can be selected when CE is Low.

6 CONCLUSION

An optimization model for determining the selection criteria of steel bars under stochastic CE was presented in this paper. The decision of selecting better steel from two competing manufacturers is modeled as a multi-period decision problem using dynamic programming over a finite period planning horizon. The working of the model was demonstrated by means of a real case study as demonstrated in section 5 of the paper.

REFERENCES

[1] ACI 318-08. "Building Code Requirements for Structural Concrete and Commentary", USA, 2008. 15

[2] Amir S, Kent A, Shahrooz M., 2012. Fatigue performance of high-strength reinforcing steel, Journal of Bridge Engineering, ASCE12

[3] ARC (Australian Reinforcing Company), 2008. Handbook: Guide to Steel Reinforcement, 518 Ballarat RoadSunshine VIC 3020, Australia.11

[4] Browse Bex, Tom, 1991. Chill testing: the effect of carbon equivalent. American Foundry Society, Inc.3

[5] BS4449, 2005. Hot rolled steel bars for the reinforcement of concrete. London: British standards Institution 2005."9

[6] Chong C. 2008. Effect of Alloying Elements on Steels, Inspector Knowledge Series, 04-0 pp. 49. **15** Antonio Augusto Gorni, 2012. Steel Forming and Heat Treating Handbook, São Vicente, Brazil

[7] Cottrell C L M, 1990 'An improved prediction method for avoiding HAZ hydrogen cracking', Welding and Metal Fabrication, Vol. 58, No. 3, April 1990, pp 178-183.8

[8] Dearden J and O'Neill H, 1940, A guide to the selection and welding of low alloy structural steel Transactions of the Institute of Welding, Vol.3, 1940, pp203-214. 4

[9] Düren C F, 1990. 'Prediction of the hardness in the HAZ of HSLA steels by means of the C-equivalent', Select Conference on Hardenability of Steels, Derby, UK, 17 May 1990, Paper 4 6

[10] Ito Y and Bessyo K, 1968. Weldability formula of high strength steels related to heat affected zone cracking', Published by the International Institute of Welding, 1968, Doc IX-576-68.5

[11] Lancaster, J.F, 1999. Metallurgy of welding - Sixth Edition. Abington Publishing. p. 464. ISBN 978-1-85573-428-9.1

[12] Lepage A., H.Tavalla, S.Pujol, 2008. Towards earthquake-resistant concrete structures with ultra-high strength steel reinforcement, The 14th World Conference on Earthquake Engineering October 12-17, 2008, Beijing, China.16

[13] Nicholas S., 2012. Elastic and Elasto-Plastic Finite Element Analysis of a Tension Test Specimen with and Without Voids. (Rensselaer Polytechnic Inst. Hartford, Connecticut).17

[14] Omajene J., J. Martikainen, P.Kah, 2014. Weldability of thermo-mechanically rolled steels used in oil and gas offshore structures. International Journal of Engineering and Science (IJES) || Volume 3, Issue 5 pp 62-69.14

[15] Pirowski Z., Wodnicki, Olszyński, 2007. Micro-additions of Boron and Vanadium in ADI Part 1. Literature Review.18

[16] Saeed N. Ghali, Hoda S. El-Faramawy, Mamdouh M. Eissa, 2012. Influence of Boron Additions on Mechanical Properties of Carbon Steel, Journal of Minerals and Materials Characterization and Engineering, 2012, 11, 995-999.19

[17] Senfuka C., Kirabira J.B, Byaruhanga J.K., 2013. Thermo-Mechanically Treated Bars Made from Recycled Steel in Uganda'. IJET UK Publications*, ISSN-2049-3444, vol. 3 No. 2, Feb., 2013.2*

[18] Steel founders' society of America, 2009. Steel castings handbook, summary of standard specifications for steel castings.

[19] Tadashi Kasuya and Yuji Hashiba, 2007. Carbon Equivalent to Assess Hardenability of Steel and Prediction of HAZ Hardness Distribution. Nippon Steel Technical Report No. 95 January 2007- 53 -UDC 621. 791. 053: 539. 531: 669. 784 20

[20] Totten G, 2007. Steel Heat Treatment: Metallurgy and Technologies CRC press, USA, Page 306-308

[21] Wissam K, 2007, Fatigue Behavior of Reinforced Concrete Beams Strengthened With GFRP Sheets, Journal of Engineering and Development, Vol. 11, No. 2, September () ISSN 1813-7822 13

[22] Yurioka N, 1990, 'Carbon equivalents for hardenability and cold cracking susceptibility of steels', Select Conference on Hardenability of Steels, Derby, UK, 17 May 1990, Paper 3.7

[23] Zhang H, Abel A., 2006, Stress concentration and fatigue of profiled reinforcing steels, International Journal of Fatigue, pp. 767-773

International Journal of Innovation and Scientific Research
ISSN 2351-8014 Vol. 17 No. 2 Aug. 2015, pp. 381-390
© 2015 Innovative Space of Scientific Research Journals
http://www.ijisr.issr-journals.org/

An Exploration of Factors that Contribute to Low Performance in Physics: A Case of a Secondary School in Kenya

Samson Murithi Njiru[1] and Simon Karuku[2]

[1]Kitui Teachers Training College, Kenya

[2]School of Education and Social Sciences, Embu University College, Kenya

Copyright © 2015 ISSR Journals. This is an open access article distributed under the ***Creative Commons Attribution License***, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT: The study reported in this paper aimed at exploring the factors that contribute to students' low performance in physics. Study participants were 2 physics teachers (a male and a female) and 57 physics students (30 males and 27 females) drawn from a coeducational, government day secondary school located in Embu County in Kenya. The study adopted a mixed method approach, whereby both qualitative and quantitative methods were utilized to gather data. Analysis of quantitative data was done using the SPSS software package while the qualitative data were analyzed manually using thematic content analysis.

Three major categories of factors were identified as contributing to students' low performance in physics; namely, learning factors, teaching factors, and administrative factors. Learning factors are those factors that emanate from the learners, such as time management skills and background in mathematics; teaching factors are those factors that are attributable to the teacher, such as quality of teacher-student interactions and teacher's content knowledge; while administrative factors are those factors that can be attributed to the administrative context within the school, such as access to resources and quality of guidance provision. Based on the research findings, a number of recommendations are made to practitioners and policy makers. For teacher educators, a proposal is made to include a course on improvisation in physics education during teacher pre-service training. For the school administrators, it is recommended that mechanisms be put in place to ensure that the students' voice is heard and supported during selection of preferred subject combinations. For teachers, it is recommended that the use of practical and interesting learning experiences during lessons be inculcated right from the first year of secondary education so as to engage the learners and sustain their attention.

KEYWORDS: Performance in physics; teaching factors; learning factors; administrative factors.

1 BACKGROUND

Physics – the branch of science concerned with the nature, structure and properties of matter – contributes enormously to the economy of any country. It plays a central role in many different sectors of industry such as telecommunications, architecture, engineering, electricity production and transmission, construction, and transport. It also provides employment for people who are in occupations that are engaged in physics as a scientific discipline – for example teachers, scholars, and other researchers. It is thus an indispensable part of any country's economic development. Furthermore, physics often provides the foundations for other disciplines such as biology, medicine and chemistry. It enables learners to develop analytical skills necessary for problem solving in various situations they encounter in life.

In Kenya, physics education will play a catalyzing role in the realization of Vision 2030, the country's national plan to become an industrialized nation by the year 2030 [12]. It is therefore important for Kenyan students to be well grounded in physics education to guarantee Kenya's economic development. In recognition of this, the Kenyan government in 1984 made physics a compulsory subject for all learners in the first two years of secondary education [7]. This move was aimed at ensuring that learners have a basis for understanding the applications of physics in real life situations. Despite the

government's effort, students have continued to register low performance in physics. The study reported in this paper sought to explore the factors that contribute to this state of affairs so as to enlighten the stakeholders in physics education on ways of improving the quality of physics education.

A review of the literature suggests that one of the key factors that affect students' performance in physics is student academic self-efficacy in physics [26]. The highly examination-oriented nature of the Kenya education system has not helped much. The pressure resulting from an over-emphasis on examinations makes students anxious and less confident about their competence in physics, thereby affecting their academic performance in this subject. A study carried out byYousefi et al. [25] revealed that examination-related anxiety decreases students' learning capability, negatively affecting their academic performance. Furthermore, examination-related anxiety decreases motivation, which ultimately leads to academic failure [15].

A student's self-confidence in performing a variety of academic tasks has an effect on their academic achievement. A study conducted by Motlagh, Amrai, Yazdani, Abderahim and Souri [13] to investigate the relation between self-efficacy and academic achievement in high school students revealed that there was a significantly positive relationship between academic success and self-efficacy. In other words, students' academic achievement increases as their self-efficacy beliefs increase. Therefore, students who perform well in physics develop confidence in their physics capabilities translating to high grades in the subject.

When students enter high school they may encounter challenges related to adjustment to a new environment. For example, they may experience a change in the mode of responding to assessment tasks. If they do not receive the necessary support to adjust, they are likely to experience tress, which might make them experience difficulty in performing academic tasks. A study by Kumari and Gartia [9] revealed that there exists a positive relationship between stress and academic achievement. The authors concluded that students with high and moderate level of stress have higher academic achievement than students with low levels of stress. This is inconsistent with the results of another study by Emmanuel, Adom and Solomon [6], which showed that stress and academic performance are not always significantly correlated.

Student absenteeism is also detrimental to students' academic achievement. When students miss class, they miss the opportunity to access new curriculum content, ask questions, or generally participate in class activities, and those missed opportunities adversely affect learning. Students who attend all the classes post higher achievement scores than peers who miss classes now and then [18, 24].

Our analysis of the literature showed that very few studies have been carried out in Kenya to explore the factors that contribute to students' poor performance in physics. This study sought to fill this void by focusing on one purposively selected secondary school in Kenya. In the following section, a description of the methodology adopted in the study is described.

2 METHODOLOGY

This study adopted mixed method design, whereby both qualitative and quantitative methods were utilized to gather and analyze the data. This was one way of increasing the overall validity of the study. Further, concurrent triangulation strategy was employed in which both the quantitative and qualitative data were collected at the same time and compared to determine if there was convergence, differences or some combination [5]. Quantitative data was collected using self administered questionnaires, while qualitative data was gathered through one-to-one semi-structured interviews and focus group discussions.

The interview involved ten students and two teachers. The sampling technique used was purposive sampling, whereby the two teachers were teaching physics, five students were studying physics and five students were not studying physics. The content of the students' semi-structured interview included: students views on student interactions, student teacher interactions, illustrations used and involvement during practical lessons among others. The teacher-participants were asked to share their views on the factors that contribute to students' low performance in physics.

A focus group discussion was also conducted with six students: two boys and four girls. In addition**,** questionnaires were administered to 41 students from among those who were taking physics students in form three and form four. The questionnaires had two sections. The first section sought the participants' demographic characteristics as well as their past performance in physics tests. In the second section of the questionnaire, the students were asked to indicate their perception on the factors that contribute to student's low performance in physics. These factors were presented using Likert-type closed-ended questions, whereby the participants were to indicate their agreement or otherwise of the factors using a five-point rating scale: 1-Strongly Agree (SA), 2-Agree (A), 3-Not sure (N), 4-Disagree (D), and 5-Strongly Disagree (SD).

2.1 DATA ANALYSIS

In this study, data analysis was done concurrently with data collection using an iterative analysis technique to ensure that the data already collected guided subsequent data collection [5]. For the quantitative data, the SPSS software package was used to analyze the data from the survey, which was used to generate charts and descriptive statistics. For the qualitative data, transcription of the audio-recorded data from interviews and focus group discussions was done, followed by reading and re-reading of the transcripts to identify the main ideas based on the similarities and differences in the data collected, and to compare the qualitative and quantitative data. During this process, the responses were coded based on the research questions. Codes were used to generate themes for answering the research question. The data analysis was done iteratively to ensure that the themes that emerged were saturated [20].

3 RESULTS

Our analysis identified three major categories of factors that contribute to low performance in physics: factors that emanate from the teacher; factors that emanate from the learners; and factors embedded in the context within which the school system operates. We termed these three categories as, teaching factors, learning factors, and administrative factors, respectively. Of the three categories, teaching factors emerged as the highest contributor to students' low performance in physics. In the following section, we discuss these three categories of factors in detail.

3.1 TEACHING FACTORS

As noted above, teaching factors refer to those factors that emanate from the teacher's personality and disposition, their style of teaching, their style of interaction with the learners, and their pedagogical content knowledge of physics.

Interviews with the students revealed that the students were taught physics in the laboratory through the lecture method. Some of the student-participants indicated that they had never had a physics practical lesson since they enrolled in the school. This situation disadvantaged students who appeared to be inclined to learn better through practical activities as one student-participant revealed during the interview by saying that, "if physics was taught practically all students would like the subject and get straight A's". Additionally, during the interviews with the teacher-participants, it emerged that the physics teachers were not incorporating practical activities in their teaching due to lack of enough time to prepare because of the huge workload. In the sampled school, there were only two teachers handling physics from form one to form four. Figure 1 shows that about 66% (27 out of 41) of the student-participants during the survey either agreed or strongly agreed with the attribution of low performance in physics to few or no practical physics lessons.

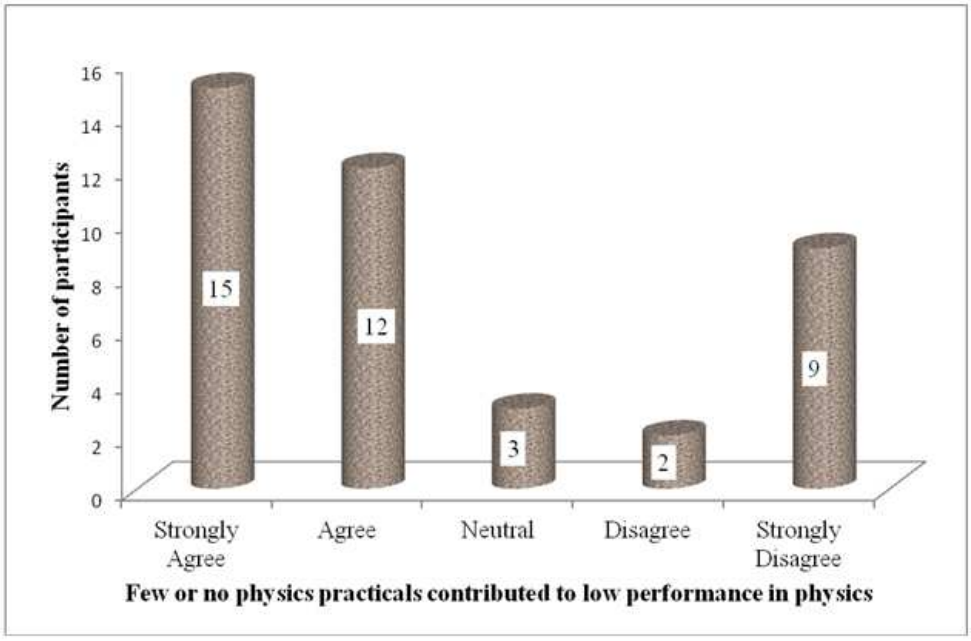


Figure 1: Student-participants' agreement with the assertion that few or no physics practical lessons contributed to low performance in physics

Apart from the non-use of practical activities in delivery of the physics lessons, the study revealed that the prevalent use of teacher-centered instructional methods was another factor that contributed to students' low performance in physics. During the interviews and focus group discussions, the student-participants indicated that the teachers taught the lessons with minimal involvement of the students. The students remained passive throughout the better part of the lesson which made them lose concentration, with majority not understanding the physics content being delivered in the lesson. During the survey, majority participants agreed with the assertion that low performance in physics was as a result of physics lessons being boring, few or no practical lessons and poor teaching methods.

A good number of student-participants indicated that their physics teacher lacked physics subject mastery. For example, some students reported that when they asked questions during the lesson, the teacher would not answer right away. Instead, the teacher would promise to provide the answer in the next lesson, which he would never do. In addition, occasionally the students would request for clarification in the areas which were not clear to them during the physics lessons but instead of helping them, the teacher would ask the students to consult textbooks.

The two teacher-participants indicated that their preferred teaching subject was not physics and they were not comfortable teaching it. They indicated that they taught physics because they were the only teachers in the school who had taken physics as their second teaching subject during their pre-service training. Given a choice, the teachers indicated that they would opt to teach their first preferred subject.

The interview with the students revealed that during the physics lessons the teacher gave exercises and occasionally marked for the particular bright students and then continued with the lesson leaving the majority of the students' work unmarked. Majority of the participants revealed that physics teachers were attending lessons late and failed to give remedial work to the weak students. According to the participants lack of teacher commitment led to low performance in physics in the internal and external assessments.

Some of the interviewed students reported that they did not like physics because their career aspirations did not require them to pursue physics. According to them, the only reason as to why they selected physics is because they wanted to escape from the biology teacher. The participants revealed that the biology teacher was very strict and occasionally gave students punishment due to incompletion of biology assignments. The physics teacher on the other hand rarely gave students assignments and therefore never gave students punishments.

Figure 2 shows that about 68% of the participants in the survey indicated that physics teacher did not give remedial work to the weak students.

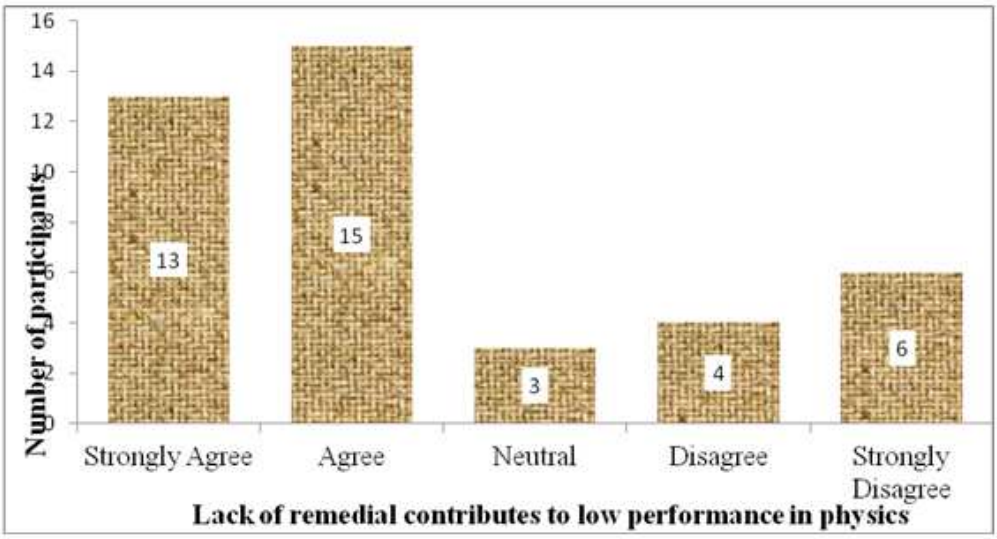


Figure 2: Student-participants' agreement with assertion that lack of remedial help to weak students was one of the factors which contributed to low performance in physics

All the student-participants were in agreement that a teacher's relation with his or her students plays a crucial role in students' learning. If the teacher is unfriendly to students, they fear him/her and find it difficult to seek clarification of the concepts they have not understood during the lesson. Besides, from the interviews students liked teachers who were free

with them. An unfriendly teacher's disposition towards students can discourage the students from approaching the teacher for further guidance on areas they are having problems with in the physics syllabus.

3.2 LEARNING FACTORS

The data revealed a number of learning factors that contribute to low performance in physics. These factors are: student's background in mathematics, peer influence and student's time management.

Mathematics is extensively used in physics to communicate concepts. The study revealed that students with good mathematical background performed well in physics. Figure 3 shows that during the survey, about 73% of the participants indicated that poor performance in mathematics contributed to low performance in physics.

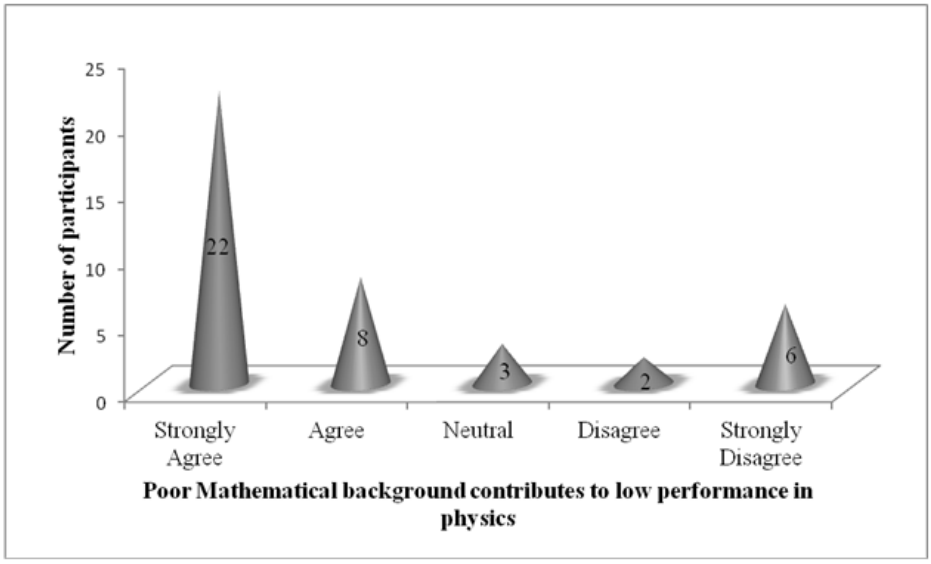


Figure 3: Student-participants' agreement with the assertion that poor performance in mathematics was one of the factors contributing to low performance in physics

Some of the students attributed their poor performance in physics to their poor mathematics background. Student-participants who had not selected to study physics in form three indicated that they had performed poorly in physics because of their poor mathematics background such that they had no idea on how to answer mathematical questions in physics examination.

Students spend a lot of time with peers and the discussion among the students becomes a major source of information concerning academic issues in the school. The study revealed that when new students join the school, they get most of the guidance from the senior students and whatever they are told they take it as the truth. It appears that students' low performance in physics was as a result of discouragement from the other students who never selected physics in form three. According to the student-participants, the senior students constanly reminded their junior peers that physics is generally hard and their performance cannot be like in other science subjects, and therefore they should not dream of performing well in the subject. This made the physics students comfortable with their low score in physics. Moreover, some students would discourage physics students from working hard by telling them that if they concentrate a lot in studying physics they will turn mad in future or become a social misfit. This is also in line with Adipo's [2] research findings that among the factors that affects students' performance in physics is negative influence from peers.

The data revealed that students' poor time management accounted to their low performance in physics. Figure 4 shows that about 61% of the participants in the survey indicated that students' poor time management was among the factors that contributed to their low performance in physics.

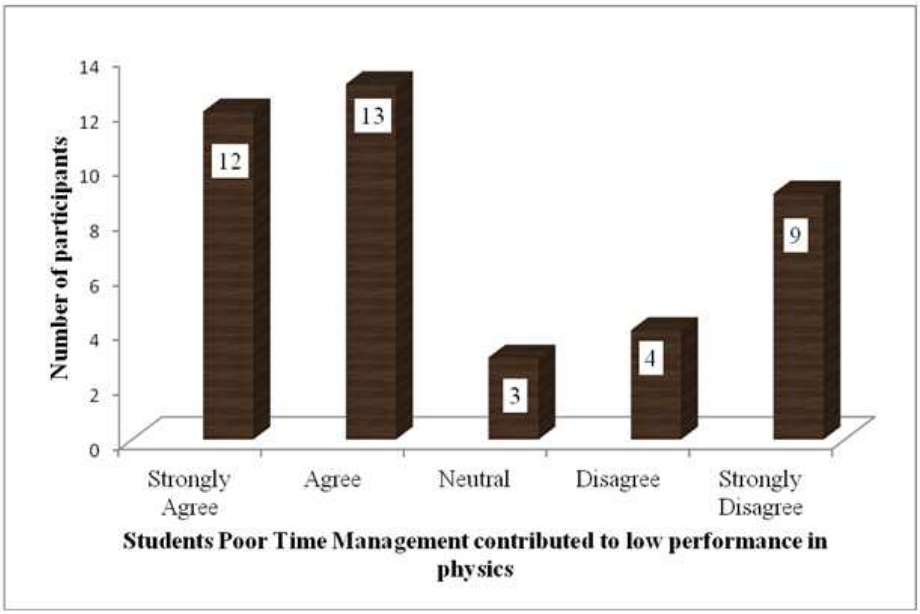


Figure 4: Student-participants' agreement with the assertion that students' poor time management was one of the factors that contributed to low performance in physics.

Time management requires the students to spend time in the most effective way to avoid spending more time in one subject than the other. During the focus group discussion it was revealed that majority of the students spend little time studying physics unlike other subjects. For example, Grace one of the student-participants said, "I have no time to read physics because at the same time I have assignments to write for other subjects. Either you do not work on the assignments and read or you work on the assignments and fail to read because one cannot do both because at the end of the day one will be very tired". Further, the study revealed that as the students wrote the assignments for other subjects they studied them but since they were rarely given physics assignments they rarely studied physics.

3.3 ADMINISTRATIVE FACTORS

Four administrative factors emerged from this study; namely, syllabus coverage, subject selection process, few physics teachers and inadequate provision of teaching/learning resources.

In the study, it came out strongly that failure to cover the physics syllabus was one of the factors that contributed to students' low performance in physics. The students attributed failure to cover the physics syllabus to frequent absenteeism by the physics teacher. The physics teacher had some health issues and the head teacher did not make arrangements to have another teacher step in those days the physics teacher was absent. During the interview one of the participants said, "the best student in end year 2013 physics examination attained 38%". This is because we had only covered three topics in form three physics syllabus. Being an external examination the questions were set from forms one to form three topics". Some of the students who were then in the first term of Form two had only covered six topics in form one syllabus because they had stayed for almost a term without a physics teacher.

All the form 3 students argued that their poor performance in physics was as a result of failure to complete the physics syllabus. According to them, they had learnt so little that they could not answer most of the questions in the end year 2013 physics examination.

In the study it emerged that students were not well guided on selection of subjects in form two, which probably contributed to low performance in physics. The student-participants revealed that the process was hurriedly done with some learners whose performance was above average in physics forced to proceed with it in form three. The participants argued that they were supposed to be well guided on subject selection process and the decision on which subjects to choose should be left to them. One student-participant said: "I do not know what I am doing in the physics class. I never selected physics. The selection was a flawed process". An interview with one of the teachers revealed that very few students select physics and, therefore, to increase the number, students who had comparatively good grades in physics were automatically included in the physics class. This implies that some of those students forced to be in physics might not be motivated to study the

subject resulting in low performance in physics. During the interview one of the teacher-participant said, "In the school we lack good guidance to the students on the subjects offered and their opportunities in life when students are in form one. This affects the choice of subjects by students in form three".

Lack of enough physics teachers also emerged as one of the factors that contribute to low performance in physics. The teacher-participants argued that they needed a manageable teaching load to be effective in their teaching; otherwise they had inadequate time for lesson preparation. They further argued that with more physics teachers in the physics department, they would be assisting each other through peer teaching, mentoring and team teaching.

While expressing concern about lack of teaching/learning resources in the school one teacher-participant remarked: "How do you expect student to attain good grades in physics when the school has only one laboratory which is not well equipped and there are other apparatus which cannot be bought because electricity has not been installed?" The teachers reported that they had only one type of physics textbook. They argued that they ought to have a variety of physics reference books for effective teaching. The student-participants also agreed with this. About 63% of the student-participants either agreed or strongly agreed that lack of physics textbooks contributed to their low performance in physics.

4 DISCUSSION AND CONCLUSION

This study sought to explore that factors that contribute to students' poor performance in physics. Findings show that student-participants had expectations of their physics teacher with regards to establishing the classroom environment for effective learning. In particular, the students expected to be engaged during the lesson through practical activities and questioning. This is important because continually engaging students in the lesson would make them feel part of the knowledge generation community, which would get them motivated to learn physics. This is in agreement with Wellington [23] and Brooks [4], who argue that although practical work can sometimes be expensive and time consuming, it has simply to be done if the learners are to advance in their understanding.

Clearly, the student-participants expected that their teachers would mediate the textbook to help them understand physics in a better way. In line with the findings of Adipo [2], this study suggests that some physics teachers in Kenya lack subject mastery, which contributes to students' poor performance in physics. It is very difficult for the students to understand that which a teacher with poor content mastery is transmitting to them. Indeed according to Olabode and Olugbenga [17], a teacher's qualification level has impact on students' performance in physics.

The importance of teacher commitment to the teaching of physics cannot be overemphasized. As revealed in this study, lack of such commitment can only contribute to poor student performance. In line with the argument by Makewa, Role and Biego [10], results from this study indicate that low levels of teacher commitment translate into poor learner achievement. This is because the teacher should lead the learners in activities that promote learning. These activities include attending lessons punctually, giving and marking students' assessment tasks, and providing remedial help to struggling students.

Poor student-teacher interactions can hinder the attainment of good grades in physics as revealed in the study. As noted by Adeyemo [1], physics teachers can facilitate student learning by facilitating a co-operative and friendly atmosphere.

It is clear from the study that students' poor mathematical foundation is one of the factors that contributed to poor performance in physics. This is in line with findings of the study by Tuminaro and Redish [21] as well as that by Meltzer [11], which showed that a complete understanding of the concepts in physics requires fluency in the mathematical language in which these concepts are couched. This means that the physics teacher should support the students in both theory and mathematical aspects of physics. Sa'adatu [19] observes that good mathematics foundation facilitates students' ability to solve physics problems.

Peer influence has both positive and negative effects on a student's academic performance. The data from this study revealed negative effects of peer influence on student academic performance in physics. It is important to be aware those students are particularly vulnerable to all forms of peer influence which affects their academic achievement in school [8] and, as such, it is important for physics teachers to proactively find ways of combating negative peer influence.

It is clear from this study that there were some students' self-inhibiting behaviors which acted as a barrier to good academic performance in physics. These behaviors were lack of proper reading schedule and hanging out with friends during the time they were supposed to be having their private study. These behaviors made them lag behind in academic performance in physics. The situation was exacerbated by students having no assignments to work on during their free time. Therefore, having few or no assignments in physics prompted them to allocate little time for physics, resulted in poor performance in the subject. Therefore, there is need for teachers to guide students on proper study time management.

This study has also revealed that students' low performance in physics can be partly be ascribed to non-completion of the physics syllabus. Adequate and timely coverage of the syllabus builds confidence in learners resulting in improved performance. The confidence emanates from the fact that students get to know all the questions in the examinations are from the areas they have covered with the teacher. Besides, students who cover the syllabus in good time find adequate time for to revise for the examinations.

Evidenced in the findings of this study is the negative impact of the subject selection process in the school on the learners' performance in physics. As revealed during interviews there was a lack of professional guidance on subject selection in the school. This led to students selecting the subjects without being well informed, which in turn affected students' performance. In view of this, the school administration should devise ways and means of providing professional advice to students during the subject selection process, and giving students an opportunity to make their own independent choices. This would make students choose subjects in line with their career aspirations thereby motivating them to study the subject translating to good performance in the subject.

In line with the findings of Victoria [22] as well as those of Musasia, Abacha and Biyoyo [14], this study revealed that low enrollment and poor performance in physics can be linked to a shortage of inspirational and well trained physics teachers. Furthermore, this study revealed that a lack of adequate resource materials for the teaching and learning of physics contributed to poor performance in the subject. These findings are related to those of Nyamba and Mwajombe [16], which showed that lack of teaching/learning materials influences students' preference and performance in physics. According to Aina [3], the teaching of physics in schools has not been encouraging due to the abstract nature of the subject. As such, the use of instructional materials is essential in facilitating students' learning in physics. There is also a need for in-service professional development to empower teachers on improvisation of teaching-learning materials in physics, so that in contexts where there is inadequacy in teaching/learning resources, the teachers can be able to improvise.

4.1 RECOMMENDATIONS

Based on the findings of this research a number of recommendations can be made to improve students' performance in physics. To begin with, there is need to improve on teacher-student ratio so as to improve on the delivery of the physics curriculum. Having enough physics teachers will reduce the teaching load of physics teachers so that they have sufficient time to prepare for physics lessons consequently leading to improvement in the academic performance in physics.

In order for teachers to be well prepared to meet the challenges of teaching physics in a school with limited teaching /learning resources, it is important for student-teachers to receive pre-service training on teaching physics through improvisation. This can be achieved through, for example, the introduction of a course on improvisation in physics education. Additionally, teacher educators can organize for an in-service professional development course on improvisation in physics education for practicing physics teachers.

In the same vein, the school administration should work with physics teachers to minimize the problem of shortage of relevant teaching/learning resources in physics. This can be done through, for instance, procurement or borrowing some of the resources from such resource centers as SMASE centers or neighboring schools.

The school administration should also ensure that the subjects' selection exercise in form two is not only helpful to the students but also democratic. The students need to be well guided on how to make the right subject choices based on their career aspirations and personal interests.

The school administration should also ensure that the curriculum is implemented as intended by supervising the teachers to ensure that the intended curriculum is covered in good time.

Physics teachers should use practical activities in physics lessons to engage the learners and to sustain their attention. In addition, the use of student-centered pedagogies in physics classrooms should be the norm rather than an exception. Besides, the physics teachers need to have good student–teacher relationships where students are free to interact with teachers. During the interactions students open up on the challenges they face in academics and teachers get an opportunity to guide them on how to overcome those challenges

Finally, physics teachers should sensitize the students on the importance of physics in career choices as soon they are admitted in the school instead of learning from their peers who discourage them from studying physics. There is also need to motivate students to study physics by linking it to real life contexts so that they can see its relevance in their lives and in national development.

ACKNOWLEDGEMENTS

This paper is substantially based on the master of education research work of the first author under the guidance of the second author. The first author is grateful to the Aga Khan University and the Government of Kenya for the financial support accorded to him during the study.

[1] References

[2] Adeyemo, S. A., Background and classroom correlates of students' achievement in Physics. *International Journal of Educational Research and Technology*, vol.1, no. 1, pp., 25–34, 2010.

[3] Adipo, O., *Causes of low enrolment in physics in national examinations in secondary schools in Bondo District(*Unpublished Masters' thesis*).* Aga Khan University, Dar es Salaam, Tanzania, 2008.

[4] Aina, K. J., Instructional Materials and Improvisation in Physics Class: Implications for Teaching and Learning. *Computer*, vol. *2, no.*20, pp. 8, 2013.

[5] Brooks, J. G., *In Search of Understanding: The Case for Constructivist Classrooms*. ASCD, 1999.

[6] Creswell, J. W., *Research design : qualitative, quantitative, and mixed method approaches*. Thousand Oaks: Sage Publications, 2009.

[7] Emmanuel, A.-O., Adom, A. E., & Solomon, F. K., Perceived Stress And Academic Performance Of Senior High School Students In Western Region, Ghana. *European Journal of Educational Studies*, Vol. *2*, no.11, pp. 88–101, 2014.

[8] Eshiwani, G. S., *Education in Kenya since Independence*. East African Publishers, 1993.

[9] Howard, N. M., *Peer influence in relation to academic performance and socialization among adolescents: A literature review* (Unpublished master's thesis). University of Wisconsin, 2004.

[10] Kumari, M. R., & Gartia, M. R., Relationship between Stress and Academic Achievement of Senior Secondary School Students. *Asian Journal of Multidimensional Research*, Vol.1, no.3, pp.152–160, 2012.

[11] Makewa, L. N., Role, E., & Biego, S., Teachers' attitude towards strengthening mathematics and science in secondary education through in-service education and training (SMASSE-INSET) Project in Nandi Central District, Kenya. *International Journal of Education and Social Sciences (IJESS)*, Vol. !, no.4,2012.

[12] Meltzer, D. E., The relationship between mathematics preparation and conceptual learning gains in physics: A possible "hidden variable" in diagnostic pretest scores. *American Journal of Physics*, Vol. *70, no.* 12, pp.1259, 2002.

[13] Misati, J. A., & Mngoda, D. M., Re-visioning Kenya's social development agenda for industrialization and sustainable development. *Scientific Conference Proceedings, 2012*.
[Online] Available on:http://elearning.jkuat.ac.ke/journals/ojs/index.php/jscp/article/view/726

[14] Motlagh, S. E., Amrai, K., Yazdani, M. J., Abderahim, H. altaib, & Souri, H., The relationship between self-efficacy and academic achievement in high school students. *Procedia - Social and Behavioral Sciences*, Vol. 1, no.15, pp. 765–768, 2011.

[15] Musasia, M., Abacha, A., & Biyoyo, E., Effect of Practical Work in Physics on Girls' Performance, Attitude change and Skills acquisition in the form two - form three Secondar y Schools' transition in Kenya. *World Journal of Education*, Vol. *2, no.*5, 2012.

[16] Nadeem, M., Ali, A., Maqbool, S., & Zaidi, S. U., Impact of Anxiety on the Academic Achievement of Students Having Different Mental Abilities at University level in Bahawalpur (Southern Punjab) Pakistan. *International Online Journal of Educational Sciences*, Vol. 4, no. 3, 2012.

[17] Nyamba, S. Y., & Mwajombe, K. K., Students' Preferences on Science Subjects: Does this Affect their Performance? A Case of Udzungwa Secondary School, Kilolo, Iringa, Tanzania. *International Journal of Science and Technology*, Vol. 2, no. 8, 2012.

[18] Olabode Thomas, O., & Julius Olugbenga, A., Effect of Teacher's Qualification on the Performance of Senior Secondary School Physics Students: Implication on Technology in Nigeria. *English Language Teaching*, Vol.5, no.6, 2012.

[19] Reche, G. N., Bundi, T. K., Riungu, J. N., & Mbugua, Z. K. (2012). Factors Contributing To Poor Performance In Kenya Certificate Of Primary Education In Public Day Primary Schools In Mwimbi Division, Maara District, Kenya. *International Journal of Humanities and Social Science*, Vol. 2, no. 5, pp. 2012.
Sa'adatu, A. M., Students' Performances in Physics Theory and Calculation Questions at Federal College of Education Zaria, Nigeria, 2012. [Online] Available on:
http://www.icidr.org/jres_vol3no2_august2012/Students%92%20Performances%20in%20Physics%20Theory%20and%20Calculation%20Questions%20at%20Federal%20College%20of%20Education%20Zaria,%20Nigeria.pdf

[20] Silverman, D., *Doing Qualitative Research: A Practical Handbook*. SAGE, 2013.

[21] Tuminaro, J., & Redish, E. F., Understanding students' poor performance on mathematical problem solving in physics. In *2003 Physics Education Research Conference* (Vol. 720, pp. 113–116), 2004.

[22] Victoria, M. B., *Factors Contributing To Under Achievement Of Zambian Female Students In O-Level Physics Examinations. A Case Of Selected High Schools In Central Province*. University of Zambia, 2011. [Online] Available on: http://dspace.unza.zm:8080/jspui/handle/123456789/1901

[23] Wellington, J., *Practical Work in School Science: Which Way Now?*. Routledge, 2002.

[24] Yahaya, A., Ramli, J., Hashim, S., & Ibrahim, M., The effects of various modes of absenteeism problem in school on the academic performance of students in secondary schools. *European of Social Sciences*, Vol. 12, no. 4, pp. 624–639, 2010.

[25] Yousefi, F., Talib, M. A., Mansor, M. B., Juhari, R. B., & Redzuan, M., The Relationship between Test-Anxiety and Academic Achievement among Iranian Adolescents. *Asian Social Science*, Vol. 6, no.5, 2010.

[26] Zhu, Z. (2007). Learning content, physics self-efficacy, and female students' physics course taking. International Education Journal, 8(2), 204-212.

International Journal of Innovation and Scientific Research
ISSN 2351-8014 Vol. 17 No. 2 Aug. 2015, pp. 391-402
© 2015 Innovative Space of Scientific Research Journals
http://www.ijisr.issr-journals.org/

ROLE OF COMMERCIAL BICYCLISTS IN ROAD TRAFFIC INJURIES IN KISUMU CITY, KENYA

WILBERFORCE ODIWUOR CHOLO[1], DIANA MENYA[2], and WILSON ODERO[3]

[1]Department of Public Health, Mount Kenya University, Kenya

[2]Department of Epidemiology and Nutrition, Moi University, Kenya

[3]School of Medicine, Maseno University, Kenya

Copyright © 2015 ISSR Journals. This is an open access article distributed under the ***Creative Commons Attribution License***, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT: *Background:* Commercial bicycling has become a popular mode of transportation in Kenya, in both rural and urban areas since early 1990's. In Kisumu city, however, its related injuries cause significant morbidity and mortality. Many road users have viewed their presence in the roads as the cause of congestion, confusion, fear, and decreased safety in the roads in the road system. Bicyclists are at high risk of road traffic accidents and the attendant injuries, but are greatly neglected and few community-based studies have investigated the problem in Kenya.
Objectives: The primary objectives were; to determine demographic characteristics of the commercial bicyclists, factors associated with road traffic injuries and crashes involving commercial bicyclists. Other objectives were to determine the perception surrounding commercial bicycling, and to determine preferred road safety interventions for commercial bicyclists.
Study design and Methods: Population based, cross-sectional study involving Four hundred and twenty commercial bicyclists, five key informants, victims of road traffic crashes and injuries involving commercial bicyclists Cluster, systematic and simple random sampling methods were used to select bicyclists at sites. Questionnaires were administered to the commercial bicyclists; Interviews were also carried out with key informants.
Results: The majority of the respondent attained primary education (55.3%), 40.7% completed secondary level of education. The ages of the respondents were grouped as 21-25 years which accounted for 51%, 26-30 years (21.3%),. People prefer using bicycles because they are flexible (39%), and not time consuming (28.9%). Inadequate signals that cannot be understood easily by other users (28.9%) and, riders losing control (19.1%) are the major risk factors. There was significant relationship between drug taking, length of time at work and occurrence of crashes. (χ^2 =7.745, p=0.001). A significant association between injury occurrence and condition of roads was also found, (χ^2=10.226, p=0.001). Road signs were inadequate (74.5%) and those available were misunderstood. There was significant relationship between inadequate road signs (signals), their misunderstanding within the road and subsequent occurrence of accidents (χ^2= 14.305; p= 0.002). Training for bicyclists (36.4%) and bicycle helmets were suggested as road safety intervention measures that could be adopted (34.5%).
Conclusion: Commercial bicyclists are men aged below 40years; they are highly exposed to crashes and injuries due to their interaction in the traffic system, since bicyclists riding in, traffic mix feel unsafe and fearful. Therefore, it is very dangerous to ride in a mixed system because there is increased risk of crashes or accident. There are poor traffic law enforcement mechanisms in Kenya. There is need to integrate this economic activity in the road system while minimizing risks to crashes and injuries.

KEYWORDS: Commercial bicyclist, Injury, risk factor, road safety, intervention, fatalities, crash, Kisumu, Kenya.

1 INTRODUCTION

Road traffic injuries contribute significantly to the burden of disease and mortality throughout the world, but particularly in developing countries[1]. Currently Road traffic injuries are ranked ninth globally among the leading causes of disability

adjusted life years lost. Globally, over 1.24 million people die road crashes annually and as many as 50 million are injured [2]. Without action, road traffic crashes are predicted to result in the deaths of around 1.9 million people annually by 2020 (WHO, 2013).[3] Low- and middle-income countries (LMICs) are estimated to be responsible for as much as 90 percent of this burden, with the African region accounting for approximately 205,000 fatalities and 7,151,000 DALYs due to RTIs (WHO 2004).[4]

Commercial bicycling is increasingly becoming a popular mode of transportation in Kenya, in both rural and urban areas since early 1990's[5]. Globally the increase of bicycling has been witnessed in USA,[6] and In Kenya, however, its related injuries cause significant morbidity and mortality. Many road users have viewed their presence in the roads as the cause of congestion, confusion, fear, and decreased safety in the roads in the road system.[5] As bicycling grows in popularity as a commuting option and a recreational activity, injuries sustained from bicycle-auto accidents are also on the rise.[7] Bicycle crashes and injuries are a public health priority because they are preventable, there are a large number of injuries and fatalities each year, and the number of vulnerable road users is increasing because bicycling is increasing. Bicyclists are identified as vulnerable road users due to lack of protection within a vehicle and differences in mass and speed compared to motor vehicles[7]

There are about 800 million bicycles in the world, twice the number of cars[8]. In Asia alone, bicycles carry more people than do all the world cars. Nonetheless, in many countries, bicycle injuries are not given proper recognition as a road safety problem and attract little research[9].

In Kenya and other developing countries, bicyclists are legally allowed to use any road but the engineers have not used bicycle as a 'design' vehicle for the roads. Since early 1990s, the bicycle has become common for Kenyan transportation in both rural and urban areas; there is increased use of these non-polluting, energy efficient and flexible vehicles. However, when one begins to investigate the use of the bicycles for transportation, one finds that there are a lot of dilemmas facing commercial bicyclists and road traffic planners[10].

The first dilemma is that the public has many misconceptions about commercial bicycling including the skills required, and the rights of bicyclists to use public roads. Many of the bicyclists think they know how to ride a bicycle, but many lack the basic bicycling skills. Instructions in technique and safety are necessary to be safe and effective. Among bicycle advocates there are relatively few who advocate for improved education and skill development[10].

The second one is that road engineers and traffic planners have often ignored bicyclists, failing to consider them in road design or traffic enforcement. The bicycle is not generally a "design vehicle," so roads are not routinely designed with bicyclists in mind. Many bicyclists operate their bicycles in dangerous or unlawful manner, but few enforcement agencies cite these violators. There are several reasons why police in many areas are unable to stop these violations. Police sometimes believe that enforcement is impossible partly because commercial bicyclists do not display number plates and cannot be threatened by license suspension[11]

Some bicycle advocates believe that until safe facilities are built society should stop blaming bicyclist for violating traffic laws. Further they argue that disobeying traffic rules is a rational response to bicyclists' predicament. This suggests that until road conditions and riding environments become more conducive to bicycling, commercial bicyclists will ride as they find it appropriate rather than as law requires of them[11]

Finally, designated bicycle facilities often do not serve the purposes their advocates propose and sometimes create dangerous conditions. The locations where bicycling is the most useful for transportation are also most challenging, especially for beginners. Bicycle education has not yet become available in a wide scale, in part because advocates, funding programs, politicians and public opinion focus on building road [11,12].

Getting beyond these dilemmas requires reliable data that can be used in policy formulation.

Risk in road traffic arises out of a need to travel to work, or for education or leisure pursuits. A range of factors determine who uses different parts of the transport systems, how it is used and at what time[13]. While in practical terms it may not be possible completely to eliminate all risks. It is possible to reduce the exposure to risk of severe injury and to minimize its intensity and consequences [13]. In road traffic, risk is a function of four elements the first is the exposure to the amount of movement or travel within the system by different users or a given population density. The second is the underlying probability of a crash given a particular exposure. The third is the probability of injury given a crash. The fourth is the outcome of injury[14]. The precise contribution of various errors such as riders loosing control, speed, environmental hazard, bicycle mechanical failure is unclear although they are all significant. [15-17] Another widespread problem is traffic signal that is not designed with bicyclist in mind. There are two problems here first in any traffic signals are actuated by buried loop

detectors and many of these are not sensitive to bicycles even though bicycle sensitive designs are readily available in some countries[18].

The human operator often adapts to changing conditions in ways that do not always serve safety. A single error can have life or death consequences. Behind road user errors, there are natural limitations. These include vision in night traffic, the detection of targets in the periphery of the eye and the estimation of speed and distance. Also influencing human error are external factors such as the design of roads traffic rules and their enforcements[19]. (http://www.etsc.be/eve.htm). Sophisticated and quality assured systems that combine human beings and machines therefore need to have an in-built tolerance of human error[14]. The incidence of bicycle – related injuries varies between countries. In Beijing China, about a third of all traffic deaths occur among bicyclists[3]. In India, bicyclists represent up to 21% of road users fatalities, the second largest category after pedestrian[20]. China is one of the developing countries where public policy until recently has encouraged the use of bicycles as a form of commuting[21]. In the United States, there are 67 million bicyclists who ride approximately 15 billion hours peryear.[20] Each year, approximately 750 persons die from injuries due to bicycle crashes and over 500,000 persons are treated in emergency departments. While over 90% of deaths from bicycle-related injuries are caused by collisions with motor vehicles[20], these collisions cause less than 25% of non-fatal head injuries. Head injury is by far the greatest risk posed to bicyclists, comprising one-third of emergency department visits, two-thirds of hospital admissions, and three-fourths of deaths[22].

Accident studies in USA show clearly that motorists were judged to be solely at fault in only 28% of car-bicycle collisions, cyclists solely at fault in 50% collisions and both were at fault in 14%[6]. This is partly due to factors such as road design, the traffic mix, climate and cultural attitude. Over 75% of fatal bicycle injuries are due to head injury[22]. Among children, bicycle injuries are the leading cause of head injury. [23]

Most bicycle related injuries occur to the upper or lower extremities, followed by the head, face, abdomen or thorax and neck.[24] Most of the injuries involve superficial trauma such as “abrasions road rash” contusions and lacerations.[25]

Head injuries occur in 22% – 47% of injured bicyclists, often as a result of collision with a motor vehicle and are responsible for over 60% of all bicycle – related deaths and the majority of long – term disabilities.[26] Injuries to the facial region include eye trauma from airborne objects such as dust, insects or debris, as well as facial soft tissue injuries and fractures.[27] Not only do injuries involve neck trauma, which usually occurs in riders who collide with motor vehicle but also trauma to the thorax, abdominal organs, viscera and pelvis are great.

Overall, off road cyclists have a 40 % lower incidence of head, facial dental injuries than on road bicyclists, primarily the result of being separated from vehicular traffic and more frequent helmet use[28]. Overuse injuries may occur in bicycle riders who regularly ride their bicycle, especially those involved in competitive racing and commercial bicycling. Ensuring that the bicycles seat (saddle), haul bars and pedals are correctly adjusted and that the bicycle is the appropriate size can be key in preventing overuse syndromes.[29] Neck aches and backaches are also common complaints resulting from the cyclists, upper body position with hyperextension of the neck and flexion of the back.[28]

Enforcement of laws on traffic violations committed by bicyclists is a necessary ingredient in improving bicyclists’ safety. It would also be helpful to target behaviour that is threatening to pedestrians such as weaving through a crosswalk (on a red signal) and riding on a sidewalk.[4]

To reduce bicycle injuries in Kenya, as elsewhere, several types of interventions are likely to be effective. Changes to the road environment can be highly beneficial. The 2004 World Report on road traffic injuries recommend the following strategies: Separating bicycles from other form of traffic, engineering measures to control traffic flow and reinforce low speeds, bicycle lanes, traffic signals and signs aimed at bicyclists, painted lines on the side of the roads, removing obstacles from roads and cycle paths, repairing road surfaces, to remove portholes, safe bicycling practices, and respectful behaviour towards others sharing the road[4.]

No studies have been done in Kenya on commercial bicycling. A lack of research means that the magnitude of the problem, its impact and the cost and effectiveness of intervention measures are not fully understood. Despite the marked increase of commercial bicycling in Kenya particularly in Kisumu and the related crashes and injuries, little effort has been made to develop and implement targeted effective interventions for commercial bicyclists. The serious neglect of commercial bicyclists by stakeholders such as traffic engineers and planners who design and operate the roadway transportation system call for a review of the local situation. Indeed commercial bicyclists and related crashes and injuries are neglected; most studies and interventions have been focused on motorcycling and motor vehicles. In deed very little has been done about the safety of the commercial bicyclists in Kenya. Most riders at times ignore or do not know the safety laws and regulations. This is reflected in the absence of basic requirements such as helmets, license and training. Yet the sector is characterized by high exposure to road traffic crashes and injuries. The focus has entirely shifted to motorized road users.

This study aimed at providing epidemiological data on bicycle related injuries and to determine demographic characteristics of the commercial bicyclists, factors associated with road traffic injuries and crashes involving commercial bicyclists. Other objectives were to determine the perception regarding commercial bicycling, and to highlight some preferred road safety interventions for commercial bicyclists.

2 METHODS

The study was done in Kisumu city the third largest city in Kenya. The city has a road network of 2,182.9Km of which 298.9Km are of bitumen standard, 923.3km of gravel and 960.7Km of earth. The main roads within the city are tarmacked. Roads in residential areas and those leading to industrial areas are in a state of disrepair. The main mode of transportation within and connecting down town Kisumu city to residential estates are matatus, commercial bicycles and walking (pedestrians). The estimated population within municipality is 970,000. A high proportion of the population is young, aged 0-19 years, which comprise 57.3%, while 41.2% is between 15-45 years. Those aged 45-65 and 65 and above are 8.98% and 3.4% of the population respectively.

The design of the current study is a descriptive cross sectional study where a multistage sampling process was carried out to identify and recruit the respondent. Selection of study participants was done in 3 stages involving 3 sampling techniques; multi stage sampling, systematic and simple random sampling. These were applied to select estates, cluster sites where bicyclists stand as they wait for clients, and bicyclists respectively. Structured questionnaire were administered to a random sample of 420 commercial bicyclists to obtain the following information: demographic data, perceptions regarding commercial bicycling, factors contributing to road traffic injuries involving commercial bicyclists and preferred road safety intervention.

The data were coded and analyzed using the SPSS statistical software. Statistical analysis was done using various tests like Chi square depending on the variables. The data were summarized using frequency table, contingency tables. Qualitative data were tape recorded, transcribed then content analysis done (coding and categorizing) manually to summarize the emerging themes and issues.

3 ETHICAL ISSUES

The purpose and methods involved in the study and its advantages were explained to the subjects/respondents in a language that they understood (English, Kiswahili, Luo). Their consent to participate was sought before administering the questionnaire. The respondents were assured of confidentiality, and that there were no risks or benefits to be derived by agreeing to participate in the study and that their participation was purely voluntary.

All the respondents were treated with respect. The respondents were allowed to withdraw from the study at their own pleasure if they were unable to continue because of some reasons. Confidentiality was ensured during and after the study, no identifying information was recorded, such as name or ID number. Ethical approval was sought from the Moi University Institutional Research Ethics Committee (IREC) prior to commencing the study.

4 RESULTS

Demographic Characteristic: The majority of the Commercial Bicyclists attained primary education (55.3%), 40.7% completed secondary level of education; only 4% had attained Post secondary level of education. Of those who had completed technical college 7 had done mechanics, carpentry (5). Of those who had University degree one did agricultural engineering, the other 2 did Bachelor of Science, Chemistry and Bachelor of Arts respectively. The ages of the respondents were grouped as 21-25 years which accounted for 51%, 26-30 years (21.3%), 31-35 years (6.5%), 15-20 years (17.7%) and 36-40 years (4.5%).Table 1

Table 1 Demographic characteristics of respondents

Age in years	No.	%
15-20	74	17.7
21-25	213	51.0
26-30	85	21.3
31-35	27	6.5
36 – 40	19	4.5
Educational level		
Primary	231	55.3
Secondary	170	40.7
Technical college	14	3.3
University	3	0.7
Total	418	100

Reasons for and not using bicycles for transport

Most people prefer using *boda boda* because they are flexible (39%) not time consuming (28.9%) and cheap (26.1%) a few said they are comfortable (6%). On the other hand, various reasons why people may not want to use bicycles for transport were mentioned. Nearly a third (31.6%) of the respondents said that bicyclists are not trained on traffic rules, 24.6% said the riders do not have skills to operate on the road, 21.1% considered them unsafe, while 22.7% perceive that bicycles are not design vehicle for ferrying passengers.(Table 2).

Risk assessment and Perception on Risk

Majority of the commercial bicyclists 89.8% cited that riding in a mixed traffic system is very dangerous, while only 10.2% said it is not dangerous. This is because they thought there is an increased risk of a crash (78.5%), other road users are bothersome to riders (13.3%) and all road users are allowed to use road.

Of those who reported that it is very dangerous to ride in a mixed system 70% said it is not safe to use road as it is (30.3%) compared to 83.3% who said it is very dangerous to ride in mixed system and do not think it is safe to use road as it is. According to χ^2 test, Cramers V test there was highly significant relationship between danger assessment and riding in a mixed system. χ^2= 14.308 P=0.000.(Table 3)

Human related factors that contribute to crashes among commercial bicyclists

Majority of the respondents (28.9%) cited inadequate signals that cannot be understood easily by other users as a major factor, riders losing control (19.1%), in- experienced riders in a mixed traffic system (18.5%), inadequate knowledge regarding road safety (12.7%), use of mobile phones while riding (11.0%), riding under the influence of alcohol (2.9%).

Time when they begin and stop working

Fifty one percent of the cyclists start work before 7am and 45% between 7 and 9am. Some 68% of the operators stop working between 5pm and 7pm while the remaining 24.1% stop after 7pm. 52% work for 10 hours, 32% work for 8 hours, 12% for 6 hours and for over 12 hours (4.%).

All of the respondents stated working for along time without rest contributes to crashes and injuries.

Drug abuse

Twenty six point six of commercial bicyclists consumed alcohol while 19.2% smoke bhang and 55.2% use both alcohol and bhang; they take to improve their strength (34.7%), to be courageous (58.2%), and feel good (6.7%). Most of them take drugs mainly in the course of the day as they work (54%), morning hours before work (26.8%) and very few take drugs in the evening after work 19.2%.Table 4

Of those who were involved in accident 58.3% take alcohol or bhang, while only 41.7% who had been involved in accident but neither use bhang or alcohol. Among the 208 respondents who drink alcohol or take bhang (53.3%) had been involved in an accident while riding a bicycle compared to 46.7 % non drug takers who had had an accident. Thirty one point one percent of the commercial bicyclists had neither been involved in accident nor take alcohol or bhang.

There was a significant relationship between the drug use and involvement of accident (χ^2 = 7.725; p= 0.005).

Factors influencing severity of injuries Involving commercial bicyclists

Analysis of the severity of injuries showed that lack of emergency preparedness including lack of first aid knowledge, equipment and materials (36.6%), and taking long time before those injured are taken to hospital and cared for (30.4%) were stated as major factors affecting severity of injuries, while other respondents stated kinetic energy of impact (20.6%) and crowding at the scene of injuries (12.4%).

Environmental factors contributing to crashes and injuries involving commercial bicyclists

The respondents were asked to state environmental factors contributing to crashes and subsequent injuries.

Of the respondents interviewed, 51.7% cited inadequate space for riding as the major factor, while other 32.5% mentioned poor road surface and 16.5% stated presence of roadside objects.

Other factors contributing to bicycle related road traffic crashes and injuries

This section includes responses which were placed as other factors because they could not fall into the above mentioned categories, nevertheless the quantity of responses were high enough to warrant inclusion.

Safety seems to be a major concern of the bicycle riders, when asked whether they had training in bicycling as business, only 3.6% said they had some training in bicycling as a business, but a large majority (96.7%) had not received any form of training in the bicycle riding as business.

In addition some 70.8% of the commercial bicyclists stated they were fearful, 22.5% felt courageous and only 6.7% felt safe while riding in a mixed traffic system.

Most of the respondents (97.9%) reported, particles enter their eyes as they ride, 55.6% of them stop to remove the particles then continue, 39.5% just rub their eyes and continue riding while 4.9% assume, only blink their eyes as they continue riding. On the other hand all respondents stated that there are obstructions on the road that always challenge their work. The object they stated include, handcarts (45.8%), stones (46.2%), sharp edge of the pavements (4.4%) and luggage to be transported or those that have been left offloaded (3.6%). All of the respondents said some loads they carry are sometimes very heavy. They quoted large and heavy passengers.

Safety equipment and materials

As summarized in Table 5, the respondents mentioned, bicycle helmets (34.9%), headlamps (30.6%), reflective clothing (17.2%), indicators (16.3%) and 1.9% gloves (1.9%) were necessary.

Other safety measures that would be adopted for and by commercial bicyclists

When asked about any other road safety measures that could be adopted for and by commercial bicyclists to prevent their exposure to road traffic crashes and injuries. They cited free training on road safety laws and regulation (36.4%); 28.9% suggested bicycle lanes. Others (16.8%) suggested strict adherence to rules and regulation by riders, while 15.6% mentioned keeping bicycle in good state by cyclists. The least of them stated promotion of bicyclists' right (2.4%) as a measure that should be adopted (Table 6)

Table 2 Reasons for and not using bicycles for transport

Why people use bicycles for transport		
	No.	%
Flexible	163	39.0
Comfortable	25	6.0
Not time consuming	121	28.9
Cheap	109	26.1
Why people may not want to use bicycle for transport.		
	No.	%
Unsafe	88	21.1
Unskilled riders	103	24.6
Bicycles are not vehicles	95	22.7
Riders need to be trained	132	31.6
Total	418	100

Table 3 Risk assessment and perception of risk

Risk assessment	No.	Percent
Very dangerous	376	89.8
Not dangerous	42	10.2
Reasons		
There is an increased risk of a crash	328	78.5
Other road uses are a bother	56	13.3
All are allowed to use road	34	8.2
Total	418	100.0

Table 4 Types of drugs taken

Type of drug	No.	%
Alcohol	76	26.6
Bhang	40	19.2
Both alcohol and bhang	112	55.2
Reasons for taking the drugs		
Strength	72	34.7
To be courageous	122	58.6
To feel good	14	6.7
When drugs are taken		
Morning hours before work	56	26.8
In the evening after work	40	19.2
During working hours	112	54
Total	208	100

Table 5 Safety equipment and materials

Equipment / Material	No.	%
Bicycle helmets	146	34.9
Gloves	8	1.9
Headlamp	124	30.6
Reflective clothing	12	2.2
Indicators	68	16.3
Side mirror	60	15.1
Total	**418**	**100**

Table 6 Other safety measures

Safety measure	No.	%
Training on road safety	143	36.4
Bicyclists own paths/lane constructed	121	28.8
Strict adherence to rules by bicyclists	71	16.8
Keeping bicycle in good state	64	15.6
Promotion of bicyclists right to use roads	10	2.4
Total	418	100

5 DISCUSSION

Road transportation plays an important part in a society for the movement of not only people but also of goods. The consequences of road crashes cannot be overemphasized as their related injuries results into significant morbidity, mortality and increased economic costs in terms of managing injuries and hospitalization.

The study found out that commercial bicycling sector is dominated by the male gender. There was no single female found working within the sites covered in this survey. Consequently the sample was composed entirely of men. This could be attributed to the nature of the work, partly due to the time and energy involved in riding the whole day on a daily basis.

The highest percentage of the respondent had primary education. As such this sector absorbs the unemployed school drop outs and thereby reducing the number of idlers and crime.

The survey found out that while the youngest worker was only sixteen years old, the eldest was 39 years. But in general the sector accommodates a comparatively young work force with majority (95.5%) being below 35 years of age. The key issue in the case of the worker under 18 years is how they could adapt work and working conditions to their capacity since they are known to be inexperienced and most of them do not know road traffic rules.

Most people preferred to use commercial bicyclist because they are flexible, not time consuming and cheap. They provide the most convenient mode of transport for the poor due its low fares for relatively short distances and transport from door to door. In addition they are reported to be fast and reliable as compared to 'matatu' which mostly have to wait for people to fill them to capacity at terminals before they can move. Although it is perceived that this mode of transport is cheaper compared to matatu, tricycle and motorcycle the latter could be cheaper over relatively long distances within the city, as they have fixed rate.

On the other hand, most of the people may not want to use bicycles as mode of transport because riders are not trained since many believe they don't have required skills to operate in road way system, others perceive bicycles are not design vehicles and therefore should not operate in roads, the more logical and ethical position is that bicycle should be design vehicles wherever they are permitted[11], although good highway design will accommodate bicyclists in many roads without special provisions, there are several key deficiencies in roadway design that reveal the lack of considerations of bicycle traffic,[13] while others thought it was unsafe. It is also perceived to be unsafe partly due to fear and the behaviour of bicyclists. According two bus park managers, People may not use bodaboda as means of transport because;

'There is lack of road safety or the fear of it due to mixing with motorists, the manner of bodaboda operation, behaviour of bicyclists, many are just thugs – but hiding in this operation. We therefore suggest, there should be proper law adherence, enforcement and training for us '

Although commercial bicyclists are always blamed for the traffic confusion and the consequences that usually befall them for their exposure to crashes and injuries in mixed traffic system, there should be a shift of focus to the government sectors because of their lack of commitment to design and effectively implement policy regarding commercial bicycling. As yet for over twenty years there is no established and functional policy on commercial bicycling. This is evidenced by lack of licensing mechanisms for commercial bicycles, lack of bicycle lanes to accommodate them, foot paths and uniforms.

Many governments including U.S. and Kenya treat bicyclist by law as drivers of vehicles and grant them right and responsibilities accordingly; however the public is not aware of this law.[14] Motorist often feel that bicyclist have no right to be on the road especially where bicyclist presence required the motorist to wait before overtaking. Some motorists tell bicyclist to get off the road. The frequency with which many bicyclists disobey traffic law contributes to public attitudes that bicyclists operate outside the law and therefore do not deserve the same treatment[13]

This study revealed that it is very dangerous to ride in a mixed system because there is increased risk of crashes or accident. It is significant to note also that more than three quarters of the bicyclists riding in, or near traffic reported feeling unsafe and fearful.

The majority of the commercial bicyclist (93.5%) stated there is no proper traffic law enforcement mechanism in Kisumu city and many of them (96%) do not have uniforms or reflective clothing.

Factors contributing to Bicycle related crashes and injuries

Most of those who took drugs didn't have work rest schedule, majority took combination of drugs including bhang, cigarettes and alcohol. The respondents who were drug users said that they use drugs for courage and strength, data from focus group discussion emphasized that they must consume drugs since, "we can't work empty headed that is, without drugs because if we don't take, one may not appear at the site for work the following day." There was significant relationship between drugs use and consequent occurrence of crashes and injuries.

The majority of the riders (79.1%), reported that the paths are not distinct and adequate and that this condition results into accidents. There was a highly significant relationship between the nature of the paths used and the occurrence of accident. The smaller and less distinct they are the higher the rate of accident. Most cyclists start work before 7am and few begin their work between 7 and 9am and stop working between 5pm and 7pm while very few stop after 7pm. Majority work

for 10 hours, others work for 8 hours, 6 hours over 12 hours. And all respondents reported that riding for long times due to fatigue contribute to crashes. The recommended duration for commercial bicyclists to take while riding has not been established and documented. Although the precise role of riding for long and crash occurrence has not been established its contribution cannot be underestimated.

The study identified that the signals (like waving hands) used are inadequate and these signals are misunderstood by other road users with consequent contribution to crash.

There was significant relationship between inadequate signals and misunderstanding within the road system and subsequent occurrence of crashes ($\chi 2 = 14.305$; $P=0.002$).

Particles enter the eyes of the riders. While majority stop to remove the particles, some just rub their eyes and continue and others assume, blink their eyes and continue riding. While the best response to adopt is not yet established, abrupt stops could also pose danger, rubbing the eyes and mere assumption and eye blinking could also be very tricky depending on the energy of impact of the particles on the eye and the size. Objects or obstructions on the road system like hand carts, stones and different types of items to be transported or those offloaded pose a lot of challenge to commercial bicyclists. All of the respondents said some loads they carry are sometimes very heavy. They quoted heavy women. It was stated that these could cause crashes.

The majority of the bicyclists (96.4%) had no formal training in road safety. At the moment there is no established training institution where commercial bicyclists can be trained on road traffic rules and regulation. The negligible proportion that had formal training were probably those who had trained as drivers but were not employed.

The major factors contributing to crashes and injuries are inadequate signals, over speeding in a mixed system, riders losing control, bicycle mechanical failure, others include, environmental hazards, riding at night without light and riding after rains.

The issue of concern is road traffic emergency preparedness this is because very negligible proportion of bicyclists prepared for emergency; they did not have first aid kit nor knowledge and skill concerning first aid. This means that most bicyclists cannot help themselves or others in the event of a crash, they have to wait for the police and this may worsen the outcome of the injuries sustained.

The study also found out that lack of emergency preparedness, and taking long time before those injured are taken to hospital are the major factors influencing severity of injuries involving commercial bicyclists. The pre hospital phase of trauma care encompassing rapid and safe transport to hospitals by use of ambulances coupled with immediate surgical treatment within the trauma system significantly reduces preventable deaths[22].

Inadequate space for riding was cited as major environmental factor resulting to crashes and subsequent injuries. Poor road surface like the case of Ondiek highway, Nairobi road, Kenyatta highway and presence of road side objects also were mentioned, example of such roads are Oloo Street and Shaurimoyo road. Other environmental solutions include separating bicyclist from traffic by use of designated lanes on streets, assuring bicycles and lacking in obstacles and discouraging "wrong way" riding on sidewalks and roads. The protective effect of sidewalks is unclear. A study suggested that riding on sidewalks may actually be more dangerous than riding on road, perhaps because rules are followed less often. [26]

Inadequate signals that could not be understood easily by other road users, inexperienced riders in a mixed system, riders losing control, inadequate knowledge regarding road safety laws and regulation, use of mobile phones accounted for more than three quarters (90.2%) of the human errors that contribute to crashes. Moreover the study revealed that human errors account for the most road crashes involving commercial bicyclists according to the data derived from the traffic police. This has a positive element to it, in that people's knowledge, attitude and behaviour can change and if this happens, there is potential to significantly reduce the number of crashes and hence death and injuries on roads.

Use Bicycle helmets, reflective clothing, and appropriate use of headlamp, are the main interventions that should be adopted, very negligible proportion stated gloves as interventions that could be adopted. Despite the least number of patient who needed gloves; cycling gloves can reduce superficial hand injuries for bicyclists, provide insulation in cold weather and prevent nerve compression. Helmets provide the best protection from head injury for bicyclist involved in road traffic crashes.[30] Non-use of helmets increases the risk of head injuries for riders by a factor of three and helmets reduce fatal and serious injuries by between 25% and 45%. Lack of helmet use was recognized by the world report on road traffic injury prevention in 2004 as one of the most important risk factor that contribute to road crashes and injury severity.[31] There is now good evidence that bicycle helmets are effective in reducing head injuries. Early population based research in the USA showed that bicycle helmets reduced the risk of severe head injuries by about 85% [32].

To promote the wearing of bicycle helmets many governments have introduced legislation making bicycle helmets mandatory. During 1990's, Australia, Canada, New Zealand and the United States brought in such laws. Since then, the Czech Republic, Finland, Iceland and Spain have followed suit [33].

In New Zealand, it has been estimated that there was a 19% reduction in head injuries among cyclists over the first three years following the introduction of bicycle helmet laws[34]. Those opposed to bicycle helmet legislation argue that wearing bicycle helmet encourages cyclist to take greater risks and therefore makes them more likely to incur injuries. To date, there is no evidence to support it[33]. Other opponents of bicycle helmet use have suggested that bicycle helmet legislation reduces the number of cyclists and it is for this reason that there are fewer head injuries. The most recent evidence though, suggests the contrary: the number of bicyclists in Canada actually increased in the three years following the introduction of bicycle helmet laws[34].

The majority of the bicyclists stated they needed free training on road safety laws and regulation. Bicycle education involves learning skills, knowledge and decision making ability in traffic, it assumes that individuals can make appropriate decisions in a variety of complex traffic situations. Unfortunately, many cyclists, motorists and governments do not place the same value on cyclists training as on drivers' education, even though they share the same roads[35]. By teaching the commercial bicyclists the necessary skills and knowledge to cycle safely, bicycle safety education can be useful means of preventing injuries and deaths. Bicycle lanes were suggested that they should be constructed for commercial bicyclists. The separation of different road users is key step for improving safety. Crashes will reduce if pedestrians and cyclists are kept off motorways; bicycle lanes and sidewalks are provided[35]. Road crashes involving bicyclists tend not to be evenly distributed throughout the network. They occur in clusters at single sites, along particular sections of road or scattered across whole residential neighbourhood, especially in areas of social deprivation[36]. While road engineering can greatly help in reducing the frequency and severity of road traffic crashes, poor engineering can contribute to crashes. The road network has an effect on crash risk because it determines how road users perceive their environment and provides instructions for road users through signs and traffic controls on what they should be doing. Many traffic management and road safety engineering measures work through their influence on human behaviour[37]. Although good highway design will accommodate bicyclists in many roads without any special provisions, there are several key deficiencies in roadway design that reveal the lack of considerations of bicycle traffic [37].

6 CONCLUSION

Commercial bicyclists are men aged below 40years; they are highly exposed to crashes and injuries due to their interaction in the traffic system, since bicyclists riding in, traffic mix feel unsafe and fearful. It is very dangerous to ride in a mixed system because there is increased risk of crashes or accident,

The massive influx of the commercial bicycles into the city has led to major conflicts within the existing transportation channels. Hence a major challenge to both city authority and the traffic today is how to tackle the large number of accidents involving cyclists and their passengers. The initial plans for the roads in the city had no provision for commercial bicycling as demonstrated by the narrow paths, congestions and lack of training for commercial bicyclists.

The commercial bicycle are preferred to other mode of transport in Kisumu city because they are perceived to be flexible as they help in door to door transport, not time consuming and relatively cheap for short distance. However other people do not use them because bicyclists are not trained on road safety and therefore they do not have skills to operate in the road system and there is un-safety caused by their presence roads.

There are poor traffic law enforcement mechanisms in Kisumu city and bicyclists do not have uniforms or reflective clothing. Human errors like misunderstanding the road signals, riders losing control, riding too fast, and drug use are the factors that contribute to crashes involving commercial bicyclists in Kisumu city. .

Human errors such as drink driving and riding, speeding, fatigue, inadequate signals use and environmental factors should remain the focus of targeted road safety intervention. This is because it has a positive element as peoples' knowledge, attitude and behaviours can change and this can significantly reduce the number of crashes through advocacy, dialogue and effective implementation.

There is need to integrate this economic activity into transport system while minimizing users conflicts and ensuring safety by providing enough space on roads and construction of bicycle lanes and ensuring that the bicyclists have the protective equipments and materials like helmets, reflective clothing and headlamps.

Information is an important resource, which commercial bicyclists lacked; generally the riders do not have adequate information regarding road safety laws and regulations. This could be attributed to lack of training programmes for the

commercial bicyclists. There is great need to identify and establish effective and mandatory training programmes for commercial bicyclists.

There is need for a more objective estimation of the contribution of various risk factors, people's perceptions and other aspects of the problem. The findings will help in stimulating interest among researchers, various government agencies and the public in this major health problem. It is hoped that specific policies and strategies for injuries prevention in this country, Kenya will be developed.

ACKNOWLEDGEMENT

We would like to acknowledge the City Mayor, Kisumu District Commissioner, City Engineer, The Bus park Manager and all the Commercial Bicyclists who participated in the study.

CONFLICT OF INTEREST

The authors declare that that was no competing interests.

REFERENCES

[1] Ameratunga S HM, Norton R (2006). Road traffic injuries: confronting disparities to address a global health problem. Lancet 367:1533–40.
[2] Peden MK, Krug E, (2000). Injury: a leading cause of the global burden of disease. Geneva: WHO; 2002. The injury chart book.
[3] WHO (2013). (World Health Organization), Global Status Report on Road Safety 2013.Geneva, World Health Organization.
[4] World Health Organization. *Global Burden of Disease: 2004 Update* Geneva, Switzerland: World Health Organization; 2008.
[5] Cholo Wilberforce, Wilson Odero, and Diana Menya, "Commercial Bicyclist Injuries in Kisumu City, Kenya: an Epidemiology of a Neglected Problem," *International Journal of Innovation and Scientific Research*, vol. 14, no. 2, pp. 228–235, April 2015.
[6] Pucher, J., & Buehler, R. (2006). Why Canadians cycle more than Americans: A comparative analysis of bicycling trends and policies. *Transport Policy, 13*(3), 265-279. doi: DOI 10.1016/j.tranpol.2005.11.001
[7] Baker, S. P., Oneill, B., Haddon, W., & Long, W. B. (1974). Injury Severity Score -Method for Describing Patients with Multiple Injuries and Evaluating Emergency Care. *Journal of Trauma-Injury Infection and Critical Care, 14*(3), 187-196.
[8] Brass P. Injury prevention and international perspective, New York, Oxford University Press, pp 274-276, 1998
[9] Ryan GA, Ukai T. Prevention and control of road traffic accidents, Peoples Republic of China (assignment report) Manila,World Health Organization. Pp.24-27, 2007
[10] Watchtel T., Forester S., and Pelz J. Signal clearance timing for bicyclist *American Medical Journal.* March pp. 38-45, 1995
[11] Clarke Andy and Linda Tracy. Bicycle safety Research synthesis. Federal administration U.S. Department of Transportation, 1995:2-4
[12] Hunter T, William K, and Jane W. Pedestrians and bicycle crash types of the early 1990's U.S Department of Transportation, 1996:95-163.
[13] Whitelegg J. A comparative study of road traffic accident and injuries. *British Medical Journal* 1998, 46:16-18
[14] Tingvall C. Van Holst H. Nygren Thord, eds The Zero Vision. *Transportation Traffic Safety theNew Mobility*. 1995:35-37.
[15] Acton CH, Thomas S, Nixon JW, Clark R, Pitt WR, Battistutta D. Children and bicycles: what is really happening? Studies of fatal and non-fatal bicycle injury.*Inj Prev*. 1995;1:86–91.
[16] Winston FK, Shaw KN, Kreshak AA, Schwarz DF, Gallagher PR, Cnaan A. Hidden spears: handlebars as injury hazards to children. *Pediatrics*. 1998;102:596–601.
[17] 20. Segers MJ, Wink D, Clevers GJ. Bicycle-spoke injuries: a prospective study. *Injury*. 1997;28:267–9.
[18] Hamm, Robert A. and Donald L. Woods (1992), Loop Detectors; results of controlled field studies. ITE journal. November pp. 12-16 1992.
[19] World health Organization. A report on road traffic injuries. World Heath Report 2004 1-31.
[20] Savill, Bicycle related Injuries. Harborview Injury Prevention and Research Center 1996)
[21] Sarima S.M et al Road accidents in India and other South East Asians Countries, *Journal of Traffic Medicin*e 2000, 54:269-274

[22] Leblac J.C, Bealtie T.L Cuhigan C. Effect of legislation on the use of bicycle helmets *Canadian Medical Association Journal* 2002, 166: 1592-1595
[23] Coffman S. Bicycle injuries and safety helmets in children, review of research, Orthopaedic Nursing 2003, 22:9-15
[24] Ross A. et al eds. towards safer roads in developing countries. A guide for planners and engineers, Crowthorne Transport research laboratory, 1991:68-69.
[25] Aeron et al. A review of road safety management and practice. Final report, crowthorne transport laboratory, 00 216, 2002.
[26] Johnston I. Traffic safety education Panacea, Prophylactic and placebo, *World journal of surgery*. 1992, 16:374-376.
[27] O. Neill B. et al. Road traffic injuries. The world banks global road safety and partnership 2002, 16:374-376.
[28] Salai M. Brosh, T. Blankstein A. Oran. Clechik A. effect of changing the saddle angle on the incidence of low back pain in recreational bicyclists. *British Medical Journal sports* 1999, 33: 398-400.
[29] Burke ER. Proper fit of the bicycle. British sports and Transportation Journal, 1994; 13:1-4
[30] Thomson RS, Rivara FP. DC. A case control study of the effectiveness of bicycle safety helmets. New England Journal of medicine. 1989, 320:1361-1367.
[31] Michael M. Oregon. Bicycle and pedestrians program. *American Medical Journal*, pp. 6-7, July 1996 (http://www.etsc.be/eve.htm).
[32] Scuffham P. et al head injuries to bicyclists and the New Zealand bicycle helmet law. *Accident Analysis and Preventions*, 2000, 32: 265-573
[33] Odero W., Khayesi M., Heda PM. Road Traffic Injuries in Kenya. Magnitude, Cause and Status of intervention*, Injury control and safety promotion*, 2003 10:53-61
[34] Sachs JJ., Holmgreen P. Smith SM. Bicycle associated head injuries and deaths in the United States from 1984-1988. How many are preventable? America Medical Journal 1991; 266:3016-3018
[35] Mac Pherson A.K, Macarthur C. Bicycle helmet legislation evidence of effectiveness of pediatric research. 2002, 52: 472.Roberts J. Power C. Does the decline in child death rates vary by class? *British Medical Journal* 1996, 313: 784-786
[36] Ogden KW. Safer roads, a guide to road safety engineering Melbourne Ashgate publishing ltd, pp. 23-45, 1996.
[37] American Association of State and Highway Transportation Officials (AASHTO). A *policy on Geometric Design of Highway and streets,* 1995*:*104-108

International Journal of Innovation and Scientific Research
ISSN 2351-8014 Vol. 17 No. 2 Aug. 2015, pp. 403-411
© 2015 Innovative Space of Scientific Research Journals
http://www.ijisr.issr-journals.org/

Systematic Descriptions and Taxonomic studies on Three (3) Species of *Plumeria* in North Central Nigeria

C.U. Aguoru, O.P. Abah, and J.O. Olasan

Department of Biological Sciences, University of Agriculture, Makurdi, Nigeria

Copyright © 2015 ISSR Journals. This is an open access article distributed under the ***Creative Commons Attribution License***, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT: Comparative macro and micromorphology of the leaf and floral features of three species of *Plumeria* was carried out. The aim was to establish the degree of relatedness or separation of the species through the use of macro-morphology, epidermal and floral features as systematic and taxonomic evidences on three species. All the species possessed unvaried anomocytic stomata type on the abaxial surfaces only. Leaf epidermal cells were irregular in shape with the exception of *Plumeria rubra* which possessed pentagonal and hexagonal epidermal cell shapes. Stomata index varied from species to species on the abaxial surfaces and could be applied in their delineation. The index for *Plumeria rubra*, *Plumeria obtusa* and *Plumeria lute* were 62.34%, 63.31% and 49.57% respectively. Macroscopically, the leaves of all the species were simple and lanceolate, except for *P. obtusa* that is elliptic. The apices of *P. rubra* and *P.lutea* are acuminate while that of *P. obtusa* is acute, the leaf margin of *P. rubra* is undulate while those of *P. obtusa* and *P. lutea* are entire. However, flower type, symmetry, inflorescence, arrangement, calyx colour, corolla shapes, floral formula and floral diagram were unvaried and affirm relatedness and placement in same genus. Variations were however observed in the colour of petals. *P. rubra* is red with yellow centre, while the colour of *P. obtusa* is white with yellow centre. *P. lutea* is yellow fading to white at the tip. The similarities and overlaps observed in the leaf and floral morphology, cell shape, stomata type and stomata index of the species have provided evidence for their genetic and evolutionary relationship and justification for their common grouping at the generic and specific taxa circumscription. These are reported for the first and maiden in its application in three species of *Plumeria*.

KEYWORDS: Micromorphology, *Plumeria*, Stomatal index, Epidermal cells, Taxonomy, Systematics.

1 INTRODUCTION

Genus *Plumeria* belongs to the Apocynaceae family and it is native to the new world. The plants from this genus are widely cultivated in the tropical and subtropical regions throughout the world. *Plumeria* L. is indigenous to tropical America and is found from Southern Mexico to Northern South America and also most abundant in India. The plants are famous for their attractiveness and fragrant flowers. The essential oils from the flowers are used for perfumery (Shaida *et al.,* 2008).

According to Tung *et al*. (1999) and Scot (2009), *Plumeria* species grow as small ornamental trees in parks, residential and commercial landscapes. *Plumeria* cultivars also adorn roadways and public lands. The decoction of the bark and roots of *P. rubra* is traditionally used to treat asthma, constipation, promote menstruation and reduce fever. The latex is used to soothe irritation (Wiart, 2002). The fruit is reported to be eaten in West Indies. In India, however, it has been used as an abortifacient (Bobbarala *et al*., 2009). The flowers are aromatic and widely used in pectoral syrups. The flowers decoction of *P. rubra* was reported to use in Mexico for control of diabetes mellitus. The leaves of are used in ulcers, leprosy, inflammations and rubifecient (Kardono *et al.,* 1990). The decoction of the bark of *Plumeria obtusa* is given in varying doses as a purgative or as a remedy against oedemas (Shinde *et al.,* 2014).

Plumeria is generally a small tree growing to about 30 ft high. Its broad, usually round-headed canopy is often about as wide as the tree is tall. The species and hybrids vary somewhat in tree size, compactness, and branching character, leaf and flower size and colour, and deciduousness. The leaves are usually glossy green but may be dull green; they are generally

Corresponding Author: C.U. Aguoru

ovate, may be blunt-tipped (*P. obtusa*) or pointed (*P. rubra var. acuminata or var. acutifolia*), and range from 2 to 4 inches wide and 8 to 12 inches long. In deciduous types, the leaves fall during wintertime, and new leaves emerge during or following the spring flowering period. *P. obtusa* and its hybrids tend to retain their foliage year-round. The flowers are tubular, expanding into a "pinwheel" of five petals that averages 2– 3 inches diameter and may be white, red, yellow, pink, or multiple colours. Flowers of most cultivars are highly fragrant and bloom from March to October. The hybrids differ in their profusion of blooms, with some producing more than 200 flowers per cluster and others only 50–60 flowers. *Plumerias* only occasionally produce seed. When pollinated, the flower produces two hard, narrow, pointed pods up to 7 inches long containing 20–60 winged seeds. Maturation of the seed pods is usually in early spring from a previous season's pollination (Richard, 1998).

Many studies have been carried out on *Plumeria* species but did not include the leaf and petal epidermal studies. In the findings of Kalam *et al.* (2013) the dried flowers of *Plumeria rubra* f. *rubra* and *Plumeria rubra* f. *lutea* were subjected to successive solvent extraction by soxhlation using n-hexane, chloroform, ethyl acetate and methanol. The extracts were subjected to preliminary phytochemical screening using standard procedures and the data obtained from the flowers of both the species was comparatively evaluated. As essential as genus *Plumeria* is, members of its species must be easily recognized without any difficulty, especially for ornamental or medicinal purposes. Members of this genus are usually identified or recognized with their flowers which are seasonal in appearance. There is therefore, the need for the use of other characteristics which are available all year round, that is, the leaves. Based on the ethno botanical uses of the species, detailed micro and macro morphological studies were carried out. The aim was to establish the phylogenetic relationship among the species (*Plumera rubra, Pluneria obtusa,* and *Plumeria lutea)* on the basis of leaf and floral similarities and differences.

2 MATERIALS AND METHOD

Fresh matured leaves and flowers of three species of *Plumeria* were collected from different parts of North Central zone of Nigeria and identified by plant taxonomists in the Botany Unit of the Federal University of Agriculture, Makurdi, Benue State. Each species was phenotypically observed, measured and compared accordingly. Microscopic preparations of the leaf and petal were made to elucidate the epidermal features following standard methods. All preparations were viewed using appropriate objective lenses of the Olympus Microscope. Ten slides were prepared from the leaf and petal of each species. From each slide, ten fields of views were recorded with respect to the stomata type, number of stomata, and number of epidermal cells, shape of epidermal cells and presence or absence of trichome. Mean values of numeric were computed. Description of stomatal complex type was done in accordance with Dilcher (1974). Photomicrographs were taken using an installed digital camera on the microscope. Stomata indices were calculated in percentages using the formula:

$$SI = S/(S + E) \times 100$$

SI = stomata index

S = number of stomata per square millimetre

E = number of epidermal cells per square millimeter

3 RESULTS AND DISCUSSION

The leaves of the species studied were hypostomatic, that is, stomata were present on the abaxial surface but absent on the adaxial surface. The stomata type present was homogenously anomocytic (stomata with five or more subsidiary cells surrounding the guard cells that are not distinguishable from other epidermal cells) (table 1; plate 1, 3, 5). Trichome was absent.

This observation agrees with the work of Chandra *et al.* (1969) who observed similar features in the leaf epidermal studies of *Plumeria rubra, Holarrhena pubescens, Plumeria alba, Wrightia tinctoria,* and *Wrightia tomentora.* The epidermal cells on all the abaxial and adaxial surfaces were irregular in all the species except in *P. rubra* which possessed pentagonal epidermal cell shape on its abaxial surface and hexagonal epidermal cell shape on the adaxial surface (plate 2). The variation recorded in the epidermal cell aligns with the report of Ghazalah *et al.* (2010) who studied the epidermal cells of 15 species of *Persicaria* Mill. and observed variation among them.

Stomata index varied from species to species on the abaxial surface. The highest stomata index was found on the surface of *P. obtusa* with an index of 63.31% and lowest on the abaxial surface of *P. lutea* with an index of 49.57% (table 1). This

shows that stomata occupied larger proportion of leaf surface in *P. obtusa* and smaller proportion in *P. lutea.* The stomatal index, which indicates the proportion of stomata relative to leaf surface, is also a reliable taxonomic character. This is because it is independent of the changes in epidermal cell size brought about by environmental factors (Metcalfe and Chalk, 1988). Similar approach was used by Aguoru and Okoli (2012) to distinguish West Africa species of *Momordica* L using stem and petiole anatomical evidence.

The anatomical features especially the plant epidermis is mildly influenced by environmental conditions and is of high structural diversity. This character represented genetic variations and have been used to solve taxonomic problems in certain other plant groups by taxonomists (Oladele, 1983; Ogunkunle, 2013; Abdulrahaman *et al.,* 2009). Their proven genetic stability and high structural diversity have been the bases for their use in identification of many groups (Ogunkunle and Oladele, 2000; Abubakar and Yanusa, 1998).

The three species therefore shared common attributes as revealed in the leaf and floral morphology. Similarity is particularly pronounced in their simple leaf type, pinnately netted venation type, alternate leaf arrangement, cuneate leaf bases, green leaf colours**.** Similar floral attributes include; bisexuality, cymose flower type, zygomorphic symmetry, green calyx colour, elliptic corolla shapes, floral formula and floral diagram (fig 6). The petals had no stomata on both the abaxial and adaxial surfaces but it was characterized by irregular epidermal cells However, the differences observed cannot be overlooked. Leaf shapes of *P. rubra* and *P. lutea* were lanceolate while that of *P. obtusa* was elliptic. The leaf apex of *P. rubra* and *P. lutea* were acuminate while that of *P. obtusa* was acute. The leaf margin of *P.rubra* is undulate while those of *P. obtusa* and *P. lutea* were entire (fig 2, 3, 4). The corolla of *P. rubra* was red with yellow centre but that of *P. obtusa* was white with yellow centre . *P. lutea* had yellow corolla fading to white at the tip as (table 2; fig 2, 3, 4).

In conclusion, based on these findings, species of the genus *Plumeria* can readily be distinguished from one another as certain features are considered diagnostic. The overlapping similarities as well as distinguishing characteristics observed among the species have provided evidences for their evolutionary relationship. This work has also provided a justification for their common grouping as well as their divergence at the generic and specific circumscription. The combination of microscopic and macroscopic evidences to establish the phylogenetic relationships among the three species of *Plumeria* has yielded a good result. This may further be enhanced by other approaches such as chemosystematics and molecular characterization.

Table1: Leaf epidermal features

Species	Leaf surface	Shape of epidermal cells	Stomata type	Stomata index (%)	Trichomes	Leaf length (cm)	Leaf breadth (cm)
P. rubra	Abaxial Adaxial	Pentagonal Hexagonal	Anomocytic Anomocytic	62.34	Absent	40.0	11.8
P. obtusa	Abaxial Adaxial	Irregular Irregular	Anomocytic Anomocytic	63.31	Absent	25.2	10.3
P. lutea	Abaxial Adaxial	Irregular Irregular	Anomocytic Anomocytic	49.57	Absent	37.0	12.1

Table 2: Floral features

Characters	*P.rubra*	*P.obtusa*	*P.lutea*
Inflorescence	Compound cyme	Compound cyme	Compound cyme
Floral symmetry	Zygomorphic	Zygomorphic	Zygomorphic
Calyx colour	Green	Green	Green
Corolla colour	Red with small yellow centre	White with small yellow centre	Yellow fading to white at the margin
Corolla free/fused	Fused	Fused	Fused
Nature of sepal	Synsepalous	Synsepalous	Synsepalous
Nature of ovary	2 fused capels to form 1	2 fused capels to form 1	2 fused capels to form 1
Ovary type	Superior	Superior	Superior
Nature of stamen	Epipetalous	Epipetalous	Epipetalous
Sex	Bisexual	Bisexual	Bisexual
Number of sepals	5	5	5
Number of petals	5	5	5
Number of anther	5	5	5
Petal length (cm)	4.5	4.2	6.4
Petal breadth (cm)	2.2	2.1	2.7

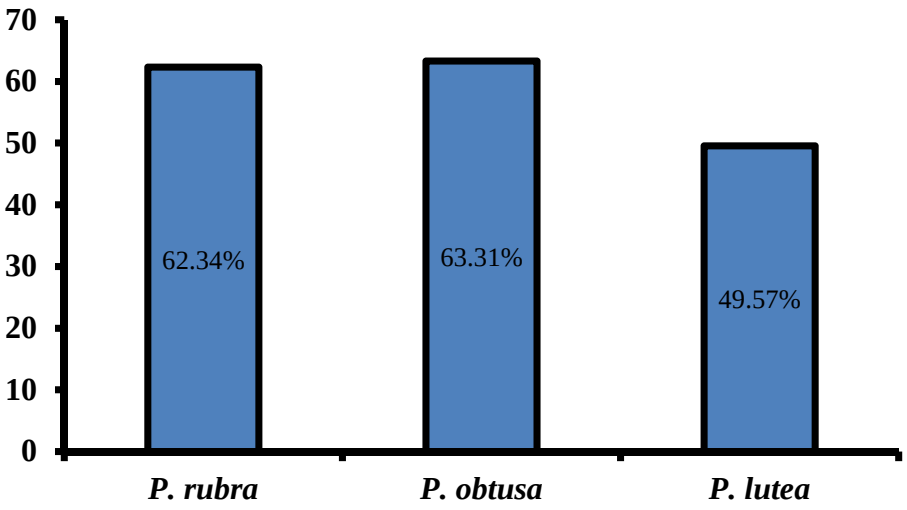


Figure 1: Stomata indices of three species of Plumeria

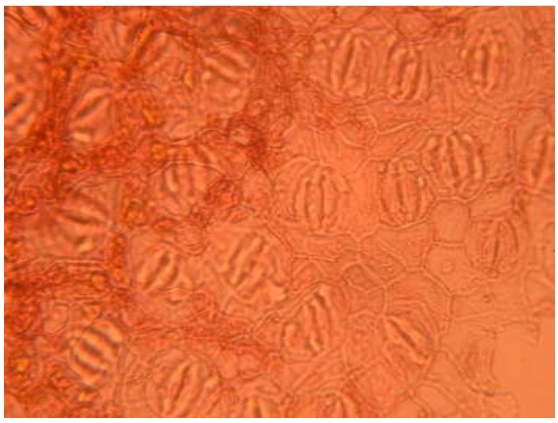


Plate 1

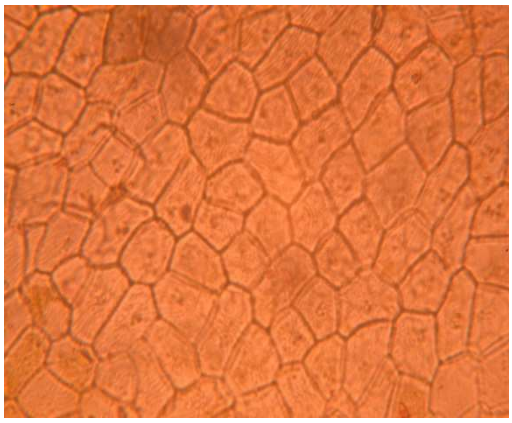


Plate 2

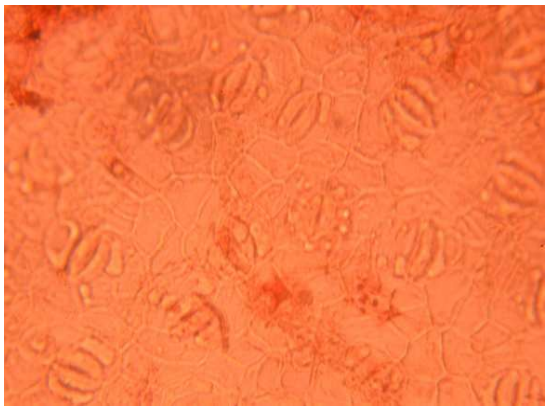


Plate 3

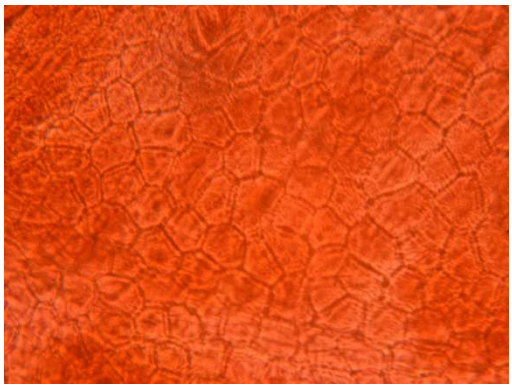


Plate 4

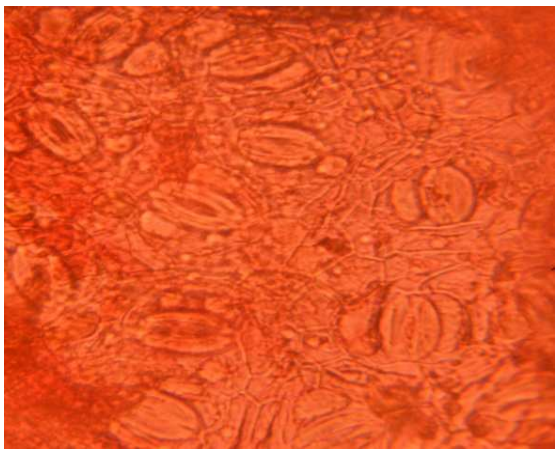


Plate 5

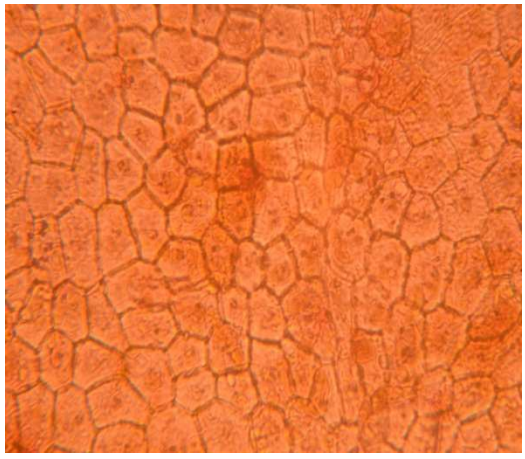


Plate 6

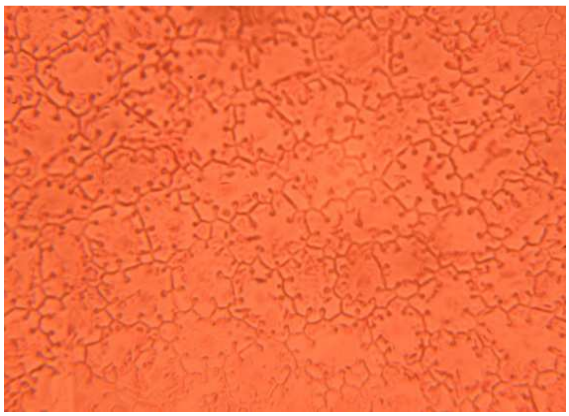


Plate 7

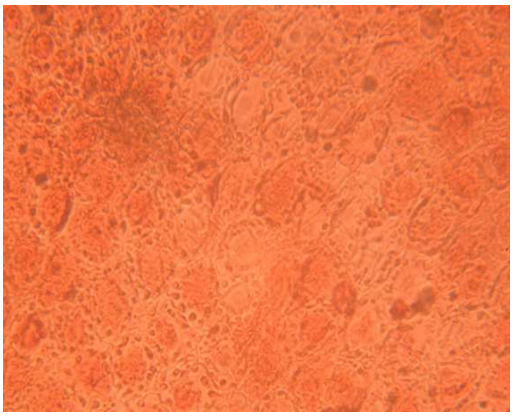


Plate 8

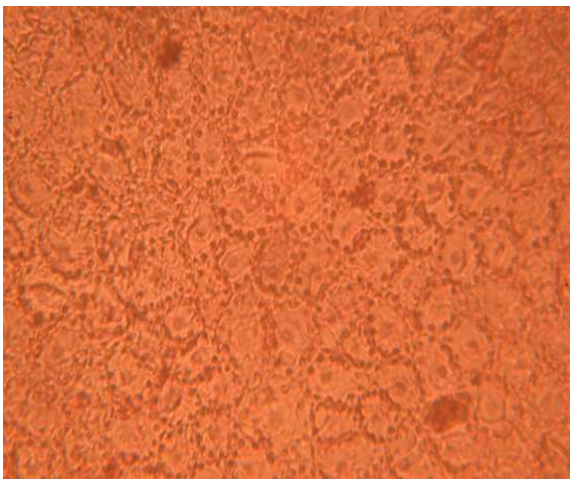


Plate 9

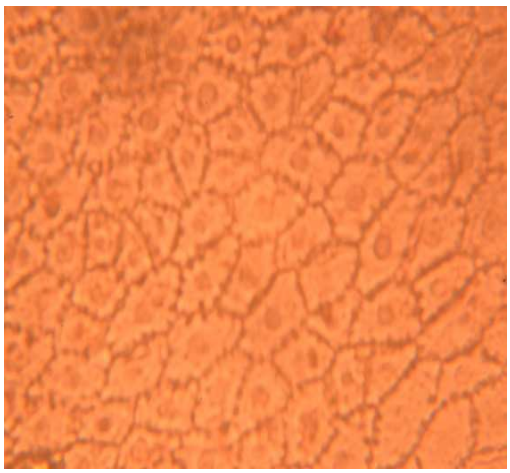


Plate 10

LEGEND:

Plate 1: *Plumeria rubra* leaf abaxial surface showing anomocytic stomata type and pentagonal epidermal cells
Plate 2: *Plumeria rubra* leaf adaxial surface showing hexagonal epidermal cells without stomata.
Plate 3: *Plumeria obtusa* leaf abaxial surface showing anomocytic stomata type and irregular epidermal cells
Plate 4: *Plumeria obtusa* leaf adaxial surface showing irregular epidermal cells without stomata
Plate 5: *Plumeria lutea* leaf abaxial surface showing anomocytic stomata type and irregular epidermal cells
Plate 6: *Plumeria lutea* leaf adaxial surface showing irregular epidermal cells without stomata
Plate 7: *Plumeria rubra* petal abaxial surface showing irregular epidermal cells without stomata
Plate 8: *Plumeria rubra* petal adaxial surface showing irregular epidermal cells without stomata
Plate 9: *Plumeria obtusa* petal abaxial surface showing irregular epidermal cells without stomata
Plate 10: *Plumeria lutea* petal abaxial surface showing irregular epidermal cells without stomata.

Fig2:P. rubra (red petal)

Fig3: P. obtusa (white petal)

Fig4: lutea (yellow petal)

$$+ \; ♀ \; K_{(5)} \; \overline{C_{(5)} A_5} \; \underline{G_{(2)}}$$

Fig.5: Floral formula of Plumeria species

LEGEND:

+= Zygomorphic symmetry; K=Calyx; C=Corolla; A=Androecium; G=Gymnoecium with superior ovary.

Fig 6: Floral diagram of Plumeria species

REFERENCES

[1] Abdulrahaman, A.A, Egbedo, F.O, and Oladele, F.A. (2009). Stomatal Complex Types, Stomatal Density, and the Stomatal Index in Some Species of *Dioscorea*. *Niger. J. Bot.* 61(4): 847-850.

[2] Abubakar, B.Y. and Yanusa, (1998). Epidermal structure and stomatal ontogeny of some species of Acacia (*Leguminoceae Mimosoidieae*). *Nigeria*. *J. Bot*., 11: 117-123.

[3] Aguoru, C.U. and Okoli, B.E. (2012). Comparative stem and petiole anatomy of West African species of Momordica L (Cucurbitaceae). African Journal of Plant Science, 6(15):403-409. DOI:10.5897/AJPS11.309

[4] Andrew, K.K., Gitta, H. and Drew, M., (2013). *Plumeria*, Propagation from Cutting. Environmental Horticulture Department. ENH1228: 1-2

[5] Anjum, P., Rubina, A. and Rabab, F., (2007). Stomata types of some Dicots within flora of Karachi, Pakistan, Department of Botany, University of Karachi, Pakistan. Pg (1017).

[6] Ashraf, M.D., Farooque M. A., Shambhawee, S. and Mazumder, R., (2012). Review on Plumeria acuminata, *International Journal of Research in Pharmacy and Chemistry,* 2:2.

[7] Bobbarala, V., Katikala, P.K., Naidu, K.C, Penumajji, S., (2009). Antifungal activity of selected plant extracts against phytopathogenic fungi *Aspergillus niger* F2723. *Indian Journal of Science and Technology,* 2(4): 87–90.

[8] Könemann, (2004). The Illustrated AZ of over 10000 garden plants and how to cultivate them. *Botanica*, p 691.

[9] Bunch, A., (2010). The Exotic *Plumeria*, The World's Number One Plumeria Catalog, P 1

[10] Carol, C. B., (2006). *Plumeria rubra f. lutea*. American Native Plants, p 1

[11] Chandra, V., Kapoor, S.L., Sharma, P.C. and Kapoor, L.D., (1969). Epidermal and venation studies in Apocynaceae-1. *Bull. Bot. Sur. India,* 11:286-287.

[12] Dilcher, D.L., (1974). Approaches to the Identification of Angiosperm Leaf Remains. Bot. rev. 40 (1): 1-157.

[13] Dutta, A.C., (2010). Botany for Degree Student: 6th ed. Oxford University Press. Pg. 25-45, 55-56, 169.

[14] Ghazalah Y., Mir, A. K., Nighat, S. and Muhammad, Q. H., (2010). Taxonomic Significance of Leaf epidermal Anatomy of Selected *Persicaria* Mill. Species of family Polygonaceae from Pakistan. *African Journal of Biotechnology*, 9(25): 3759-3768.

[15] Kalam, S., Yegnambhatla, R., Periyasamy, G., Meesa, M., Guggulothu, H. and Yegnambhatla, A., (2013). Comparative Phytochemical and Pharmacological Evaluation of flowers of *Plumeria rubra* L. f. *rubra* and *Plumeria rubra* f. *lutea. British Biomedical Bulleti,* pg. 1

[16] Kapoor, S.L., Sharma, P.C., Chandra, V. and Kapoor, L.D., (1969). Epidermal and venation studies in Apocynaceae-II. Bull. *Bot. Surv. India,* 11 (3 and 4): 372-376.

[17] Kardono, L.B., Tsauri, S., Padmawinata, K., Pezzuto, J.M. and Kinghorn, A.D., (1990). Cytoxic constituents of the bark of *Plumeria rubra* collected in Indonesia. *Journal of Natural Product.* 53: 1447-1455.

[18] Kumar, A., Chanda, I. and Singh, A.K., (2009). Extraction and evaluation of pharmacological activity of Saponin extract of *plumeria rubra* leaves. *Pharmacologyonline,*Dept of Pharm. Sci., S.B.S. (PG) IBSR, Dehradun, Uttarakhand, India. 1: 969-974.

[19] Lawren, S. and Christine, S., (2013). Leaf Venation, structure, function, development, evolution, ecology and applications in the past, present, and future. Department of Ecology and Evolution, University of California Los Angeles, Pg (993-1000).

[20] Madhavan, V., Mohamed, S.U., Gurudeva, M.R. and Yoganarasimhan, S.N., (2010). *Indian Journal of Natural Products and Resources*, 1(1):38-43.

[21] Mery, D., Inna, G., Naama, M., Mariana, O.V., Moshe, S., Eran, P., Dani, Z., Efraim, L., Zach, A., David, W., Alexander, V., (2005). Flower Proteome: Changes in protein spectrum during the advanced stages of rose petal development. Faculty of Agriculture, Food and Environmental Quality Sciences, Hebrew University of Jerusalem, Israel, pg 37-45.

[22] Metcalfe, C.R. and Chalk, L., (1988). Anatomy of the Dicotyledons, 2nd ed. Clarendon Press, Oxford, 1:100-106.

[23] Ogunkunle, A.T.J. and Oladele, F.A., (2000). Diagnostic Value of Trichomes in Some Nigeria Species of *Ocimum* L., *Hyptis jacg*, and *Tinnea kotschy* and *Peyr*. (Lamiaceae). *J. Applied Sci.,* 3: 1163-1180.

[24] Ogunkunle, A.T.J., (2013). The Value of Leaf Epidermal Characters in Diagnosing Some Nigeria Species of *Ficus* L. (Moraceae). *Research Journal of Botany,* 8: 1-14.

[25] Oladele, F.A., (1983). Patterns of Cuticular Sculpture in the Hybrid *Cypressosyparis leylandii* (Jackson and Dallimore) Dallimore and its Putative Parents. *New Phytol.,* 94: 293-295.

[26] Ozoker, E. and Misirh, A., (2011). Research on leaf properties and stomata distribution of some *Pistacia spp*; Department of Horticulture, Faculty of Agriculture Ege University, Turkey, pg 1.

[27] Peter, D., Jon, A., Christer, B., Piritta, H. and Katri, K., (2008). Leaf Trichome formation and plant resistance to herbivory; marine science Institute, University of California Barbara. Pg 89.

[28] Richard, A. (1998). Ornamental flowers: Plumeria. Cooperative Extension Service, C/T/A/H/R. Department of Horticulture, College of Tropical Agriculture & Human Resources. OF-24:1-2.
[29] Richard, A.C., (2005). Ornamentals and flowers: Plumeria. Cooperative Extension Service, C/T/A/H/R. Department of Horticulture, College of Tropical Agriculture & Human Resources, University of Hawai'i at Manoa. OF-32:1-29.
[30] Scot, N., (2009). Plant disease, Department of Plant and Environment Protection Science. College of Tropical Agriculture and Human Resources University of Hwai'I at Manoa. Pg.1.
[31] Shaida, F., Salmy, S., Tan, L., Tengku, S. and Tengku, M., (2008). Chemical components of the essential oils from three species of malaysian *Plumeria*. and their effects on the growth of selected microorganisms. *Journal of Bioscience*, 19(2): 1–7.
[32] Sharma, G.K., (1972). Environmental modifications of leaf epidermis and morphological features in *Verbena canasensis. The South-Western Naturalist*, 17(3):221-228.
[33] Shinde, P.R., Patil, P.S. and Bairagi, V.A.,(2014). Phytopharmacological Review of *Plumeria species, Scholars Academic Journal of Pharmacy*, Department of Pharmacognosy, K.B.H.S.S. Trust's Institute of Pharmacy, Malegaon, Dist: Nasik-423105. Maharashtra, India. 3(2): 217-222
[34] The Southern Califonia Plumeria Society (2011). Caring for Your New Plumeria. Rev. 2, pg 1.
[35] Tung, A.V., (1999). Pepohon Pinggir Jalan Daun Lebar. Amiza Publishing, Selangor: pg 6–11.
[36] Wiart, C. (2002). Medicinal Plants of Southeast Asia. Kuala Lumpur, Pearson Malaysia, pg 6-10.

International Journal of Innovation and Scientific Research
ISSN 2351-8014 Vol. 17 No. 2 Aug. 2015, pp. 412-422
© 2015 Innovative Space of Scientific Research Journals
http://www.ijisr.issr-journals.org/

Determination of Some Essential and Toxic Metals in Low Grade Coal and drinking water in Chilga, Amhara region, Ethiopia

Tsegu Lijalem, Arul Jeevan, Tariku Bekele, and Abrha Berhe

Department of Chemistry, College of Natural and Computational Sciences, University of Gondar, P.O. Box 196, Gondar, Ethiopia

Copyright © 2015 ISSR Journals. This is an open access article distributed under the ***Creative Commons Attribution License***, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT: The levels of selected essential (Ca, Fe, Zn, Mn, Cr and Cu) and potentially toxic (Cd and Pb) metals were analyzed using flame atomic absorption spectrophotometer (FAAS) from low grade coal and drinking water collected from Chilga, Ethiopia using composite sampling technique by developing an optimized digestion procedure and recovery tests. The average concentrations from the digests were found as Ca (3176.6 ± 12.3 μg/g), Fe (704 ± 3.2 μg/g), Zn (365 ± 5.8 μg/g), Mn (120.2 ± 0.6 μg/g), Cr (53 ± 0.33 μg/g), Cu(167 ± 0.1 μg/g), Pb (14.5 ± 0.12 μg/g) and Cd (0.8 ± 0.04 μg/g) in low grade coal and Ca (142.81 ± 0.05 μg/mL), Fe (9.632 ± 0.06 μg/mL), Zn (18.08 ± 0.4 μg/mL), Mn (3.21 ± 0.3 μg/mL), Cr (3.01 ± 0.02 μg/mL) and Cu(4.165 ± 0.004 μg/mL) in drinking water composite samples. While Pb and Cd were both not detected (ND) for the method used in drinking water sample located in Chilga near the coal area selected. Fe and Zn were obtained predominantly in coal and drinking water respectively.

KEYWORDS: Low grade coal, water, digestion, optimization procedure, % recovery test, toxic metals, essential metals, FAAS.

1 INTRODUCTION

The economic significance of coal is for electricity generation through underground coal gasification and coal clean technology. Energy plays an important role in the industrial and economic growth bringing prosperity to the nations [1]. Coal is a sedimentary rock containing more organics than inorganics [2]. Coal composed chiefly of rings of six carbon atoms joined together in an extremely complex composition of layered arrangement containing oxygen and nitrogen with varying amounts of sulfur and other environmental pollutants [3]. Coal contains a wide variety of metallic elements generally enriched by sequestration from ground water by humic acid compounds at the peat or sub-lignite stage of the coalification. Almost all naturally occurring elements, including major elements (C, H, O, N, S, Na, K, Ca, Mg, P, Si, Al, Fe, and Ti) and 74 trace elements, have been reported to be present in different coal types using a number of modern analytical techniques [4].

Environmental pollution has become a key focus of concern for all the nations worldwide, as not only the developing countries but developed nations as well are affected by and suffer from it. Contaminations of the environment with toxic metals are from mining discharges that are mostly coal enriched deposits eroded by runoff or artificially by man activities during mining [4, 5]. To accurately determine the total concentrations of trace metals in environmental matrices, such as urban residential particles, dust, airborne particulate matter, soils, water, and sediments is a significant challenge. This has led to the development and continuous improvement of various analytical methods for sample digestion or pre-concentration. In addition, new instrumental techniques have been developed to obtain exhaustive chemical information in a relatively short time. Determining the concentrations of essential and toxic elements allows for the study of their distributions, the pollution level, and the risks they pose to the investigated ecosystems [6].

Quantitative study of metal content can give information concerning the origin, depositional environment, organic matter content and maturation of the coal [7]. Naturally, trace metals can be resided in mineral deposits as well as in volcano areas. As the result of deposition, the trace metals can be distribute to rivers, soils of agricultural areas through anthropogenic activities [8]. The disruption of the strata of the coal below ground by mining and naturally by runoff causes metals to be

Corresponding Author: Tsegu Lijalem

oxidized and mobilized in to water and agricultural discharges near the coal strata. These contaminated water sources and agricultural irrigated lands can seep in to quality water veins and aquifers [7-9].

Leaching of elements from different substrates, including coal ash, can be influenced by different factors such as pH or complexing capability of the reagent. One of the mechanisms of heavy metal mobilization is due to changes of ionic strength, whose variations in the aquatic environment will necessarily cause ionic exchange reactions. It should be expected that the increase of ionic strength of the extractant will enhance ion-exchange processes [10].

Diverse amounts of heavy metals may be found everywhere; in soils, water, sediments and plants. Heavy metals may chemically or physically interact with the natural compound, which changes their forms of existence in the environment. In general they may react with particular species, change oxidation states and precipitate. They may be bound or sorbed by particular natural substances, which may increase or decrease mobility [11]. Heavy metals even at their trace level can disrupt the metabolic function of humans by accumulating in their body, and thus disturb the functions of the vital organs and glands such as heart, brain; kidney, bone, liver etc or they dislocate vital nutritional minerals from their original place and thus hinder their biological function [12].

Metals can be determined nicely by a variety of methods, with the choice often depending on the precision and sensitivity required flame atomic absorption spectrometer (FAAS) [13], hydride (HGAAS) or electro thermal atomization (ETAAS) [14], graphite furnace atomic absorption (GFAA) [15, 16], inductively coupled argon plasma optical emission spectrometry (ICP-OES) [17] and inductively coupled atomic emission spectrometry (ICP-AES) [18,19] are most commonly used for the determination of metals in water and coal materials because of their inherent selectivity, sensitivity, precision and accuracy.

Many techniques employed for elemental analysis require the conversion of the sample matrix into a solution form. The selection of an appropriate treatment for sample dissolution depends on the nature of the sample and different approaches are required for predominantly inorganic and organic matrices. Geological, geochemical, and soil samples generally contain silicate, metal oxides, carbonates, and, in many cases, organic matter. Such samples must be dried and ground to a fine powder to facilitate dissolution [20]. Frequently, the sample is not soluble in water and must be treated with acids or mixtures of acids to facilitate solubilization. The type of acid treatment must be given careful consideration, since particular acids may or may not oxidize the sample, and may be incompatible with certain elements.

Microwave assisted sample decomposition with HNO_3 or its mixtures with HCl or H_2SO_4 (with or without added H_2O_2) is these days predominantly used for fast and efficient decomposition of a variety of inorganic and organic materials [20, 21]. Today, Ultrasound (US) assisted sample decomposition procedures are considered as alternatives for solid sample pre-treatments. They were found to be superior in facilitating and accelerating such sample preparation steps as dissolution, fusion and leaching [21].

Ethiopia, has a low grade coal (lignite) deposits that are recently studied their heating value to generate electric power. In this particular area of study in Chilga, this low grade coal is sometimes used for home kitchen supplements by the rural residents. Furthermore, the geographical location of the coal area is highly exposed to water runoff. The naturally occurring metals bound in the coal structure may migrate toward the soil agricultural fields and drinking water through leaching behaviours of the metals due to man activities. Trace and toxic metals have a bioaccumulation and biomagnifications behaviour in which they incorporate into our food chain system. Assessment on these selected metals is then an important role to know the concentration levels which may pose toxic effect to human being beyond their dosage.

The literature survey revealed that there is no report on the levels of metals in low grade coal located in Chilga, Ethiopia. Thus, this paper includes (i) development a feasible working procedure coal and drinking water sample (ii) development of an optimized procedure for digestion of coal and drinking water sample to determine some selected metals by FAAS (iii) determination of levels of essential metals (Ca, Fe, Zn, Mn, Cr & Cu) and toxic (Pb and Cd) in the samples from coal and drinking water (iv) comparison of the level of concentration of metals determined for coal and drinking water in the study area and (v) to compare the levels of the selected metals in Chilga low grade coal and drinking water samples taken with the levels of metals analyzed from the other part of the world in literatures.

2 EXPERIMENTAL

2.1 DESCRIPTION OF THE STUDY AREA

Collection of coal, soil, cow's milk and drinking water samples were from Chilga, Gondar. Chilga is located 52 kms southwest of Gondar and the basin is found between 1900 and 2100 m above sea level, 12 boreholes were drilled in the

central part of the basin. The reason for selection of this place from other sites of coal deposits was based on the availability of the sample needed and societal problems with unknown non-point source pollution but that might be related to unbalanced nutrient composition of the coal deposits that may enter to the food chain. The Chilga basin is situated $12^0$25'N and $37^0$03' - $37^0$11'E latitude and longitude respectively as it is mapped in Fig 1.

2.2 APPARATUS AND INSTRUMENT

A polyethylene (PE) plastic bags and bottles, open beakers, sieves (0.125 mm diameter size), volumetric flask, whatmann No.542 (90mm) filter paper, mortar and pestle, drying oven (DIGITHEAT, J. P. SELECTA, S. Spain), A refrigerator (Hitachi, Tokyo, Japan) were used in the site and laboratory. A 250 mL necked round bottom flasks fitted with reflux condenser on digestion block (Gerhardt apparatus) and micropipettes (20-100 µL and 100-1000 µL), Digital analytical balance (Mettler Toledo, Model AG 204, Switzerland) with a precision of ± 0.0001 g and BUCK SCIENTIFIC MODEL 210 VGP (East Norwalk USA) AAS equipped with deuterium background corrector using air- acetylene flame, were used for analysis of the metals.

2.3 CHEMICALS AND REAGENTS

Analytical reagent grade chemicals, reagents, distilled and de-ionized water were used throughout the study. All glassware and plastic containers used were washed with detergent solution followed by soaking in 0.5 M HNO_3 and then rinsed with de-ionized water. HNO_3 (69-72%, Spectrosol, BDH, England) and $HClO_4$ (70% Reagent, Qialikems Pvt. Ltd. New Delhi) were used to digest the matrix samples. Calibration standard solutions of each metal (Ca, Mn, Fe, Cu, Zn, Cr, Cd and Pb) were prepared from stock solutions by appropriate dilution of 2% HNO_3 prepared with de-ionized water to plot the calibration curves for their respective metals.

2.4 SAMPLE COLLECTION AND HANDLING

A total of six coal samples were collected and stored in PE plastic bags from site selected of the coal area. The coal samples collected were allowed to be air dried and prevented from direct sun light exposure for two weeks. A 200g from each crushed and ground of the six coal samples was homogenized and kept in oven at room temperature prior to analysis of levels of metals.

Drinking water samples were collected with 0.5M HNO_3 acid sterilized 500 mL PE plastic bottle sampling containers from around the coal area. A total of eight PE plastic bottle water samples were collected from the available drinking water supplies. The sampling bottles were pre-soaked overnight with 0.5 M HNO_3, rinsed with de-ionized water and rinsed using water sample itself before samples were collected. Equal volume of water sample from each was taken and homogenized to be used as a composite sample. Preservation of water samples was done by adding two drops of conc. HNO_3 to each water sample before storage below 4°C.

2.5 OPTIMIZATION OF WORKING PROCEDURES

Before applying the digestion procedure for the analysis of samples, digestion time, reagent volume ratio and temperature were optimized by varying one parameter at a time for the digestion of low grade coal and drinking water. Thus, for the complete digestion of 0.5 g of homogenized coal composite sample 8 mL conc.HNO_3 and 2 mL conc. $HClO_4$ for a total of 2.5 hrs at 250 ^{o}C was selected as optimized procedure while for 200 mL drinking water composite sample, 3 mL HNO_3 and 2 mL conc. $HClO_4$ for 1.5 hrs at 250 ^{o}C. The final solution of the digest obtained was a clear colorless with no suspended and residue within the solution which was transferred to a 50mL volumetric flask and diluted with de-ionized water to its mark.

Digestion of a reagent blank was also performed in parallel with the samples keeping all digestion parameters the same for each type of sample. For the analysis of reagent blank, nine samples were prepared and the digested samples were stored in refrigerator until analysis using FAAS.

2.6 INSTRUMENT CALIBRATION AND METHOD DETECTION LIMIT

The standard deviation of the nine reagent blanks was calculated. The detection limits were obtained by multiplying the standard deviation of the reagent blank by three. The wavelengths at which analysis was done, the correlation coefficients of the calibration curve for each of the metals and method detection limits of each metal are given in Table 1 & 2. The results

clearly show that the calibration curves with good correlation coefficients and lower method detection limits were obtained during the analysis.

2.6.1 PRECISION

The precision of the results of this analysis is reported with corresponding standard deviation of nine measurements for a bulk sample of triplicate reading per sample and percent relative standard deviation.

2.6.2 RECOVERY TEST

The method validation was checked by spiking experiments of only one sample which costs small time, temperature and smaller reagent volume of the acid during digestion. The spiked samples were prepared by adding a small known amount of metal standard solutions depending on the concentration of the unspiked sample obtained. Because of high concentration standard solution that is to spiked may have a problem during digestion, 30-70% of the concentration of the un-spiked sample and the cumulative volume of the known standard solutions added were less than 1 mL. The spiked and non-spiked samples were digested and analyzed in similar conditions.

3 RESULT AND DISCUSSION

3.1 RECOVERY TEST

The efficiency of the optimized procedure was checked by adding known concentration of each metal to a 200 mL water sample. The results of percentage recoveries for the studied metals were lie within the acceptable range (100±10) in water sample except for chromium as shown in Table 3. The lower recovery of chromium was found to be due to the strong matrix-analyte interaction. This indicates that contamination was not a trouble during the digestion procedure and the recovery results were in good agreement with the expected values. Therefore the recovery test and precision of the method were found satisfactory to validate the experimental practice. Recovery test for Pb and Cd have not carried out because these metals were not detected (ND).

3.2 LEVELS OF METALS IN COAL AND DRINKING WATER SAMPLES

The accuracy and precision of the method were tested by spiking the samples with a standard solution of the analyte metals. Thus, in the present work, the concentration of eight selected essential (Ca, Fe, Zn, Mn, Cr & Cu) and toxic (Cd & Pb) metals in the digested coal and drinking water samples were analyzed by FAAS. The result indicates that the concentrations of metals determined are found in agreement within the acceptable range (100 ± 10%) for all metals except Cr. Among the analyzed metals Cd and Pb were lie below the MDL in water except in coal and soil samples but the rest metals shown with their respective percent relative standard deviation (% RSD) in Table 4.

3.3 DISTRIBUTION PATTERN OF METALS IN DIFFERENT SAMPLES

The levels of the metals show considerable variation among different samples between the same metals. Mineral levels of coal is depend on the pH, cation exchanging capacity, ion strength, organic matter content and the age or rank of the coal itself as it can be shown from Table 4 and Fig. 2a.

The composite sample of coal contains high levels of Ca (3164.3 – 3188.9 µg/g) due to the fact that Ca is one of the macronutrients available for plants, animals and human being as well for their health in large amounts. The other probable reason for higher level of Ca is due to coal is formed by degradation of plants in swamp areas and the earth's layers and rocks at various depths are primarily composed of lime and phosphate rocks.

Fe (700.8 – 707.2 µg/g) was the most predominant trace metal followed by Zn (359.2-370.8µg/g), Mn (119.6-120.8 µg/g), Cu (166.9 – 167.1µg/g),Cr (52.66 – 53.33µg/g) and the toxic metals, Pb (14.62 – 14.38µg/g) and Cd (0.76 – 0.84µg/g). The considerable high concentration of Mn is also coal pH dependence has its own effect on Mn availability on the composition of the coal.

The water sample collected from eight drinking water supply of the residents around the coal sampling site were found some detectable metal contents of Ca, Fe, Zn, Mn, Cr and Cu and the toxic metals Pb and Cd were below MDLs of the method

used in the water composite sample. Fig. 2b showed that high amount of Ca when it is compared to the trace elements as it is expected and from the trace metals Mn is the predominant followed by Fe and Cu.

The composition of water varies widely with local geological conditions. Neither ground water nor surface water has ever been chemically pure water, since water contains small amounts of minerals of natural origin. The total concentrations of substances dissolved in fresh water considered to be of good quality can be hundreds of mg/L [22]. The extreme levels of Ca obtained are due to hardness arising from neighboring limestone deposit that is sticked along in the soil layers as well as in the coal deposit.

3.4 COMPARISON OF LEVEL OF METALS BETWEEN DRINKING WATER AND COAL SAMPLES

Surface drinking water supplies are influenced by higher level of trace metal levels containing in coal or in soil through natural leaching. Generally there is a direct relation in the levels of metals in drinking water and coal. Zn contains 365µg/g and 18.08µg/mL in analysis of coal and water samples respectively. These indicate that, large levels of metals in coal, makes higher the levels of metal in water. Coal pH has also a critical reason for the degree of mobilization of trace metals from their sources.

3.5 COMPARISON OF AVERAGE METAL LEVELS OF THIS STUDY WITH OTHER LITERATURES AND GUIDELINES

As listed and compiled in Table 5, average levels of coal composite samples of this study (ETH) is compared with other reports from five coal deposits of South Africa (SA), United states geological survey (USGS), Nigeria coal (Nig), West Virginia Geological and Environmental Survey (WVGES), Australian thermal exports coal (AU), and average range of global value (Ave.R.G) is depicted in Fig.3. The average levels of metals determined in Chilga, Ethiopia is found to be in the lower boundaries of the average global ranges except for Australian thermal export coals and some of the Nigerian coal. The abundance of these metals with their high concentration indicates that those coal samples are coupled with their coal beds could be a good sources of these metals [23, 24].

Except Pb and Cd that were not detected, the other trace metals found to be exceeded from their drinking water guidelines. This is due to solubility and leaching behaviors of metals from their active deposits. This solubility and distribution of metals mainly depend on redox potential, cation exchange capacity and pH of the background component from which it is leached [25, 26].

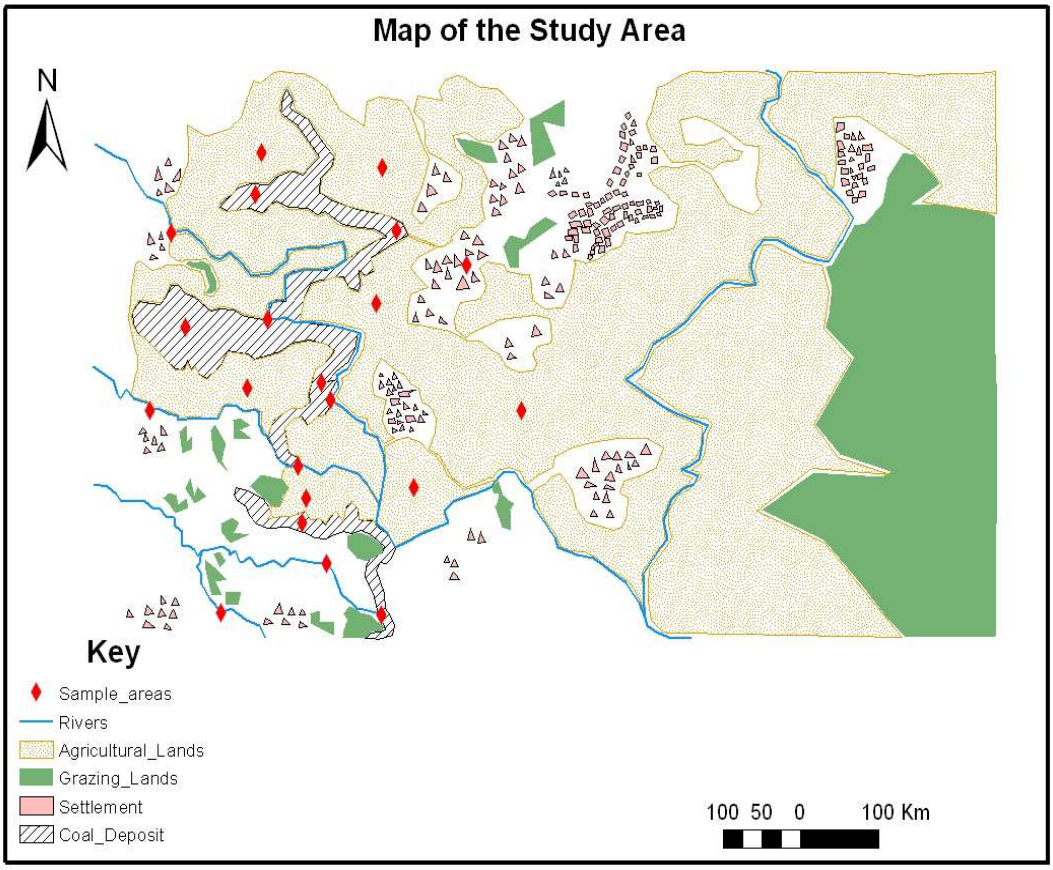


Fig. 1. Map of the study area

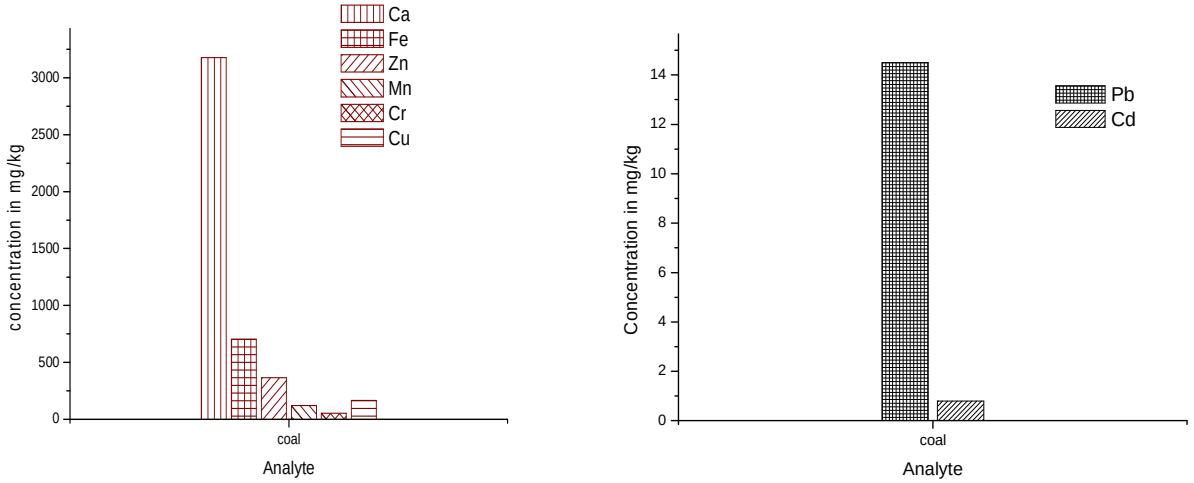


Figure 2a Comparison of levels between Ca, Fe, Zn, Mn, Cr, Cu, Pb and Cd in low grade coal composite sample

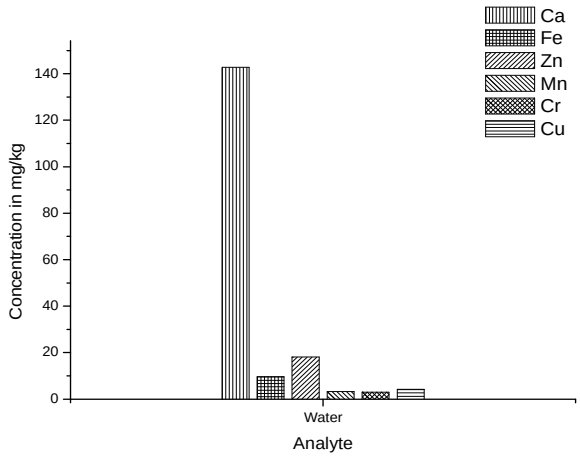


Figure 2b Comparison of levels between Ca, Fe, Zn, Mn, Cr, Cu, Pb and Cd in water sample

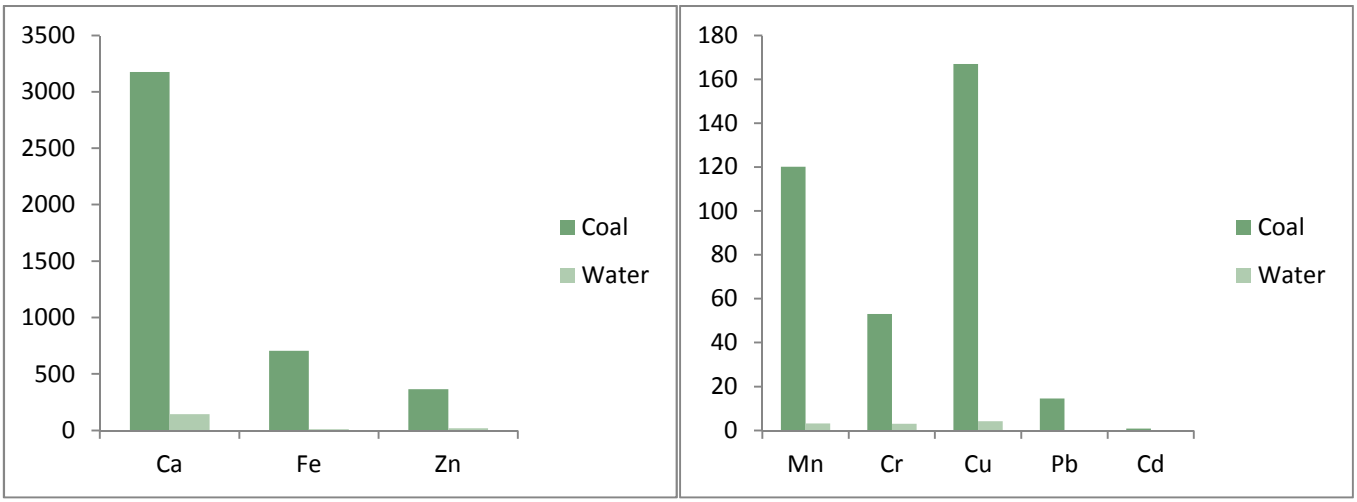


Figure 3 Comparison of average levels of essential and toxic metals in coal and drinking water samples.

Table 1. Concentration of working standard solutions for FAAS instrument calibration and correlation coefficient of calibration curves

Element	Wavelength(nm)	Concentrations of working standard solutions in (mg/L)	Correlation coefficients (R^2)
Ca	422.7	1.0, 2.0, 4.0, 8.0	0.9990
Zn	248.3	0.5, 1.0, 2.0, 4.0	0.9965
Cu	213.9	0.2, 0.4, 0.8, 1.6	0.9996
Fe	279.5	0.5, 2.0, 4.0, 8.0	0.9969
Cr	357.9	1.0, 2.0, 4.0, 8.0	0.9968
Mn	324.8	0.2, 0.4, 0.8, 1.6	0.9996
Pb	283.3	0.2, 0.4, 0.6, 0.8	0.9989
Cd	228.9	0.02, 0.04, 0.08, 0.16	0.9983

Table 2. Method detection limits for coal, soil, water and milk samples

Metal	Instrumental detection limit (IDL) in (ppm)	MDL of coal in (ppm)	MDL water in (ppm)
Ca	0.0100	4.0950	4.9890
Fe	0.0300	0.3520	0.1400
Zn	0.0050	1.7540	1.7690
Mn	0.0100	0.0230	0.0195
Cr	0.0500	0.5240	0.4710
Cu	0.0500	0.0970	0.0620
Pb	0.1000	0.1910	0.1180
Cd	0.0050	0.0076	0.0076

Table 3. Recovery tests for the optimized procedure of water sample

Metal	Conc. in unspiked sample(mg/L)	Amount added(mg/L)	Conc. in spiked sample(mg/L)	% Recovery
Ca	35.703 ± 0.0123	10.711	45.758 ± 0.017	93.88 ± 1.38
Fe	2.408 ± 0.014	1.445	3.826 ± 0.009	98.13 ± 4.62
Zn	4.520 ± 0.096	2.26	6.869 ± 0.012	103.93 ± 0.97
Mn	0.802 ± 0.0074	0.4812	1.312 ± 0.0034	105.91 ± 0.7
Cr	0.752 ± 0.005	0.4514	1.106 ± 0.002	78.25 ± 7.86
Cu	1.041 ± 0.001	0.729	1.726 ± 0.001	93.90 ± 0.2
Pb	ND	-	-	-
Cd	ND	-	-	-

Table 4. Average concentration (mean ± SD, N = 9, µg/g dry weight basis for coal and µg/mL for samples taken as liquids) and % RSD of essential and toxic metals in the specified samples

Metal	Average conc. ± standard deviation		% of relative standard deviation	
	Coal	Water	Coal	Water
Ca	3176.60 ± 12.30	142.81 ± 0.05	3.24	2.91
Fe	704.00 ± 3.20	9.63 ± 0.06	8.68	10.14
Zn	365.00 ± 5.80	18.08 ± 0.40	7.19	10.03
Mn	120.20 ± 0.60	3.21 ± 0.30	2.21	4.07
Cr	53.00 ± 0.33	3.01 ± 0.02	15.79	18.75
Cu	167.00 ± 0.10	4.17 ± 0.004	1.92	0.46
Pb	14.50 ± 0.12	ND	14.26	-
Cd	0.80 ±0.04	ND	10.45	-

Table 5. Comparison of average metals concentrations of this study in coals with the global range (in mg/L) unless specified.

Metals	**ETH[a] (µg/g)**	**SA(2005) [b]**	**Nig(µg/g)**	**USGS(2004)[c]**	**WVGES(2002)**	**AU(µg/g)[d]**	**Ave. R.G [e]**	
							1990	2004
Cd	365±5.80	0.05 - 0.51	-	0.47	0.1	0.067	0.1-3	0.6
Zn	53±0.33	23 - 69	0-13.53	15.0	17.85	15.9	0.5-60	10
Cu	167±0.10	9 - 16	60.33-83.51	16.0	20.4	9.8	0.5-50	15
Pb	14.5±0.12	4.2 - 11	-	11.0	8.19	6.8	2.80	25
Mn	120.2±0.60	84 - 117	12.11-206.7	0.11	21.29	51.4	5-300	50
Cr	0.8±0.04	8-19	28.2-65.43	53.0	14.97	12	5-300	50

Table 6. Recommended metal levels for drinking water quality criteria from different organizations and countries (in ppm)

Metals	WHO	EU	Canada	USA	South Africa	this study
Fe	0.3	NG	NG	NG	NG	9.63±0.06
Zn	3.0	0.1- 5.0	5.0	5.0	0 – 3.0	18.08±0.4
Mn	0.4	0.05	0.05	0.05	0 – 0.05	3.21±0.3
Cr	0.05	0.05	0.05	0.1	0 – 0.05	3.01±0.02
Cu	2	0.1 – 3.0	1	1	0 – 1.0	4.165±0.004
Cd	0.003	0.005	0.005	0.005	0 - 0.005	ND
Pb	0.01	0.05	0.05	0.015	0 – 0.02	ND

4 CONCLUSION

Coal contains appropriate amount of metals (essential and non- essential) but Pb and Cd were not identified in water because they are below the method detection limit of the validated method used. Only calcium is selected from the major metals which was present in larger concentration. The levels of trace metals analyzed have showed an elevated increase except Pb and Cd as they compared to the quality baseline concentration in water. There was also a difference on the levels of average concentration of coal as compared to literatures of other countries. The trace metals identified here were almost in lesser levels when compared to the literatures given in the industrialized western countries but greater than the ranges of quality guideline criteria.

ACKNOWLEDGMENTS

The authors express their gratitude to the Department of Chemistry, University of Gondar, Ethiopia, for providing the laboratory facilities.

REFERENCES

[1]. Wolela Ahmed, (2008), Fossil Fuel Energy Resources of Ethiopia, *Bull. Chem. Soc. Ethiop. 22(1), 67-84*.
[2]. Boris A. and Lemos M.J. (2002), "Documented international enquiry on solid sedimentary fossil fuels; coal: definitions, classifications, reserves-resources, and energy potential, *International Journal of Coal Geology*, (50), 3– 41.
[3]. Olajire A., Ameenab A., Amdul- hammed M., Adekolaf A.(2007), Occurrence and distribution of metals and porphyrins in Nigerian coal minerals, *J. Fuel Chemistry & Technology*, 35(6), 641−647.
[4]. Hing M.C., Christine K., Kishan K., Olivier R., and Harriet V. K., Assessment of Dietary Exposure to Trace Metals in Baffin Inuit Food, Centre for Nutrition and the Environment of Indigenous Peoples, McGill University, Canada.
[5]. Sastre J., Sahuquillo A., and Vidal M., Rauret G. (2002), determination of Cd, Cu, Pb and Zn in environmental samples: microwave-assisted total digestion versus aqua regia and nitric acid extraction, *Journal of Analytical Chemistry, Vol.462 pp59-72.*
[6]. Melquiades F.L., Parreira P.S., Appoloni C.R. (2011), quantification of metals in river water using a portable EDXRF system, *Journal of Applied Radiation and Isotopes vol. 69 327–333.*
[7]. Johanna S.B., Hans-Joachim D., (1998), Inorganic trace analysis by mass spectrometry, *Spectrochimica Acta Part B 1475–1506.*
[8]. Rajaganapathy V., Xavier F., Sreekumar D. and Mandal P.K. (2011), Heavy Metal Contamination in the Soil, Water and Fodder and their Presence in Livestock and Products, *Journal of Environmental Science and Technology, 4(3):234-249.*
[9]. Barbara Gottlieb, Steven G. Gilbert, Lisa Gollin Evans (2010),"The toxic threat to our health and environment" A Report from physicians for social responsibility and earth justice.
[10]. Ogabiela E.E, Udiba U.U, Adesina O.B, Hammuel C, Ade-Ajayi F. A, Yebpella G.G, Mmereole U.J and Abdullahi M, (2011), Assessment of Metal Levels in Fresh Milk from Cows Grazed around Challawa Industrial Estate of Kano, Nigeria, *J. Basic. Appl. Sci. Res., 1(7)533-538.*
[11]. Aleksandar P., Dragana D. and Predrag P. (2000), Leaching of trace and major elements from coal ash dumps, *Journal of Toxicological & Environmental Chemistry, 75:3-4, 141-150.*
[12]. Duruibe, J. O., Ogwuegbu, M. O. C.and Egwurugwu, J. N. (2007), Heavy metal pollution and human biotoxic effects, *International Journal of Physical Sciences, 2 (5), 112-118*,
[13]. Yirgaalem W., Chandravanshi B. S., and Taddese W. (2012), Concentration levels of metals in vegetables grown in soils irrigated with river water in Addis Ababa, Ethiopia, *Journal of Ecotoxicology and Environmental Safety, 77, 57–63.*
[14]. Malbe M., Otstavel T., Kodis I. and Viitak A. (2010), Content of selected micro and macro elements in dairy cows' milk in Estonia, *Agronomy Research, 8 (2), 323–326.*
[15]. Khan S., Cao Q., Zheng Y.M., Huang Y.Z., and Zhu Y.G.(2008), Health risks of heavy metals in contaminated soils and food crops irrigated with wastewater in Beijing, *Journal of Environmental Pollution, (152) 686- 692.*
[16]. Timo M., Vaino¨ M., Kalevi K., and Rose Ma. (2002), Simultaneous determination of As, Cd, Cr and Pb in *aqua regia* digests of soils and sediments using electrothermal atomic absorption spectrometry and fast furnace programs, *Journals Spectrochimica Acta, Part B 57 1681–1688.*
[17]. Li-Qiang Q., Xiao-Ping W., Wei L., Xing T., and Wei-Jun T. (2009), The Minerals and Heavy Metals in Cow's Milk from China and Japan, *Journal of Health Science, 55(2) 300-305.*
[18]. Elham M. E., Ahmed M. H., Sanna M. B. and Amr A. M. (2011), A Survey of Selected Essential and Toxic Metals in Milk in Different Regions of Egypt using ICP-AES, *International Journal of Dairy Science*, Page

[19]. Zoran P. (2012), Concentration of trace elements in some coals from republic of Macedonia, with emphasis on the potentially hazardous, *International Journal of Engineering Science and Technology 4(02).*

[20]. Henryk M. (2003), Wet Digestion Methods, *Polytechnic Poznanska, 60-965*.

[21]. Maja W., Anna S.M., and Pawel P. W., Quality of the Trace Element Analysis: Sample Preparation Steps, *Journal of Environmental Pollution, 112-143.*

[22]. Anita S., Rajesh K. S., Madhoolika A., and Fiona M. M. (2010), Health risk assessment of heavy metals via dietary intake of foodstuffs from the wastewater irrigated site of a dry tropical area of India, *Journal of Food and Chemical Toxicology 48 ,611–619.*

[23]. Soylak M., Divrikli U., Saracoglu S., and Elci. L. (2002), Monitoring Trace Metal Levels in Yozgat-Turkey: Copper, Iron, Nickel, Cobalt, Lead, Cadmium, Manganese and Chromium Levels in Stream Sediments, *Polish Journal of Environmental Studies, 11(1), 47-51.*

[24]. Nicola J. W., and Bafana H. (2005), The occurrence of potentially hazardous trace elements in five Highveld coals, South Africa, *International Journal of Coal Geology, 63, 228– 246.*

[25]. Mulugeta Legesse (April 2012), Assessment of Trace Metals Distribution in Sediments of the Little Akaki River, Addis Ababa, Ethiopia, M.Sc. Thesis, UNESCO-IHE Institute for Water Education.

[26]. Nganje T. N., Adamu C. I., Ntekim E. E. U., Ugbaja A. N., Neji P., and Nfor E. N., (2010), Influence of mine drainage on water quality along River Nyaba in Enugu South-Eastern Nigeria, *African Journal of Environmental Science and Technology, 4(3), 132-144.*

International Journal of Innovation and Scientific Research
ISSN 2351-8014 Vol. 17 No. 2 Aug. 2015, pp. 423-429
© 2015 Innovative Space of Scientific Research Journals
http://www.ijisr.issr-journals.org/

SOLVING MODELS OF ELECTRICAL NETWORKS BY AN IMPROVED HOMOTOPY PERTURBATION METHOD

ADEWOYE R. ADEBISI

MATHEMATICS/STATISTICS DEPARTMENT,
RUFUS GIWA POLYTECHNIC, OWO, Nigeria

Copyright © 2015 ISSR Journals. This is an open access article distributed under the ***Creative Commons Attribution License***, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT: In this paper, an efficient numerical algorithm to find exact solutions for the system of linear equations based on homotopy perturbation method (HPM) is presented. A reliable modification is proposed, and the modified method is employed to solve the system of linear equations generated from some models of electrical networks; the results are compared with those obtained by the conventional methods of solving the system of linear equations. Two examples are given to illustrate the ability and reliability of the improved homotopy perturbation method. The results reveal that the improved method is very simple and effective.

KEYWORDS: Electrical Networks, Homotopy Perturbation Method.

1 INTRODUCTION

Homotopy perturbation method was first established in 1999 by J. Huan He, a Chinese researcher and a Mathematician. It was later improved and developed by him in 2000 and 2001. Many asymptotic techniques including homotopy perturbation method by He (1999, 2000, and 2003), energy method by He (2002), D'Acunto (2006) called this method as He's variational method, modifications of Lindstedt-Poincare method by HE (2000), bookkeeping parameter method, parameterized perturbation method by He (1999). Cai et al (2006) called this method as He's perturbation method, iteration perturbation method by He (2001), and Exp-function method by He (2006) were suggested by Prof. J Huan He during 1999-2008. For a relatively comprehensive survey on the method and its applications, the reader is referred to Prof. He's review article in 2006.

The HPM, proposed first by He, was further developed and improved by scientists and engineers in 2007 by M Gorji, D.D. Ganji and S Soleimani in their New Application of He's homotopy perturbation method. The method, which is a coupling of the traditional perturbation method and homotopy in topology, deforms continuously to significant advantage in that it provides an analytical approximate solution to a wide range of nonlinear problems in applied sciences. The HPM is applied to nonlinear oscillators by He (2004), to bifurcation of nonlinear problems by He (2005), to the system of linear equations by Keramati (2007), to nonlinear partial differential equations of fractional order by Wang (2006), to boundary value problems by He (2006), to solve integral equations by Biazar (2007) and functional integral equations by Abbasbandy (2007), to solve the system of integral equations by Yusufoglu (2007) and to other fields.

Here we present an improvement of the HPM, as developed by Yusufoglu Elcin in 2009, to find exact solutions for the system of linear equations. An accelerating vector based on the HPM is introduced which leads to a rapid convergence and gives exact solutions. Two examples are given to illustrate the efficiency of the improved method.

2 HOMOTOPY PERTURBATION METHOD

Consider the system of linear equations

$$\boldsymbol{Ax} = \boldsymbol{b}, \tag{1}$$

Where

$$\boldsymbol{A} = [a_{ij}], \quad \boldsymbol{x} = [x_j], \quad \boldsymbol{b} = [b_i], \qquad i = 1,2,\dots,n, j = 1,2,\dots,n.$$

To explain the HPM, we reconstitute (1) as

$$L(\boldsymbol{u}) = \boldsymbol{Au} - \boldsymbol{b} = \boldsymbol{0}, \tag{2}$$

With solution $\boldsymbol{u} = \boldsymbol{x}$, and we define the homotopy $H(\boldsymbol{u}, p)$ by

$$H(\boldsymbol{u}, 0) = F(\boldsymbol{u}), \qquad H(\boldsymbol{u}, 1) = L(\boldsymbol{u}), \tag{3}$$

Where $F(\boldsymbol{u})$ is a functional operator with solution, say, $\boldsymbol{u_0}$, which can be obtained easily. We may choose a convex homotopy

$$H(\boldsymbol{u}, p) = (1-p)F(\boldsymbol{u}) + pL(\boldsymbol{u}) = \boldsymbol{0}, \tag{4}$$

And continuously trace an implicitly defined curve from a starting point $H(\boldsymbol{u_0}, 0)$ to a solution $H(\boldsymbol{x}, 1)$. The embedding parameter p monotonically increases from zero to one as the trivial problem $F(\boldsymbol{u}) = \boldsymbol{0}$ is continuously deformed to the original problem $L(\boldsymbol{u}) = \boldsymbol{0}$. The embedding parameter $p \in [0,1]$ can be considered as an expanding parameter

$$\boldsymbol{u} = \boldsymbol{u_0} + p\boldsymbol{u_1} + p^2\boldsymbol{u_2} + \cdots \tag{5}$$

When $p \to 1$, Eq. (4) corresponds to Eq. (2) and Eq. (5) becomes the approximate solution of Eq. (2), i.e.,

$$\boldsymbol{x} = \lim_{p\to 1}(\boldsymbol{u_0} + p\boldsymbol{u_1} + p^2\boldsymbol{u_2} + \cdots) = \sum_{k=0}^{\infty} \boldsymbol{u_k}. \tag{6}$$

Taking $F(\boldsymbol{u}) = \boldsymbol{u} - \boldsymbol{w_0}$, we substitute (5) into (4) and equate the terms with identical powers of p, obtaining:

$$p^0: \quad \boldsymbol{u_0} - \boldsymbol{w_0} = \boldsymbol{0}, \quad \boldsymbol{u_0} = \boldsymbol{w_0}, \tag{7}$$

$$p^1: \ (\boldsymbol{A} - \boldsymbol{I})\boldsymbol{u_0} + \boldsymbol{u_1} - \boldsymbol{w_0} - \boldsymbol{b} = \boldsymbol{0}. \ \boldsymbol{u_1} = \boldsymbol{b} - (\boldsymbol{A} - \boldsymbol{I})\boldsymbol{u_0} + \boldsymbol{w_0}, \tag{8}$$

$$p^2: \ (\boldsymbol{A} - \boldsymbol{I})\boldsymbol{u_1} + \boldsymbol{u_2} = \boldsymbol{0}. \ \boldsymbol{u_2} = -(\boldsymbol{A} - \boldsymbol{I})\boldsymbol{u_1}, \tag{9}$$

And in general

$$\boldsymbol{u}_{n+1} = -(\boldsymbol{A} - \boldsymbol{I})\boldsymbol{u_n}, \quad n = 1,2,\dots, \tag{10}$$

If we take $\boldsymbol{u_0} = \boldsymbol{w_0} = \boldsymbol{0}$, then we have

$$\boldsymbol{u_1} = \boldsymbol{b} \tag{11}$$

$$\boldsymbol{u_2} = -(\boldsymbol{A} - \boldsymbol{I})\boldsymbol{u_1} = -(\boldsymbol{A} - \boldsymbol{I})\boldsymbol{b}, \tag{12}$$

$$\boldsymbol{u_3} = (\boldsymbol{A} - \boldsymbol{I})^2\boldsymbol{b}, \tag{13}$$

.

.

.

$$\boldsymbol{u}_{n+1} = (-1)^n(\boldsymbol{A} - \boldsymbol{I})^n\boldsymbol{b}, \tag{14}$$

Hence, the solution can be of the form

$$\boldsymbol{u} = [\boldsymbol{I} - (\boldsymbol{A} - \boldsymbol{I}) + (\boldsymbol{A} - \boldsymbol{I})^2 - \cdots]\boldsymbol{b}, \tag{15}$$

The convergence of the series (15) has been proved by Keramati. In practice, all terms of series (6) cannot be determined and so we use an approximation of the solution by the truncated series:

$$\boldsymbol{u_m} = \sum_{k=0}^{m-1} \boldsymbol{u_k} \tag{16}$$

3 AN IMPROVEMENT TO HPM

In this section we propose a scheme to accelerate the rate of HPM applied to system of linear equations. We define new homotopy $H(\boldsymbol{u}, p, \alpha)$ by

$$H(\boldsymbol{u}, o, \alpha) = F(\boldsymbol{u}), \qquad H(\boldsymbol{u}, 1, \alpha) = L(\boldsymbol{u}), \tag{17}$$

and typically, a convex homotopy as follows

$$H(\boldsymbol{u}, p, \alpha) = (1-p)F(\boldsymbol{u}) + pL(\boldsymbol{u}) + p(1-p)\alpha = \boldsymbol{0} \tag{18}$$

Where $\alpha = [\alpha_i]^t$ is called the accelerating vector, and for $\alpha = \boldsymbol{0}$ we define $H(\boldsymbol{u}, p, \boldsymbol{0}) = H(\boldsymbol{u}, p)$, which is the standard HPM.

By substituting Eq. (5) in Eq. (18) and equating the terms with identical powers of p, we obtain

$$p^0: \ \boldsymbol{u_0} - \boldsymbol{w_0} = \boldsymbol{0}, \quad \boldsymbol{u_0} = \boldsymbol{w_0}, \tag{19}$$

$$p^1: \ (\boldsymbol{A} - \boldsymbol{I})\boldsymbol{u_0} + \boldsymbol{u_1} - \boldsymbol{w_0} - \boldsymbol{b} + \boldsymbol{\alpha} = \boldsymbol{0}, \quad \boldsymbol{u_1} = \boldsymbol{b} - (\boldsymbol{A} - \boldsymbol{I})\boldsymbol{u_0} + \boldsymbol{w_0} - \boldsymbol{\alpha}, \tag{20}$$

$$p^2: \ (\boldsymbol{A} - \boldsymbol{I})\boldsymbol{u_1} + \boldsymbol{u_2} - \boldsymbol{\alpha} = \boldsymbol{0}, \quad \boldsymbol{u_2} = -(\boldsymbol{A} - \boldsymbol{I})\boldsymbol{u_1} + \boldsymbol{\alpha} \tag{21}$$

$$p^3: \ (\boldsymbol{A} - \boldsymbol{I})\boldsymbol{u_2} + \boldsymbol{u_3} = \boldsymbol{0}, \quad \boldsymbol{u_3} = -(\boldsymbol{A} - \boldsymbol{I})\boldsymbol{u_2}, \tag{22}$$

.

.

.

$$p^{n+1}: \ (\boldsymbol{A} - \boldsymbol{I})\boldsymbol{u_n} + \boldsymbol{u_{n+1}} = \boldsymbol{0}, \quad \boldsymbol{u_{n+1}} = -(\boldsymbol{A} - \boldsymbol{I})\boldsymbol{u_n}, \tag{23}$$

If we take $\boldsymbol{u_0} = \boldsymbol{w_0} = \boldsymbol{0}$, then we have

$$\boldsymbol{u_1} = \boldsymbol{b} - \boldsymbol{\alpha}, \tag{24}$$

$$\boldsymbol{u_2} = -(\boldsymbol{A} - \boldsymbol{I})\boldsymbol{u_1} + \boldsymbol{\alpha} = -(\boldsymbol{A} - \boldsymbol{I})(\boldsymbol{b} - \boldsymbol{\alpha}) + \boldsymbol{\alpha} \tag{25}$$

$$\boldsymbol{u_3} = -(\boldsymbol{A} - \boldsymbol{I})\boldsymbol{u_2}, \tag{26}$$

.

.

.

$$\boldsymbol{u_{n+1}} = -(\boldsymbol{A} - \boldsymbol{I})\boldsymbol{u_n}, \tag{27}$$

We try to find the parameters α as such that

$$\boldsymbol{u_2} = \boldsymbol{0}, \tag{28}$$

Hence from (25) we should have

$$-(\boldsymbol{A} - \boldsymbol{I})(\boldsymbol{b} - \alpha) + \alpha = 0, \tag{29}$$

Or

$$\boldsymbol{A\alpha} = (\boldsymbol{A} - \boldsymbol{I})\boldsymbol{b}, \tag{30}$$

From Eq. (30) we conclude that

$$\boldsymbol{\alpha} = (\boldsymbol{I} - \boldsymbol{A^{-1}})\boldsymbol{b}, \tag{31}$$

Thus from (27), we have $\boldsymbol{u_3} = \boldsymbol{u_4} = \cdots = \boldsymbol{0}$, and the exact solution will be obtained as

$$\boldsymbol{u} = \boldsymbol{u_0} + \boldsymbol{u_1} = \boldsymbol{0} + \boldsymbol{u_1} = \boldsymbol{u_1}, \tag{32}$$

4 DERIVATION FROM THE CIRCUIT

In figs 1 and 2, the unknown currents are i_1, i_2 and i_3 in the electrical networks. To obtain it, we label the current as shown, choosing directions arbitrarily. If a current will come out negative, this simply means that the current flows against the direction of our arrow. The current entering each battery will be the same as the current leaving it. The equations for the currents result from Kirchoff's laws:

Kirchoff's Current Law (KCL): At any point of a circuit, the sum of the in-flowing currents equals the sum of the out-flowing currents.

Kirchoff's Voltage Law (KVL): In any closed loop, the sum of all voltage drops equals the impressed electromotive force.

Example 4.1

Consider the derived system of equations (See Appendix 1)

$$5i_1 - i_2 + 2i_3 = 3$$
$$-i_1 + 4i_2 + i_3 = 8 \qquad (33)$$
$$-2i_1 + i_2 + 3i_3 = 2$$

The true solution by other conventional methods is $(0.81,\ 2.07,\ 0.51)^t$

By improved homotopy,

We solve the system $\boldsymbol{Au} = \boldsymbol{b}$, where

$$\boldsymbol{A} = \begin{bmatrix} 5 & -1 & 2 \\ -1 & 4 & 1 \\ -2 & 1 & 3 \end{bmatrix}, \quad \boldsymbol{b} = \begin{bmatrix} 3 \\ 8 \\ 2 \end{bmatrix}, \quad \boldsymbol{u} = \begin{bmatrix} \alpha_1 \\ \alpha_2 \\ \alpha_3 \end{bmatrix}$$

Now by (30), i.e. $\boldsymbol{A\alpha} = (\boldsymbol{A} - \boldsymbol{I})\boldsymbol{b}$, we have

$$\begin{bmatrix} 5 & -1 & 2 \\ -1 & 4 & 1 \\ -2 & 1 & 3 \end{bmatrix}\begin{bmatrix} \alpha_1 \\ \alpha_2 \\ \alpha_3 \end{bmatrix} = \begin{bmatrix} 4 & -1 & 2 \\ -1 & 3 & 1 \\ -2 & 3 & 2 \end{bmatrix}\begin{bmatrix} 3 \\ 8 \\ 2 \end{bmatrix}$$

or

$$\begin{bmatrix} 5 & -1 & 2 \\ -1 & 4 & 1 \\ -2 & 1 & 3 \end{bmatrix}\begin{bmatrix} \alpha_1 \\ \alpha_2 \\ \alpha_3 \end{bmatrix} = \begin{bmatrix} 8 \\ 23 \\ 6 \end{bmatrix}$$

Hence by (31) i.e. $\boldsymbol{\alpha} = (\boldsymbol{I} - \boldsymbol{A}^{-1})\boldsymbol{b}$,

The solution of this system gives as $\alpha = (2.19, 5.93, 1.49)^t$. Thus the solution of Eq (33) becomes $\boldsymbol{u} = \boldsymbol{u_1} = \boldsymbol{b} - \boldsymbol{\alpha} = (3, 8, 2)^t - (2.19, 5.93, 1.49)^t = (0.81, 2.07, 0.51)^t$, which is the exact solution of Example 1.

Hence $i_1 = 0.81;\ i_2 = 2.07;\ i_3 = 0.51$

Example 4.2

Consider the derived system of equations below (see Appendix 2)

$$i_1 + i_2 + 3i_3 = -4$$
$$-2i_1 + 6i_2 + i_3 = 33 \qquad (34)$$
$$4i_1 - 2i_2 + i_3 = 3$$

The true solution by other conventional methods is $(6.83,\ 8.87, -6.57)^t$

By improved homotopy,

We solve the system $\boldsymbol{Au} = \boldsymbol{b}$, where

$$A = \begin{bmatrix} 1 & 1 & 3 \\ -2 & 6 & 1 \\ 4 & -2 & 1 \end{bmatrix}, \quad b = \begin{bmatrix} -4 \\ 33 \\ 3 \end{bmatrix}, \quad u = \begin{bmatrix} \alpha_1 \\ \alpha_2 \\ \alpha_3 \end{bmatrix}$$

Now by (30), i.e. $\boldsymbol{A\alpha} = (\boldsymbol{A} - \boldsymbol{I})\boldsymbol{b}$, we have

$$\begin{bmatrix} 1 & 1 & 3 \\ -2 & 6 & 1 \\ 4 & -2 & 1 \end{bmatrix}\begin{bmatrix} \alpha_1 \\ \alpha_2 \\ \alpha_3 \end{bmatrix} = \begin{bmatrix} 0 & 1 & 3 \\ -2 & 5 & 1 \\ 4 & -2 & 0 \end{bmatrix}\begin{bmatrix} -4 \\ 33 \\ 3 \end{bmatrix}$$

or

$$\begin{bmatrix} 1 & 1 & 3 \\ -2 & 6 & 1 \\ 4 & -2 & 1 \end{bmatrix}\begin{bmatrix} \alpha_1 \\ \alpha_2 \\ \alpha_3 \end{bmatrix} = \begin{bmatrix} 42 \\ 176 \\ -82 \end{bmatrix}$$

Hence by (31), i.e. $\boldsymbol{\alpha} = (\boldsymbol{I} - \boldsymbol{A^{-1}})\boldsymbol{b}$,

The solution of the system gives as $\alpha = (-4, 33, 3)^t$. Thus the solution of Eq (34) becomes, $\boldsymbol{u} = \boldsymbol{u_1} = \boldsymbol{b} - \boldsymbol{\alpha} = (-4,\ 33,\ 3)^t - (-10.83,\ 24.13,\ 9.57)^t = (6.83,\ 8.87,\ -6.57)^t$, which is the exact solution of Example 2

Hence, $i_1 = 6.83;\ i_2 = 8.87;\ i_3 = -6.57$

5 CONCLUSION

Here a modification to the HPM was first proposed in which accelerating parameters were introduced to solve the system of linear equations. a new homotopy therefore was constructed named the accelerating vector. This accelerating vector of course leads to a fast convergent rate, since only one iteration leads to exact solution. The examples analyzed illustrate the ability and reliability of the improved method presented in this paper and reveal that the improvement of HPM is a simple and very effective tool for calculating the exact solutions.

REFERENCES

[1] Abbasbandy, S. (2006): Application of He's homotopy perturbation method for Laplace transform, Chaos Solitons Fractals 30 (2006) 1206-1212.

[2] Abbasbandy, S. (2007): Application of He's homotopy perturbation method to functional integral equations, Chaos Solitons Fractals 31 (2007) 1243-1247.

[3] Biazar, J., Eslami, M., Ghazvini, H. (2007): Homotopy perturbation method for system of partial differential equations, Int. J. Nonlinear Sci. Numer. Simul. 8 (2007) 413-418.

[4] Cai, X.C., Wu, W.Y., Li, M.S. (2006): Approximate period solution for a kind of nonlinear oscillator by He's perturbation method, Int. J. Nonlinear Sci. Numer. Simul. 7 (1) (2006) 109-112.

[5] D'acunto, M. (2006), Determination of limit cycles for a modified van der Pol oscillator, Mech. Res. Comm. 33 (2006) 93-98.

[6] He, J.H. (1999): Homotopy perturbation technique, Comput. Methods. Appl. Mech. Engrg. 178 (1999) 257-262.

[7] He, J. H. (2000): A coupling method of homotopy technique and perturbation technique for nonlinear problems, International journal. Non-Linear Mech 35 (2000) 37-43.

[8] He, J. H. (2003): Homotopy perturbation method: a new nonlinear analytical technique, Appl. Math. Comput. 135 (2003) 73-79.

[9] He, J. H. (2002): Modified Lindstedt-Poincar methods for some strongly nonlinear oscillations Part 1: Expansion of a constant, Internat. J. Non-Linear Mech. 37 (2) (2002) 309-314.

[10] He, J. H. (2001): Bookkeeping parameter in perturbation methods, Int. J. Nonlinear Sci. Numer. Simul. 2 (2001) 257-264.

[11] He, J. H. (1999): Some new approaches to Duffing equation with strongly and high order nonlinearity (II) parametized perturbation technique, Commun. Nonlinear Sci. Numer. Simul. 4 (1) (1999) 81-83.

[12] He, J. H. (2001): Iteration perturbation method for strongly nonlinear oscillations, J. Vib. Control 7 (2001) 631-642.

[13] Siddiqui, A., Mahmood, R., Ghori, Q.(2007): Thin film flow of a third grade fluid on moving belt by He's homotopy perturbation method, Int. J. Nonlinear Sci. Numer. Simul. 7 (2007) 7-14.

[14] Yusufoglu, E. (2007): A homotopy perturbation algorithm to solve a system of Fredholm Volterra type integral equations, Math. Comput. Modelling, doi: 10.1016/j.mcm.2007.06.022.

[15] Yusufoglu, E. (2009): An Improvement to homotopy perturbation method for solving system of linear equations. Computer and Mathematics with Application. 58 (2009) 2231-2235.

APPENDIX 1

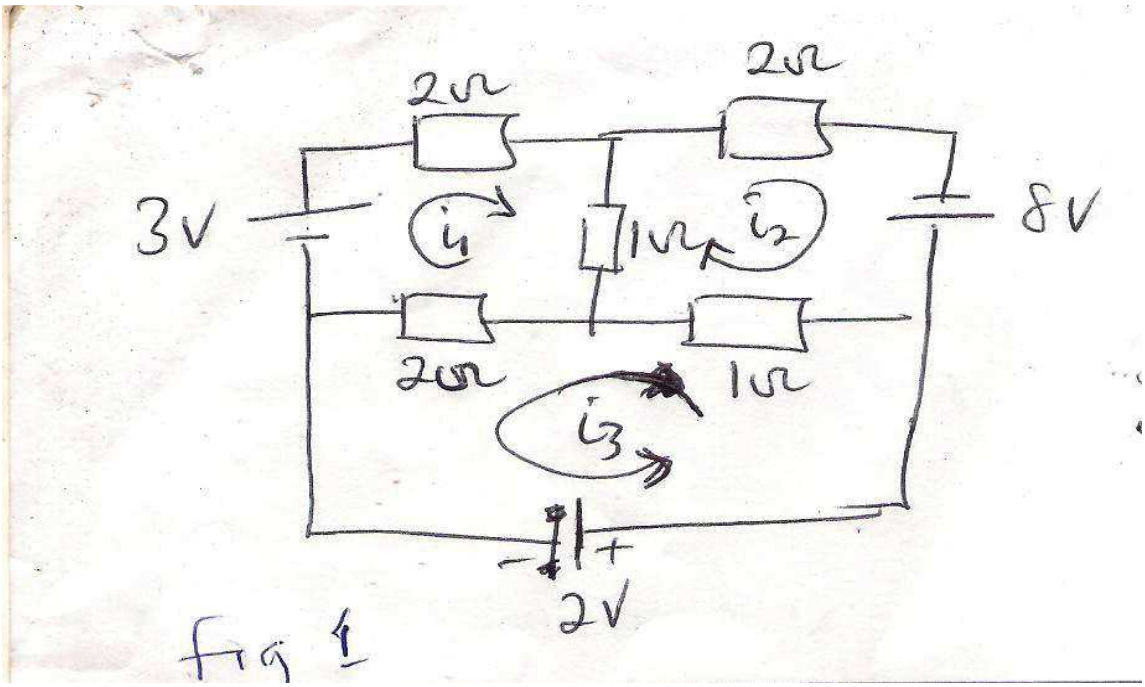


Fig 1: Electrical network model

The derived equation from fig 1:

$$5i_1 - i_2 + 2i_3 = 3$$
$$-i_1 + 4i_2 + i_3 = 8$$
$$-2i_1 + i_2 + 3i_3 = 2$$

APPENDIX 2

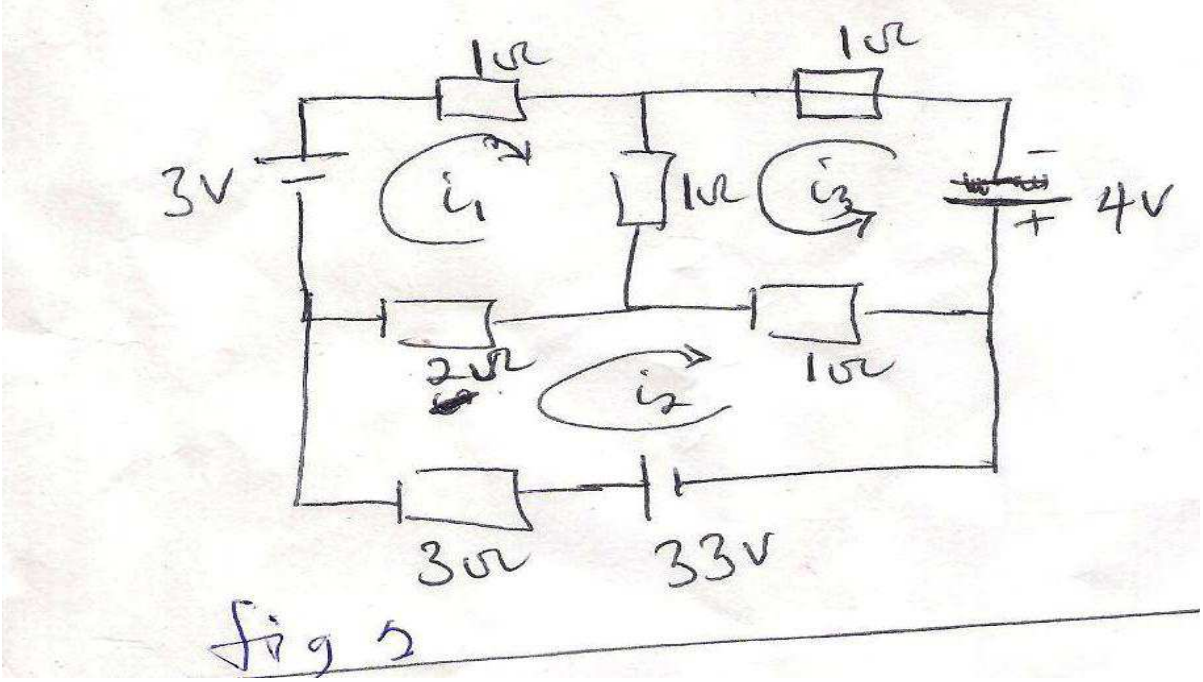


Fig 2: Electrical network model

The derived equation from fig 2:

$$i_1 + i_2 + 3i_3 = -4$$
$$-2i_1 + 6i_2 + i_3 = 33$$
$$4i_1 - 2i_2 + i_3 = 3$$

International Journal of Innovation and Scientific Research
ISSN 2351-8014 Vol. 17 No. 2 Aug. 2015, pp. 430-442
© 2015 Innovative Space of Scientific Research Journals
http://www.ijisr.issr-journals.org/

Corporative Parking Location Choice and Route Guidance: The case of Urban Area of Tunis

Sana BENHASSINE[1], Riadh HARIZI[2], Rafaa MRAÏHI[1], and Elyes KOOLI[3]

[1]GEF-2A, The Higher School of Digital Economy, University of Monouba, Campus universitaire, 2010, Manouba, Tunisia

[2]GEF-2A, The Higher Institute of Management of Tunis, Tunis University, Bouchoucha City, 2000, Bardo, Tunis, Tunisia

[3]The High Institute of Technological Studies of Ksar-Hellal, Avenue Hadj Ali Soua, 5070, Tunisia

Copyright © 2015 ISSR Journals. This is an open access article distributed under the ***Creative Commons Attribution License***, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT: Cruising for parking angers drivers, increases traffic congestion and pollution, and wastes fuel and time. This paper proposes and studies new strategies for parking guidance based on a network of intelligent agents which can helps drivers to find a parking place, before or during their travel at anytime and anywhere. With reference to the objective that is interested to bring vehicles to vacant parking place with the aim to reduce the traveling time and to ensure efficient use of available parking capacities, this study offer three services: the search for a vacant parking place, directions to that parking place and booking the place for parking. This study takes on optimal route guidance algorithm, which is simulated and analyzed by the platform MATSim transport simulation.

KEYWORDS: Intelligent car parking management; Multi-agent system; Benefit evaluation; Urban transportation; parking guidance.

1 INTRODUCTION

Parking problems are a great challenge to facilitate traffic and ensure the quality of urban life. For a long time, looking for a place to park was neglected because of its invisibility, even though its negative externalities have been identified. The severity of impacts caused by the problem of finding a parking place motivates researchers to study the parking management problem and to come up with solutions to solve problems met by drivers and to reduce impacts on traffic, environment, and society. Vehicles in search of a parking space represent a share that cannot be ignored in urban traffic. At the end of the trip, the driver shall park his vehicle, but in the absence of parking, it will look for another car or an illegal site, or turn around the parking lot, or postpone its activity. As it seeks a place, the motorist gradually widens its circle of research. Studies have shown that a small search time by car can create a surprising amount of extra traffic which is source of urban traffic congestion [1]. Finding a place is still responsible for the causes of accidents, waste fuel and time, air pollution, and degradation of the pedestrian environment [2] [3]. Reducing of the traffic externalities is one of several objectives of good parking policy. There are other goals such as ameliorating accessibility, maximizing turn-over for shops to develop the local economy, reducing the congestion, encouraging the using of public transport. Generally, the establishment of an optimal parking is often difficult because these objectives are in conflict [4].

The good parking policy is then which taking into account the maximum of economic, social and environmental constraints. It needs the evaluation of its numerous effects as many other urban policies (urban transport policy, land-use policy). The literature showed that numerous tools have been used to achieve one or more of these objectives. Some of them are economic as parking pricing [5], fiscal as parking taxing, and technological as intelligent parking management.

Corresponding Author: Elyes KOOLI

In this paper we propose the application of Technologies of Information and Communication (TIC) to elaborate an intelligent parking system. These studies proposed parking system which are based on technologies as especially on Cellular Automata (CA) and Multi-Agent System (MAS). Contrarily to traditional regional models, these new models have permitted to pass from macroscopic to microscopic parking modeling approach throughout the simulation models [6]. Particularly, Traditional models aggregate all origin and destination points of traffic flows in zones of the considered area to "average points" namely "centroids" and all drivers to the "average driver". However, new models disaggregate all variables in areas and can studding the behavior of every driver taking into account the variety of parking's, links, origins, destinations, and real traffic and parking environment. Search time for finding parking place, walking time, traffic flow, traveled distance gain and associated energy consumption and pollutants emission are the main impacts measured by these studies.

A lot of information and communication technologies are likely to set up a promising smart parking such as the website, staking systems dynamics parking lots, mobile phones, the multi-agent and ad hoc networks without son. Vehicular Ad Hoc Networks (VANETs) is a new technology that has mostly gained the attention of researchers in road traffic management. Safety and efficiency of transportation system are the two essential problems where it is applied. Dynamic staking systems of parking lots try to bring the flow of vehicles heading to saturate parking and to less busy areas. They display the name of the car park, the direction and the filling of the parking lot. The search strategy, based on dynamic staking systems of parking lots, is unassisted. Indeed, the driver turns into a search radius where the node information on the availability of parking places and it can get as close to parking places. Nevertheless, it's to be noted that ad hoc network without a son is an opportunistic assisted research strategy. Thanks to standard interfaces without son, the information on the availability of vacant parking place is provided to all motorists who are in the coverage area. Vehicular Ad-hoc Networks based real-time navigation of parking was studied recently [7]. The basic idea consists to use of restricted stock units for monitoring and management of the entire parking lot. These units are activated by communication among vehicles and RSUs (Road Side Units: units across the road) in an ad-hoc network.

Mobile phones, the Web site and multi-agent systems represent a centralized assisted research strategy. In this case, it is a central server or a central unit responsible for the dissemination of data on vacant parking place. Once the reservation is made, the driver simply moves to the designated place. The Internet can be the best way to help drivers find a place to park, online in an occupied city. Motorists can also use their cell phones to check available space, make a reservation and get directions. Furthermore, the multi-agent artificial intelligence is one of the new technologies of information and communication that are now applied to parking. Numerous existing studies have created a multi-agent platform for several objectives and with a variety of constraints. [8] proposed a platform which correspond to an implementation of a dynamic system of negotiations parking place. They used a system of intelligent agents, and given that the price of parking is negotiable, it selects the best car for the driver. [6] presented a parking model, PARKAGENT, which simulates the behavior of drivers capture the complex self-organizing dynamics of a large collective of parking agents within a non-homogeneous (road) space. Authors applied their multi-agent model to residential parking in Tel Aviv city and aimed to determine if the additional parking supply can reduce the search time of parking place. Along similar lines, [9] created a system of information and guidance for parking by the alliance of GIS (Geographic Information System) with GPS (global positioning system) and 3G (wireless system).

The objective of our work is then to reduce the traveling time and to ensure efficient use of available parking capacities. This study integrates a multi-agent network. In fact, with rapid technological advancement in computing and telecommunications, Multi-Agent approach may be appropriate to minimize wasted time and fuel, to improve traffic flow, to optimize the use of parking lots and to reduce the negative effects on society and the environment. To emphasize our goal, a comparison among two methods is imposed. For the first method, the cars travel randomly in the hope of finding a vacant place. Here, the strategy adopted by the driver during his research depends on both the urban context in which they are searched and the individual characters. Gradually, as he seeks a place, the driver gradually widening its circle of research and can sometimes give up its activity. For the second method, the cars will be guided to a parking space around their destinations through our system.

After presenting the various methods and technologies to solve the problem of finding a place or park in section 2, the architecture of our proposed system is described in section 3. A section 4 deal with the implementation of the architecture proposed in the simulation model MATSim, presents the results and their analysis, and describes the algorithms used in the system. Conclusions are drawn in section 5.

2 SYSTEM ARCHITECTURE

The conceptual model of our system is based on Multi-Agent network.

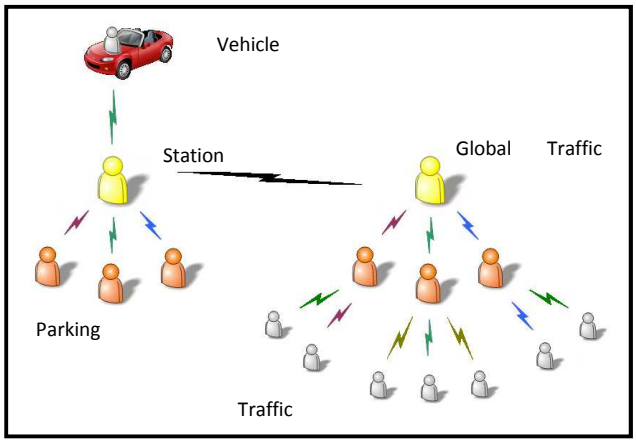


Fig. 1. Hierarchical structure between agents

This model is a way of representing our real world. This allows us to represent the dynamics of resource parking use, namely the interactions regarding the use of parking resources among vehicles which are the main actors of our system. Here, we assume that all cars and parking places are fully connected to the information network.

The basic organizational structure of our system is a hierarchical structure. The hierarchical organization of agents allows a default message routing which facilitates the development of agents. There are five types of agents having each one characteristic that distinguish it from others: vehicle agent, traffic agent, global traffic agent, parking agent and station agent.

2.1 VEHICLE AGENT

This is the only dynamic component that drives the road network. Each vehicle is equipped with sensor allowing the agent to perceive information from its environment. They produce information contributing to knowledge in real time, traffic conditions or to predict traffic conditions. Indeed, all the parameters such as: average speed, travel time, inter-vehicular time ... will be calculated by the agent on board the vehicle to determine the approximate state traffic: fluid or dense traffic..

Each disturbance in traffic conditions observed by the vehicle during its movement must be transmitted to other vehicles, which transmit this message to the nearest traffic agent. Generally the exchanged data are intended to produce alerts and inform drivers so as to be more attentive.

2.2 TRAFFIC AGENT

This is a static component that represents a specific point of the transport network: at each intersection (or node), we introduce a traffic agent. It produces, in real time, information about the current state of traffic within the road segments that it manages.

The traffic agent must first handle messages emitted by vehicles in the first place to inform the global traffic agent of disruptions to normal traffic situation. Second, he warns motorists on their way to the place of accident for example. The average speeds, the inter-vehicle distance ... can be exploited by the traffic agent as information on the status of traffic: fluid, dense or saturated.

2.3 GLOBAL TRAFFIC AGENT

The vehicle-to-vehicle communication and the vehicle-to-infrastructure communication are used to exchange a wealth of accurate information on traffic conditions. Following these exchanges, the global traffic agent will have a global vision on the road network of the area it oversees. The main goal of this supervision is to maximize road safety and minimize the time spent on the roads to make them friendlier.

The global traffic agent collects the information on road conditions from traffic agents then synthesizes the data. Once the global traffic agent has a more complete view of the road network, it broadcasts information to traffic agents. For example, the agent tries to reduce road congestion by seeking alternative routes for vehicles aware of traffic conditions: it produces a path map that guides them to alternative routes more secure.

2.4 PARKING AGENT

For each parking lot, one parking agent is installed (parking, sidewalks). Their role is to follow in every moment the state of occupation of parking places. They get information on the availability of parking space through sensors installed throughout the car park on-Street, or through the automatic gates installed at the Off-street parking. Each park agent must in turn report to the station agent, in real-time, the number of parking places available compared to the total capacity of the park.

In fact, the parking agent provides to the station agent two data types: static and dynamic. When it comes to static data, it represent an invariable data such as the name of the park, the maximum capacity, the price (sometimes variable), the coordinates of the car, type of parking (to determine if this is a car park on-Street or off-street) parking time. With respect to the dynamic data they stand for the number of reserved places and the number of available parking places.

2.5 STATION AGENT

The station agent has a global view on all car parks in the area**.** It acts as a central supervisory entity through direct interaction with parking agents**.** He is responsible for acquiring and managing in a real-time a set of information**.** This information may come from different parking agents as they may stem from the global traffic agent**.** In a more explanatory**,** The station agent is a central location for storage of information detailing the state of parking places in the area it manages. At each time**,** he gathers the list of vacant parking and with the collaboration of the global traffic agent coordinates with motorists to guide them to open space.

2.6 COMMUNICATION PROTOCOLS

The vehicle agent acquires information in the form of observed events, either by itself, or through exchange of information with other vehicles, or whether through an infrastructure. Similarly to the traffic agent who acquires information by the vehicle agents, or through the global traffic, or by other traffic agents in control of the global traffic agent. Each vehicle is equipped with a sensor (eg antennas) to generate data and with an agent to deal with them. At each intersection and we install a post in charge of collecting information and an agent responsible for processing information. With the 802.11 communication protocol information can flow in real time between the different agents in the same area. In this study, we assume that all of cars and parking places are fully connected to the information network.

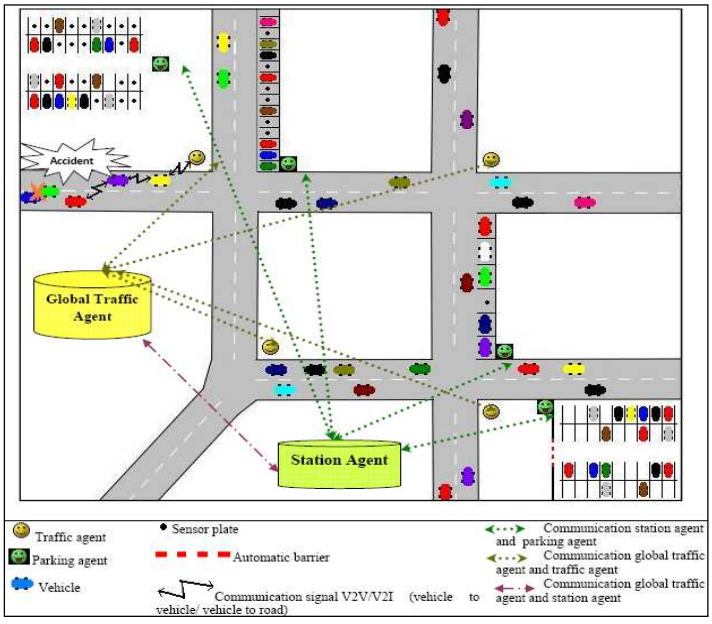


Fig. 2. Scenario of communication between different agents

The parking agent collects information from plates installed in the ground for each parking place or through the automated gates installed at the entrance of the park. In addition, it receives information from the station agent. The latter has two sources of information: the parking agents and the global traffic agent (Fig. 1). The plates are sensors powered by an onboard battery. The signals from these small devices will be transmitted in real time, to parking agents installed on sidewalks. Signals from the sensors contain information on seat availability.

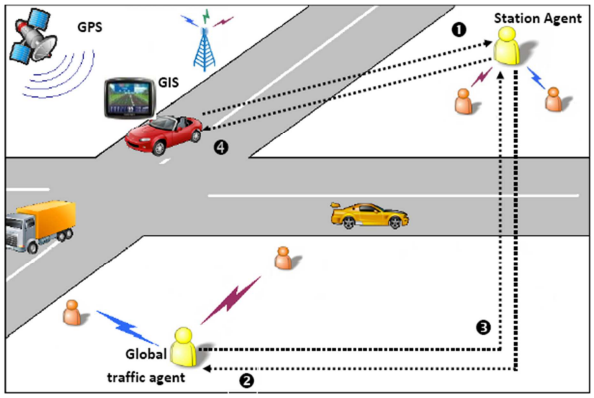
Sometimes during the existence of traffic lights, different agents can cooperate to minimize the waiting time of vehicles at intersections. Agents of highest priority vehicles such as ambulance vehicle [10], inform the parking agent of their attentions to park. The parking agent on his part communicates with the global traffic agent for information. And the latter under the action of the agent traffic, will try to reduce the waiting time of the vehicle by adjusting the next sequence of each traffic light.

3 THE FUNCTIONING OF THE SOLUTION

The idea of our smart parking system is to develop a procedure which coordinates road between driver and car parks in order to solve the problem of finding a parking place and then provide more convenience and comfort in terms of conduct. New information technologies such as GPS and GIS are used to facilitate the process of parking (Fig. 2).

Our system will enable pilots to:

- Search free parking places, quickly, at anytime and anywhere.
- Acquire a lot of information, among others, as prices, locations of parks around their destinations.
- Search for the optimal path to reach the destination quickly and avoid traffic jams (the algorithm of the shortest path applied in our study is the A * algorithm).
- Ensure the principle of seat reservation.



(1) The vehicle requires the station agent a parking place.
(2) The station agent sends the list of car parks available to the global traffic agent.
(3) The global traffic agent returns the shortest path for each car.
(4) The station agent calculates the cost of parking (C) and returns to the driver a dataset.

Fig. 3. General Design of the Solution

3.1 THE SEARCH FOR PARKING PLACE

Once the driver reaches the air in "D" where he wants to park, it must register with the station agent by entering its destination: the GPS accurately measures the coordinates of the current location of driver [9]. Through the GIS, the positioning of this point will be located on a map displayed in the GUI man-machine. The user can then view its destination and highlight it. The vehicle is the agent responsible for transmitting all information to the station agent. It's worth noting that the station agent, who has, in real time, the list of car parks with open place, interacts with the global traffic agent and asked him to find the shortest path associated with each parking place. The global traffic agent refers to the current location of the driver and contact information for each parking place contained in the list.

The idea of seeking for the shortest path can lead to beneficial results not only in terms of reducing time spent on the road but also in terms of improving traffic efficiency and reduced consumption of fuel (energy saving).

Based on the information transmitted by the global traffic agent and on the price and duration of parking, the agent assigns a cost to each parking place. Indeed, the cost (*C*) is the combination of three elements. The first element is the multiplication between the travel time of the shortest path (*K*) leading to the parking and fuel consumption (*F*). The second element is the multiplication between the parking price (*P*) and the parking duration (*D*) of the driver. Finally, a multiplication of the length of the distance in feet to walk (M: distance between parking and destination) and the time's value of the driver and his companions (R). Afterwards, all costs will be sorted in ascending order from minimum to maximum, which is likely to allow the solicitor the opportunity to choose the most convenient parking.

$$C = (K \times F) + (P \times D) + (M \times R) \quad (1)$$

Where *C* is the cost evaluated with Tunisian dinar (TND), *K* is the travel time by car (*h*: hours), *F* is the fuel consumption (TND/h: dinars/hour), *P* is the price of parking (TND/h: dinars/hour), *D* is the parking time (h: hours), *M* is the travel time to work in feet (h: hours), *R* is the time value of the driver and the number of people in the car (TND/h: dinars/hour).

3.2 THE GUIDANCE TO A PARKING PLACE

As soon as the calculations are completed, the list of free parking places (unoccupied) appears instantly on the screen of the dashboard: the GIS produced a map that illustrates consulting geographical positioning of each parking place compared to the driver's location and destination. Several information associated with each parking are also displayed: name parking, type of parking (on-street or off-street ...), cost (*C*), parking price (*P*)…

Once all information at the disposal of the user, it must take the initiative to decide which parking place he wants?

The driver can select the parking that suits him on the basis of the cost function calculated by the station agent, or according to its time value, calculated on the basis of the distance of walking. This latter is between the parking and the chosen destination target. This factor reflects the time value of driver that can be solved at its selection of the location of the parking lot.

A simple touch of the screen and the selected car park is designated by the user. Following this choice will start two steps: (1) The GIS produces a path map that guides the driver's current location to the desired parking location (display the shortest path already computed by the global traffic agent). (2) The station agent must sign a seat booking contract with the vehicle agent.

3.3 THE RESERVATION

The system ensures, through the principle of reservation, a parking space available for the driver. Indeed, the station agent must provide to the vehicle agent a reservation guarantee, if we fall back into the same conflict of lost time due to the search for a place. In a simpler way, once the driver manages to have the reservation, it will go straight to the chosen car park. While the concept of reservation is not guaranteed by our system, there are certainly other cars currently looking for a place to park. When the driver reaches the target location, it will most likely find its space already occupied by another vehicle. Subsequently, our driver must try to do another search [11] [12].

Once the order booking is confirmed by the station agent, the vehicle agent and the parking agent must inform each other to follow the progress of the vehicle. The follow up of the car as it moves towards the car park, gives information on exceptional events that may hinder the progress of the vehicle. When the space detects the presence of a vehicle, the parking agent must check the identity of the agent vehicle. If the identity is not confused, the agent must warn the car driver through the vehicle agent, that this place is reserved.

4 SIMULATION AND RESULTE

The network created in our system is an extract from Open Street Map (Fig. 3) containing only roads in the region of interest, Tunis city center.

This sample contains about 50,000 vehicles / day (randomly generated). This network includes only roads with cars of 2500 links and 1000 nodes.

Fig. 4. Tunis city center according to Open Street Map

According to the municipality of Tunis, the selected area has a capacity of 11.201 parking spaces divided into two categories: off-street parking and on-street parking (fig4).

The municipality of Tunis attempted to increase the capacity of the off-street parking by the construction of car parks intended primarily to capture migrants (merchants and employees), residents and partly those who have a need for long-term parking. Off-street parking of Tunis offers 6001 seats.

To reduce the on-street parking, the center of Tunis has several parks with capacity reached 5200 seats. The on-street parking offer the paid parking or Parking in the blue zone (tab .II.) Following the creation of a blue area, the municipality of Tunis has made the generalization of short-term parking in the street, this type of paid parking and limited in duration. Parking in the blue zone of Tunis offers 5200 seats including parking time shall not exceed two hours and this is what allowed from 8:00 until 20:00. The unit price of a place to park is 0.500 TND per hour.

The generalization of paid parking policy with short-term parking in the city center is implemented to improve the management of the supply of available parking on public highway this is by setting the rotary parking with the installation of parking meters. The objective of this new technique of payment in the blue areas is to facilitate the process of paid parking allowing drivers to have a simple method, faster and more secure.

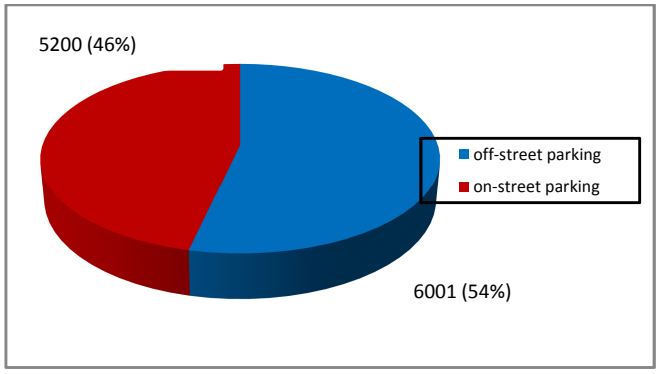


Fig. 5. Parking supply of Tunis city center

We have developed a simulation's environment in the software simulation MATSim (Multi-Agent Transport Simulation). As a matter of fact this software provides a toolbox to implement large-scale transport simulations based agents.

Moreover, for the project described, two methods were highlighted. For the first method, people can move randomly in the hope of finding places to park their vehicles in the area of their destinations. However, in the second method, drivers are

guided to parking places. Thus, a comparison between the two methods was established. Figure 4 provides an overview of the data structure.

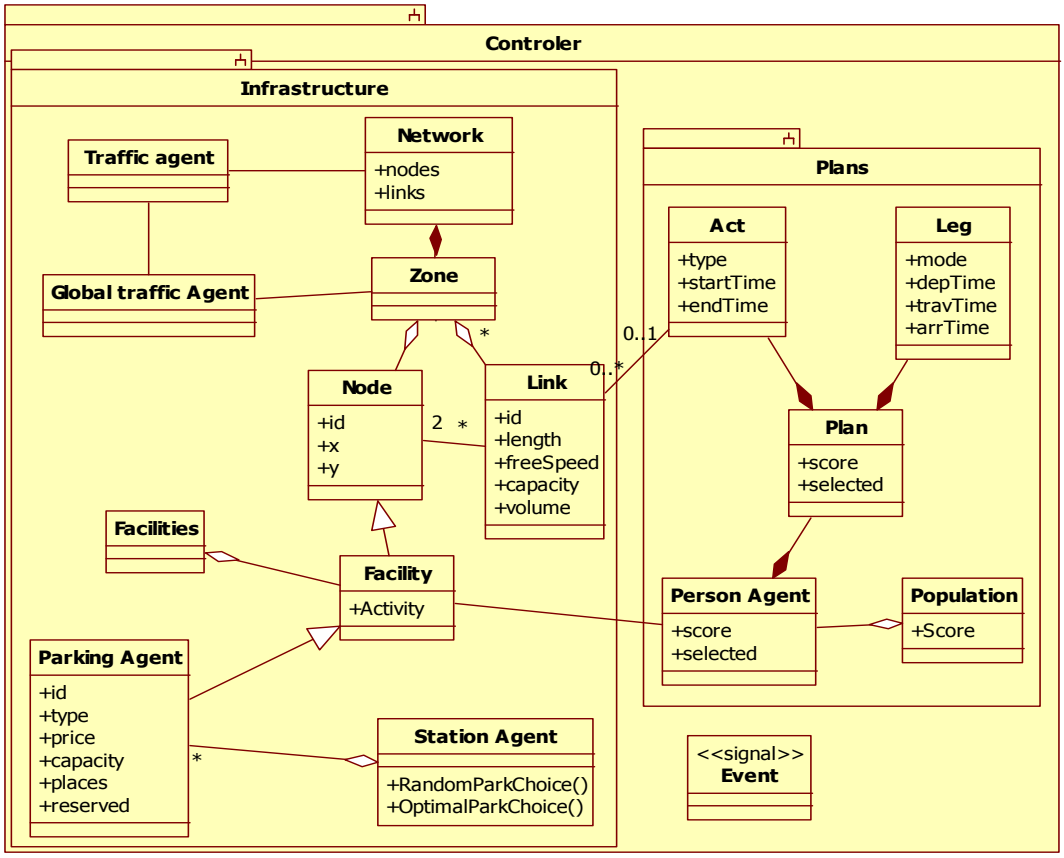


Fig. 6. The data network-based activity data

Network:

1) Node: each node is identified by a unique id and has *x*, *y* attributes which are converted from geographical location.

2) Link: each link has a unique id and is defined by a start and end node. Further important link attributes are length, capacity (vehicles per hour), free-flow speed and number of lanes.

Plan:

3) Agent person: each agent person refers to a citizen.

4) Itinerary: each itinerary contains the trips and activities done by the agent throughout a given time period. Within that period, each agent only has one itinerary. Each agent should and only have one itinerary for one day.

5) Trip: each trip contains multiple nodes and has distance, start and end time attributes. Hence the exact location of an agent at certain time can be retrieved.

6) Activity: each activity is what the agent is doing at a given time. It contains the activity type, such as shopping and education, location, start and end time attributes. Activity can also be considered as a trip with an event type and no change in the location.

4.1 CHANGES IN THE NUMBER OF VEHICLES IN CIRCULATION OVER TIME

After each simulation, MATSim generates a set of curves representing departures and arrivals of vehicles agents and the number of those on the roads. Figures 5 and 6 show the traffic for one day during the week by the two different methods.

These are curves that reflect the number of staff vehicles arriving, departing or moving every hour of the day. By doing so the red symbolizes the number of vehicles that have left their places of origin, the green curve represents the number of cars circulating in the street, whereas the blue curve shows the number of vehicles that have reached their destinations.

In order to compare the results of both methods, we proceed by comparing the curves. Table 1 can summarize the main results distinguished. Then we can notice that:

- With the method 2, the green curve is lower and the red curve is higher than of method 1. This implies that if drivers are guided to parking places, first the number of cars circulating in the street is fewer, and second the number of vehicles which have reached their destinations is higher despite that the number of vehicles which have left their places of origin is more important than if drivers are moved randomly in the hope of finding places to park their vehicles. The blue curves show that the number of vehicles that have led to their destinations on the 24 hours studied is higher in the case of method 2.
- The curves have two peaks: a first peak in the morning, which peaked at 8.00 and a second peak at the end of the day which peaked at 18:00. In fact, the morning peak reflects the number of vehicles that gets to the desktop. While the evening peak reflects the vehicles leaving work and returning home. In the morning, the maximum number of car (pic) is 12100 cars for method 1 against 11100 cars for method 2. It can be concluded that first, the traffic for method 2 is proportionally more fluid than the traffic of method 1. Second, the 2% of vehicles or 1000 cars reduced for method 2 represent the proportion of motorists who were looking for places to park. Therefore less time to find a parking place represents a reduction of travel time. This reduction has positive repercussions on the psychology of drivers, especially in the morning. The evening was recorded by more than 14.250 cars for method 1 against 13.900 cars for method 2. The traffic is fluid in the evening and compared to method 2, the percentage of reduced vehicle traffic is currently equal to 0.7%. It's lower than that found in the morning because the conductive agents who broke away from their workstations will move toward the periphery of the city center (away) or they will move downtown to a pattern of leisure or purchase; they are more likely to find vacancies. Similarly, for people arriving from the outskirts of the city center will be guided to parking places unoccupied.
- The number of vehicles in circulation is damped to 22:00 for Method 1 and to 21:00 for the method 2. One hour of traffic accounts for 4.17% of road traffic or 2084 vehicles. This is explained by traffic that has become more fluid and by lessening the time to find a parking place.

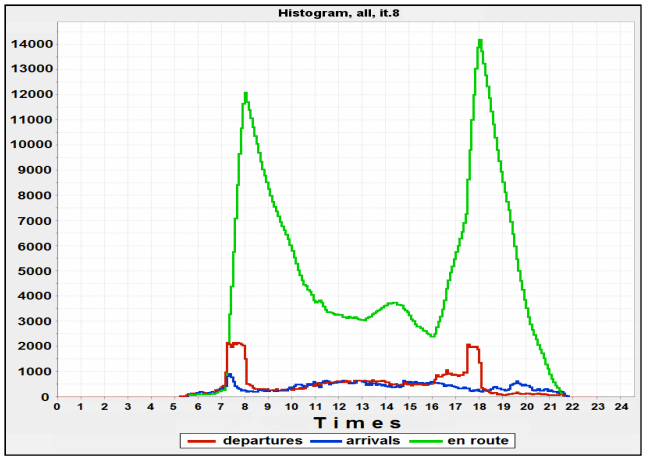


Fig. 7. Simulation of 50000 vehicles (Method 1)

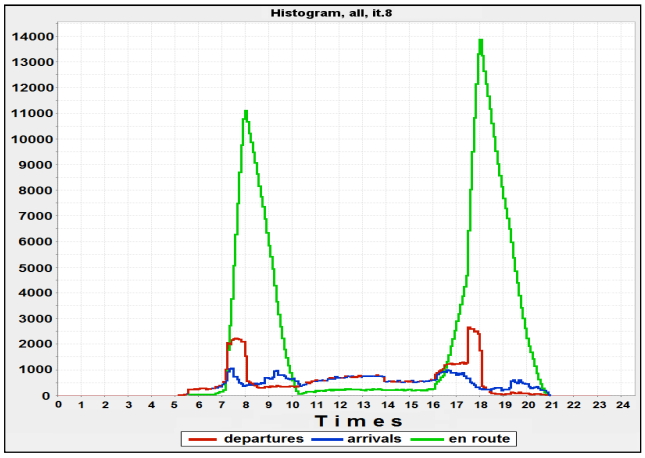


Fig. 8. Simulation of 50000 vehicles (Method 2)

Results obtained from method 2 imply that an intelligent management of parking demand could have several positive impacts on the environment (pollution, noise, energy ...), and the society (health, comfort, lower gas evolution ...).

4.2 Study of Statistical Scores according to MATsim

Three types of statistics are available for eight iterations generated in simulation: the best plan, the average plan and the worst plan as curves. Thus, the score function according to MATsim is defined as:

$$U_{plan}=\sum_{i=1}^{n}\left(U_{act,i}+U_{wait,i}+U_{lat,i}+U_{travel,i}\right) \quad (2)$$

Where, *i* denotes the activity, *n* the number of activities, the utility of a plan (U_{plan}) is the sum of four components: the total utility due to the implementation of the plan of activity *i* ($U_{act,i}$), the positive utility due to the establishment of the activity *i* ($U_{wait,i}$), the negative utility following a delay to achieve the activity *i* ($U_{lat,i}$), and the negative value due to the effect of the distance traveled to arrive at the *i* acitivity ($U_{travel,i}$).

Results of statistical scores (Table 1), show that method 2 is more efficient and more effective than Method 1.

4.3 STATISTICS DISTANCE TRAVEL

Figures 7 and 8 show the evolution of the total distance traveled by the 50000 vehicles for each iteration.

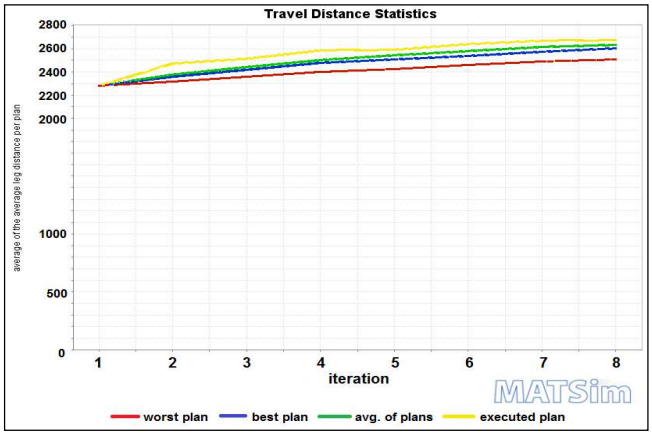


Fig. 9. Statistics on Distance Travel (Method1)

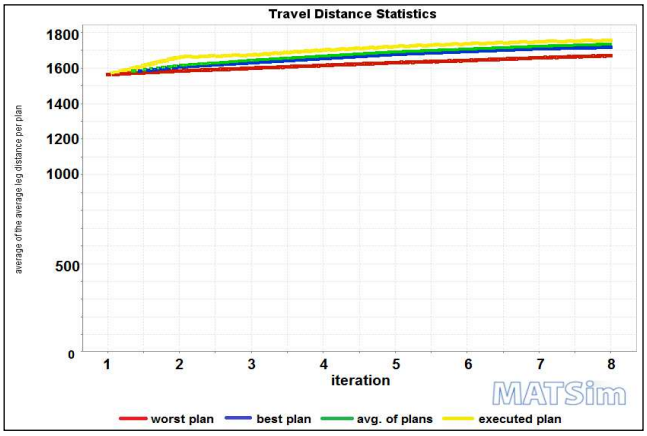


Fig. 10. Statistics on Distance Travel (Method2)

Table 2 presents the main differences between the two methods in term of the best distance traveled, the worst distance traveled, the average distance traveled, and the associated average saving of energy consumption.

Results of statistics distance traveled (Table 2) show also that method2 is more efficient and more effective than Method1.

Depending on the distance traveled, the average saving of energy consumption can be measured as:

$$ASEC = NV \times AFC \times D \times APD \quad (3)$$

Where, *ASEC* is the Average Saving of Energy Consumption, *NV* is the number of vehicles (50000), *AEC* is the average fuel consumption per 100 km (7 liters/100 km = 7%), *DT* is the distance traveled, and *APD* is the average price of fuel (1.250 TND). According the method 1, the average saving of energy consumption is:

$$1.09375\times10^{10} = (50000\times7\%\times2500\times1.250)\cdot$$

However, according method 2, it's:

$$0.74375\times10^{10} = (50000\times1700\times1.250)\cdot$$

A decrease in daily distance traveled by the resulting method 2 causes a reduction in average savings of energy consumption of 0.35×10^{10} .

Table 1. Statistical scores

	Method 1	***Method 2***
Score of the best plan	-55	23
Score of worst plan	-310	-103
Average score	-187.5	-47
Score of implementation	-160	-37.5
Score of start	-305	-92

Table 2. Comparative statistics

	Method 1	***Method 2***
Best distance traveled	2500 km	1700 km
Worst distance traveled	2400 km	1680 km
Average distance traveled	2520 km	1710 km
ASEC	1.09375×10^{10}	0.74375×10^{10}

Therefore, vehicles of a method 1 began with a distance of -305 km. While at iteration 1, vehicles reached a distance of 1570 km in method 2. The results of the travel distances reinforce the idea that method 2 is more efficient and more effective than Method 1.

The results show that finding a parking place is now guided. It can also provide a time saving, less congestion, less mileage, less movement and energy consumption and therefore less pollution. Then, it is possible to calculate for instance the average saving of energy consumption on the study area (table 2).

An impressive difference between the two proposed methods appears in the average distance traveled. Indeed, the best distance traveled by vehicles is 2500 km by method 2 against 1700 km by method 1, so there's been down for 800 km through the park during the 24 hours studied, making a decrease of 292000 km throughout the year. This decrease is synonymous with significant decrease energy consumption.

However, the Tunisian fleet consists of 40% of gasoline vehicles, diesel vehicles of 42% and 18% of diesel-50 vehicles (National Agency for Energy Conservation, 2009). Light vehicles, rolling months of 50 km-h average consume 7.17%, making 20936.4 liters of energy for all the vehicles and over a period of one year.

$$EE = 209364 \ \ liters \times AEP \qquad (4)$$

Where *AEP* is the average price of all energy types $((1.25+1.200+1.350+1.380)/4)$. So, with this intelligent parking management energy consumption expenditures can be reduced by 27112.638 (TND).

4.4 CHANGES IN THE OCCUPIED PARKING OVER TIME

The parking occupancy study involves field observations. It helps to determine the number of parking spaces occupied at different times of the day. We are interested in a first step, to all the car parks (on-street and off-street). Then we focus on the variation of the occupancy of two examples of parking: an on-street parking and another off-street parking. This study will observe the distribution of flows discounted vehicles through method 2.

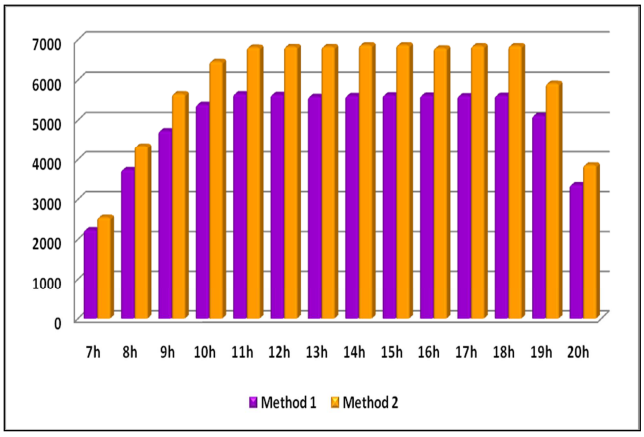


Fig. 11. Changes in the occupation of the parking space

The graph below is a comparison between the parking occupancy rate for method 1 and the occupancy rate of parking for method 2. It was found that using the method 2, we could better allocate vehicles looking for a parking spot, over all existing parking in downtown Tunis (cited above). This graph shows that the maximum vehicle accumulation is reached at 14h and 15h 6900 with parked cars.

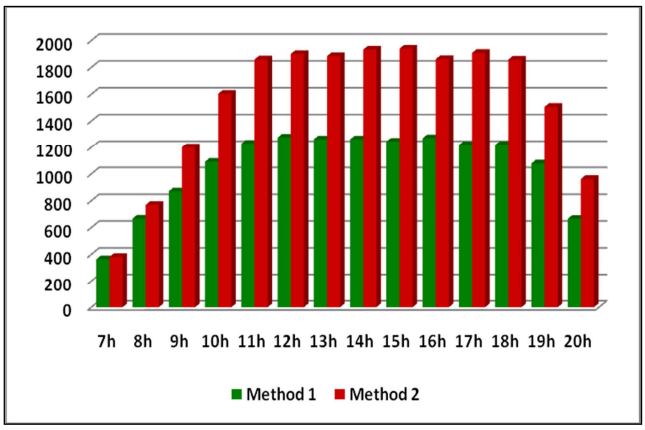


Fig. 12. Changes in the occupied of off-street parking

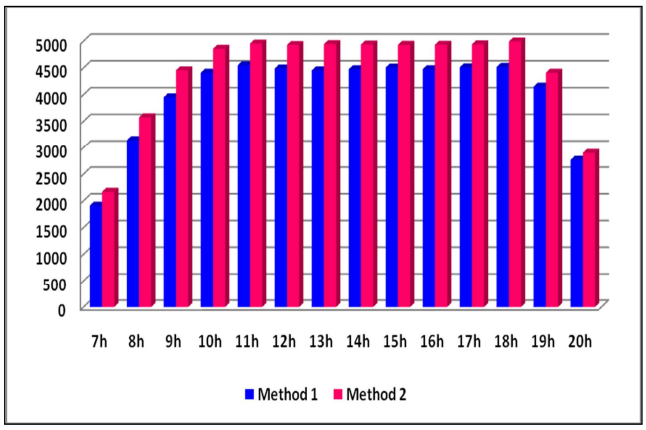


Fig. 13. Changes in the occupied of on-street parking

A comparison of Figure 12 and Figure 13 approves the method 2 is more efficient compared to Method 1. We also note that the on-street parking occupancy rate resulting from the method 1 and 2, is almost equal to the maximum occupancy of on-street parking rates. However, the occupancy rate gained by method 1 and 2, is less than the maximum occupancy rate of off-street parking. This can be explained by the behavior of drivers over at walking distance. Indeed, the drivers prefer the on-street parking rather than off-street parking, as parking is on-street located near the various activities while off-street car parks are more or less distant from the center of Tunis.

5 CONCLUSION

In order to research an intelligent car parking management system, this paper proposed a multi-agent system for minimizing the time spent in search of a location in a parking place. It starts with the description of the considered system organization in order to arrange the interactions, communications and coordination between agents. The coordination between them implies to find a vacant parking place, guide the driver to this area, and guarantee the reservation of the targeted area. Faced with all the possibilities that are available, the agents try to optimize the choice of driver for convenience and comfort.

Simulations established in this work show firstly the importance of our model of multi-agent in organization parking in a town center and secondly the differences between two methods, the first involving that people can move randomly in the hope of finding places to park vehicles and the second supposes however that our people are guided to park places. The results of the simulations from downtown Tunis are considered quite satisfactory in terms of reducing the search space for parking. Indeed, one could improve circulation by reducing the number of cars in the morning of 2% and 0.7% of the evening. In addition, the traffic per hour per day was reduced by approximately 4.17%. These results are due to the minimization of time looking for a parking place. The consequences of this minimization of search time has resulted in a reduction of the distance traveled, energy consumption, pollution, noise and other benefits such as an increase in the average age of the infrastructure, improving the psychology of drivers...

REFERENCES

[1] D.C., Shoup, "Cruising for parking". Transport Policy, 2006, 13, 479-486.

[2] A. Tofani, G. Dipoppa, G., "Report on available infrastructure simulators. Ente per le Nuove Tecnologie, l'Energia e l'Ambiente (ENEA), DIESIS ; Design of an Interoperable European federated Simulation network for critical Infrastructures, 23 octobre 2008. Available in http://www.diesis-project.eu/include/Documents/Deliverable2.3.pdf

[3] R. Mraihi, "Transport Intensity and Energy Efficiency: Analysis of Policy Implications of Coupling and Decoupling. In M. Eissa (Ed.), *Energy Efficiency - The Innovative Ways for Smart Energy, the Future Towards Modern Utilities*. Chapter 13 (pp. 271-288), InTech, 2012.

[4] G. Marsden, "The evidence base for parking policies-A review". *Transport Policy: Special Issue on Parking*, 13(6), 2006, 447–457.

[5] W. Fan, M. K. Babar "Modeling the parking pricing of multiple parking facilities under different operation regimes".*Journal of Transportation Technologies*, 2, 2012, pp. 260-266.

[6] I. Benenson, K. Martens, S. "PARKAGENT: An agent-based model of parking in the city. *Computers, Environment and Urban Systems*, 32, 2008, pp. 430-439.

[7] R. Lu, H. Zhu, "An Intelligent Secure and Privacy-Preserving Parking Scheme Through Vehicular Communications. *IEEE Transactions on vehicular*, 59, 2010, pp. 2773-2784.

[8] S.Y. Chou, S.W. Lin, C.C. Li, "Dynamic parking negotiation and guidance using an agent-based platform. *Expert Systems with Applications*, 35 (3), 2008, pp. 805-817.

[9] Y.C. Shiue, J. Lin, S.C. Chen, "A Study of Geographic Information System Combining with GPS and 3G for Parking Guidance and Information System. *World Academy of Science, Engineering and Technology*, 2010, pp. 418-423.

[10] F. Baumarius, "A multi-agent approach towards modeling urbain trafic scenarios. *The Research report RR- 92-47*, Deutsches Forschungszentrum fOr KOnstliche Intelligenz GmbH, 1992, pp. 2-16.

[11] H. Wang, W. He, "A reservation-based smart parking system. In Proc. 5th International Workshop on Cyber-Physical Networking Systems (colocated with IEEE INFOCOM), April 2011.

[12] M.T. Tsai, C.P. Chu, "Evaluating parking reservation policy in urban areas: An environmental perspective. *Transportation Research*, *Part D*, 17, 2012, pp. 145-148.

International Journal of Innovation and Scientific Research
ISSN 2351-8014 Vol. 17 No. 2 Aug. 2015, pp. 443-450
© 2015 Innovative Space of Scientific Research Journals
http://www.ijisr.issr-journals.org/

Removal of Acetic Acid from Aqueous Solution by using Activated Carbon

Abrha Berhe, Arul Jeevan, and Tsegu Lijalem

Department of Chemistry, College of Natural and Computational Sciences, University of Gondar, Gondar, Ethiopia

Copyright © 2015 ISSR Journals. This is an open access article distributed under the ***Creative Commons Attribution License***, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT: Adsorption of acetic acid from aqueous solution onto activated carbon was investigated to evaluate the effects of initial acetic acid concentration, contact time, nature of adsorbent and adsorbent dose on the removal of acetic acid systematically. The optimal contact time value for acetic acid adsorption onto the activated carbon was found to be 30 minute. Greater percentage of acetic acid adsorbed with increase in the initial concentration of acetic acid and increase in amount of adsorbent used. Adsorption data was modeled using the Langmuir and Freundlich isotherms. For all the samples, these data fitted well the Langmuir isotherm models in the range of the concentrations tested. Maximum amount of acetic acid adsorbed was 16.67 m mol/g. Adsorption of acetic acid onto treated sugar cane bagasse was highly favorable sorption than the activated carbon and the peels of banana.

KEYWORDS: Langmuir isotherm, Freundlich isotherm, Adsorption, Peels of banana (PB), Acetic acid, Activated carbon (AC), Treated sugarcane bagasse (TSG).

1 INTRODUCTION

Chemical industries are a major source of environmental pollution and large quantities of liquid streams that are sent out into the environment. Acetic acid is one of such contaminants found in waste streams. It a major component in the very useful manufacturing processes such as, the high grade phosphate fertilizer, rust proofing of iron, baking powder, phosphate syrups used in soft drinks, and water softening agents [1,2]. Adsorption is a surface phenomenon which involves interactions between the three components: the adsorbent, the adsorbate and the solvent. The interactive force that controls it is the affinity of the adsorbate for the adsorbent, as well as the solubility of the adsorbate in the solvent [3]. Nowadays pollution due to heavy metal contaminants from aqueous solutions is one of the most important environmental concerns due to their high toxicity and impact on human health. Heavy metals and is widely used in many industries including painting, petrochemical, newsprint, smelting, metal electroplating, mining, plumbing and battery industries [4]. Water is of fundamental importance for life on earth. The whole mechanism of metabolism, the synthesis and structure of colloidal cellular constituents, the solution and transport of nutrients inside cells and interactions with the environment are closely related to the specific characteristics of water [5]. The activated carbon has been till now the most used adsorbent but is expensive to use on a large scale and the idea of using natural adsorbents from waste material rises in this perspective. Banana plants belong to the family Musaceae. They are cultivated and used to a lesser extent for the production of fiber and as ornamental plants. The fruit averages 125 g, of which 25% is dry matter and the remaining is water. Banana is one of the largest consumed fruit in the world and useless peels therefore, creates one of the major agro-waste problems. For this reason, banana peels have been tested as adsorbents for acetic acid from aqueous solutions [6]. Sugarcane bagasse is one of the primary agroindustrial wastes. It contains carboxylic and hydroxyl groups, which show the capacity to adsorb the dye molecules by the ion exchange phenomena or by complexation hence it can be used as a cheap, attractive and effective adsorbent for the removal of acetic acid from wastewater [7,8].

This work is based on the identification and on the comparison of the adsorption properties of ACs obtained from sugar cane baggase, peels of banana and industrial prepared charcoal under different operating conditions, different impregnation ratios and to evaluate the validity of Langmuir and Freundlich isotherms and to investigate the effect of different parameters, such as initial concentration, adsorbent dose, and contact time. Acetic acid is an organic pollutant with a specific surface area

Corresponding Author: Arul Jeevan

close to that of nitrogen most often used in adsorption experiments, hence its is used in this study to characterize ACs samples.

2 EXPERIMENTAL SECTION

2.1 MATERIALS AND CHEMICALS

The reagents and chemicals used were Analytical grade acetic acid (99%) sodium hydroxide (Avishkar LAB TECH Chemicals. LOT), Adsorbent (commercial carbon, treated sugar cane bagasse and Peels of banana), Phenolphthalein indicator, distilled water was used throughout the work. Rotary shaker (VRN-480, GEMMY orbital shaker, Taiwan), Electronic balance (OHAUS, E1114, Switzerland), Electronic mill (GERMANY), Filter paper (whatman542, 90 mm diameter), Sieve of different size, oven, Magnetic stirrer, Burette, dropper, Elmneyer flask, measuring cylinder, 250ml of beaker, 50 ml beaker.

2.2 SOLUTION PREPARATION

The stock solution of acetic acid has 17.4 molar concentrations. The working solutions were made by diluting the former with distilled water. The range in concentrations of acetic acid solution was prepared from standard solution varied between 0.2 M – 1.0 M.

2.3 BATCH ADSORPTION STUDIES

The batch tests were carried out in glass-stoppered, Erlenmeyer flasks with 50 mL of working volume, with a concentration of 0.8 M. A weighed amount (2.0g) of adsorbent was added to the solution. The flasks were agitated at a constant speed of 200 rpm for 90 minute in a magnetic stirrer at 298^0K. Initial acetic acid concentration (0.2, 0.4, 0.6, 0.8, 1.0 M), contact time (10, 30, 50, 70, 90 min), adsorbent dose (0.5, 1.0, 1.5, 2, 2.5 g), were evaluated during the present study. The amount of acetic acid adsorbed in milli mole per gram was determined by using the following mass balance equation:

$$q_e = \frac{(c_i - c_e)V}{m}.$$

Where q_e is the amount of acetic acid adsorbed onto per unit weight of the adsorbent in mmol/g, C_i is the initial concentration of acetic acid in M, C_e is the equilibrium acetic acid concentration in M, V is the volume of adsorbate in liter and m is the weight of the adsorbent in grams. The percentage of removal of acetic acid was calculated from the following equation:

$$\text{Removal}(\%) = \frac{(c_i - c_e)}{c_i} \times 100$$

3 RESULT AND DISSCUSSION

3.1 EFFECT OF OPERATING PARAMETERS

The adsorption is influenced by various factors, which include initial acetic acid concentration, amount of adsorbent, nature of adsorbent, temperature, nature of adsorbent and contact time. The initial acetic acid concentration is one of the most important factors that determine the equilibrium concentration.

3.1.1 EFFECT OF INITIAL CONCENTRATION ON ADSORPTION

The effect of acetic acid concentration on activated carbon is given in Fig. 1. An increase in initial concentration of acid led to an increase in the adsorption capacity of acid on the activated carbon. This indicates that the initial concentration of acetic acid played an important role in the adsorption capacity of acetic acid on activated carbon.

3.1.2 EFFECT OF ADSORBENT DOSE ON ADSORPTION

The adsorbent dose is also one of the important parameters to optimize an adsorption system. The effect of adsorbent dose on the adsorption of acetic acid has been investigated by employing different doses of AC varying from 0.5 to 2.5 g. The

removal of acetic acid increases with increase in adsorbent dosage is given in Fig. 2. When the activated charcoal dosage was 0.5 g, the removal efficiency of acetic acid was 65.0 %. As the dose increased to 2.5 g, the trend of removal efficiency tended to be increased to 68.13%. An increase in the adsorption with increase in adsorbent dosage can attribute to greater surface area and the availability of more adsorption surface sites.

However, the adsorption capacity decreases from 52.0 to 10.9 mmol/g by increasing the adsorbent amount from 0.5 – 2.5. The decrease in adsorption capacity is basically is because of the available sites for adsorption are unsaturated and is depicted in Fig. 3. In high adsorbent concentration, adsorption capacity is reduced and it can be as a result of overlapping adsorption sites on adsorbent surface. There is an excess surface area of the adsorbent for adsorption and hence for 2.5 g adsorbent the optimum percent of removal of acetic acid and adsorption capacity are found to be 68.13% and 10.9 mmol/g respectively.

3.1.3 EFFECT OF CONTACT TIME ON ADSORPTION

Batch adsorption studies have also been conducted at different contact times (10, 30, 50, 70, 90 min) by taking initial concentration of acetic acid 0.8 M with 2 g adsorbent dose of activated charcoal in 10 mL acetic acid solution and at 25 °C temperature . Effects of contact time on removal of acetic acid by activated charcoal are presented in Fig. 4. Time of contact of adsorbate and adsorbent is of great importance in adsorption since contact time depends on the nature of the system used. It is seen from these curves that initially the uptake of acetic acid is quite rapid, becoming slower with the lapse of time and then equilibrium was achieved. It is clear that after a time of contact of 30 minutes with activated charcoal, the adsorbed amount of the acetic acid does not vary practically any more and attained equilibrium at 30 min for acetic acid in the studied concentration range. Therefore, it is good agreement with literature value.

3.1.4 EFFECT OF NATURE OF ADSORBENT ON ADSORPTION

The amount adsorbed from a solution depends on the properties of the adsorbent (chemical nature of the surface, dimension of the pores) those of the solution and of its constituents. The effect of nature of adsorbent surface on adsorption phenomena is illustrated in Fig. 5. The percent of adsorption of acetic is highest in treated sugar cane bagasse. A high coefficient A_{ma} guarantees a good adsorption of acetic acid on treated sugarcane bagasse.

3.2 ADSORPTION ISOTHERM

3.2.1 LANGMUIR ISOTHERM ADSORPTION

The results obtained from the Langmuir model for the removal of acetic acid onto AC are shown in Fig. 6. The correlation coefficients reported and showed strong positive evidence on the adsorption of acetic acid onto AC follows the Langmuir isotherm. The applicability of the linear form of Langmuir model to AC was proved by the high correlation coefficients R^2 =0.996. This suggests that the Langmuir isotherm provides a good model of the adsorption system.

The R_L parameter is considered as a more reliable indicator of adsorption. In both the cases, the values of R_L (Table 1) are found to be positive and less than one indicating thereby a highly favorable adsorption in all cases.

3.2.2 FREUNDLICH ADSORPTION ISOTHERM

From the Fig. 7 and table 2, it was found that Freundlich adsorption constant value $1/n$ is greater than one and K_F is less than 1, indicating the adsorption of acetic acid from aqueous solution in the concentration range is not favorable [9,10].

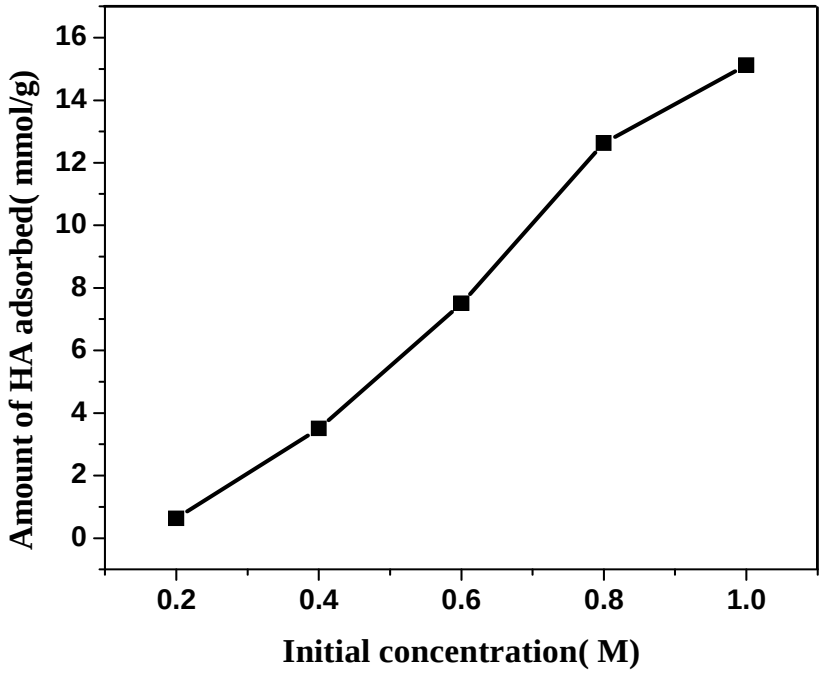


Fig. 1. Effect of adsorbate concentration on adsorption (Adsorbent dose 2.0 g, volume of adsorption medium: 10 mL, temperature: 298 K and contact time 90 min, rpm = 200)

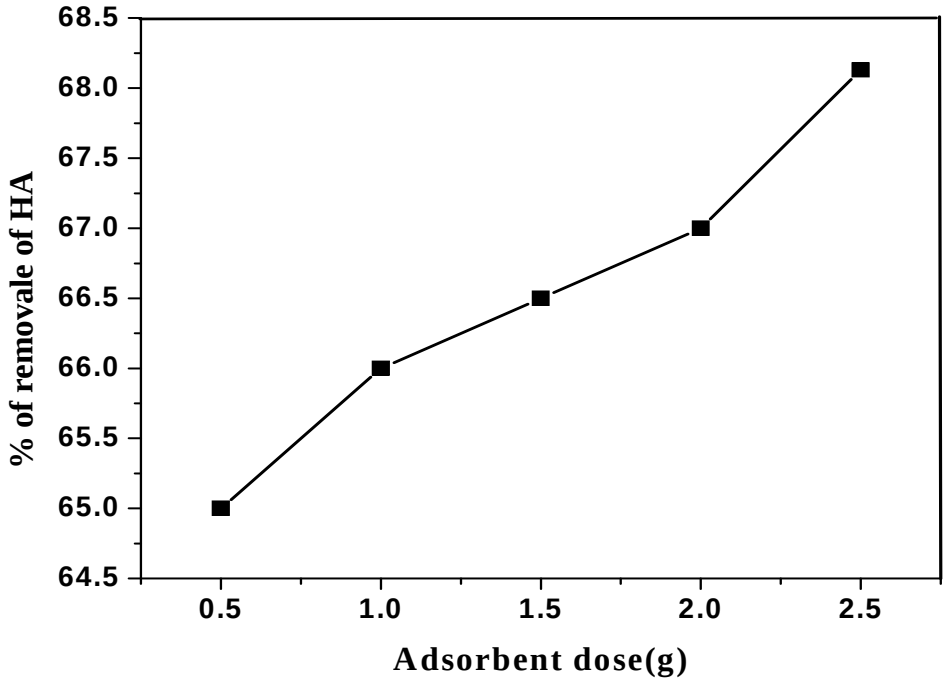


Fig. 2. Effect of adsorbent dosage on adsorption (Contact time 90 min, Initial acetic acid concentration 0.8 M, volume of adsorption medium 10 mL T = 298 K, rpm = 200)

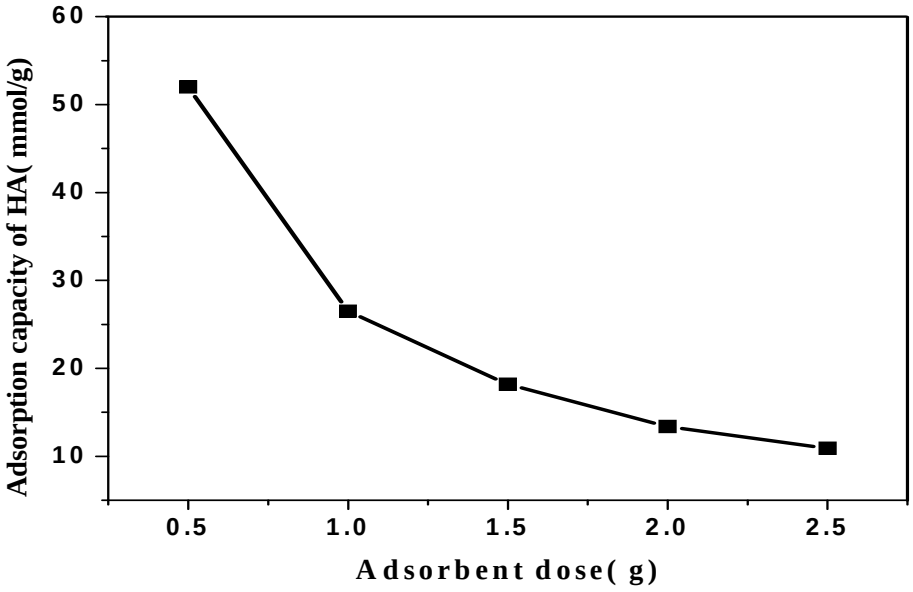


Fig. 3. Effect of adsorbent dosage on adsorption (Contact time 90 min, Initial acetic acid concentration 0.8 M, volume of adsorption medium 10 mL, T = 298 K, rpm = 200)

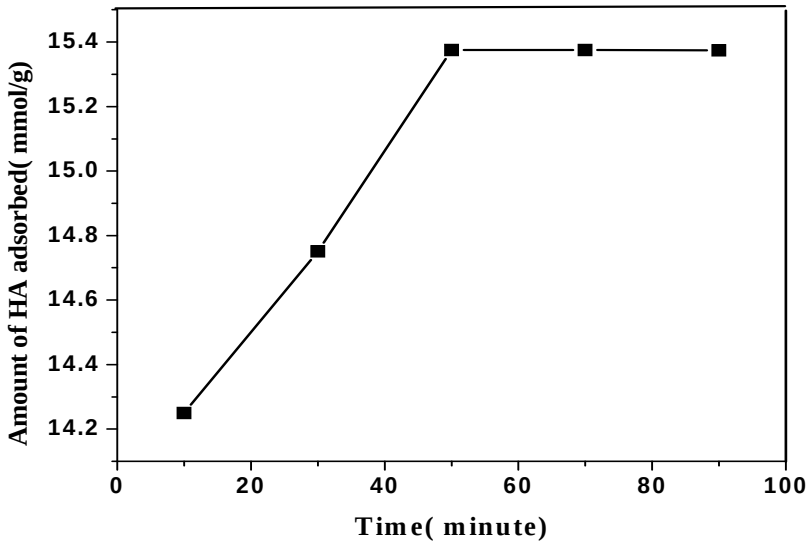


Fig. 4. Effect of contact time on adsorption (Adsorbent dose 2 g, Initial acetic acid concentration 0.8 M, volume of adsorption medium 10 mL, T = 298 K, rpm = 200)

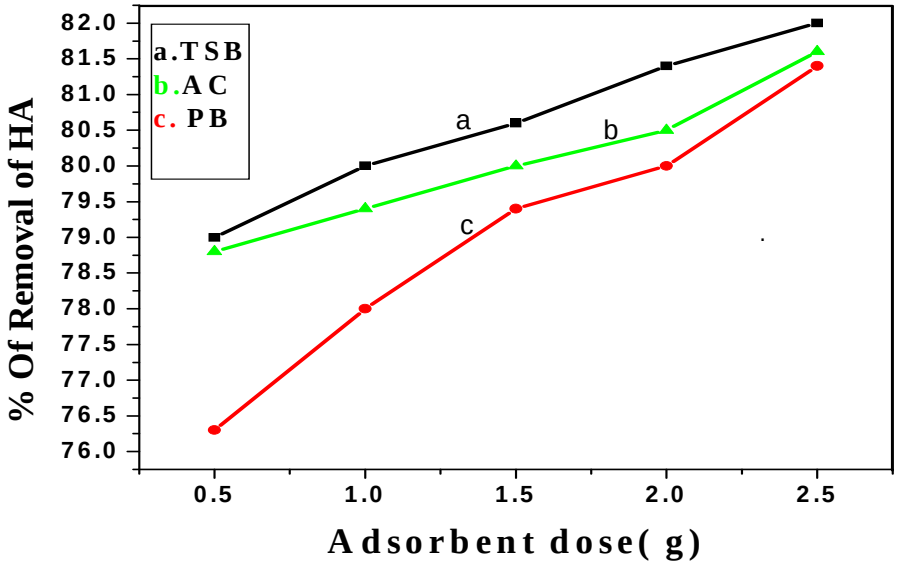


Fig. 5. Effect of nature of adsorbent on adsorption (Adsorbent dose 0.5-2.5 g, Initial acetic acid concentration 0.8 M, volume of adsorption medium 10 mL, T = 298 K, rpm = 200)

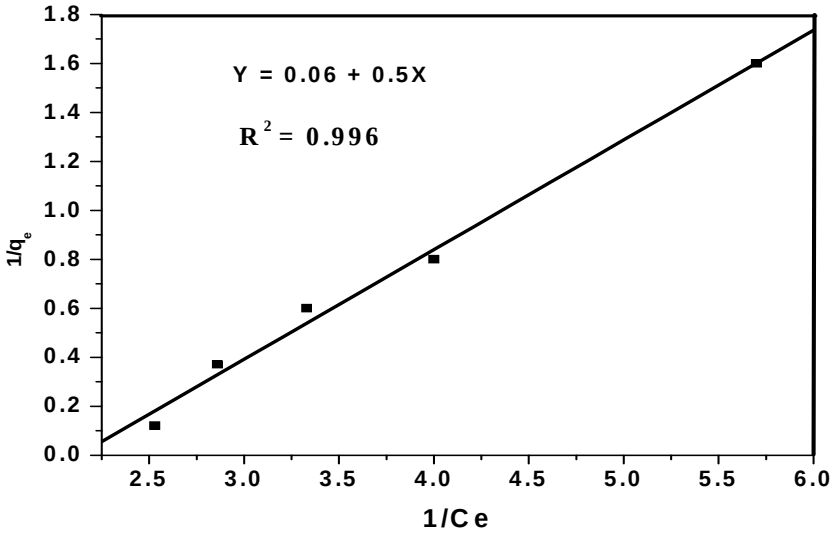


Fig. 6. Langmuir plots for adsorption of acetic acid on various concentrations at 25^0C, adsorbent dose 2 g, volume of adsorption medium 10 mL, T = 298 K, rpm = 200

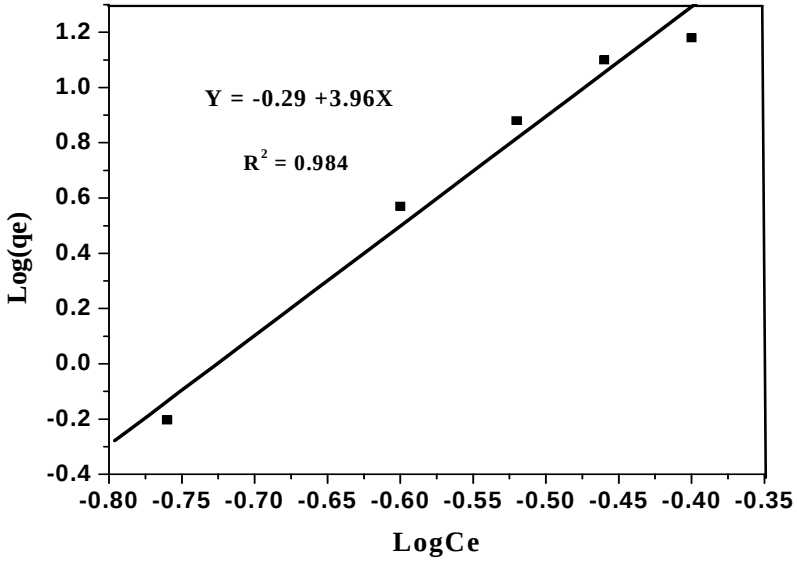


Fig. 7. Freundlich plots for adsorption of acetic acid on various concentrations at 25^{0}C, adsorbent dose 2 g, volume of adsorption medium 10 mL, T = 298 K, rpm = 200

Table 1. Characteristics of Langmuir isotherm constant (separation factor, R_L)

Initial Acetic acid Concentration (C_0)	$R_L = \frac{1}{1+K_L C_0}$
0.2	0.97
0.4	0.94
0.6	0.92
0.8	0.89
1.0	0.86

Table 2. Freundlich and Langmuir adsorption isotherm constants

Lanqmuir isotherm			Freundlich isotherm		
A_{max}	K_L	R^2	K_F	1/n	R^2
16.67	**0.125**	**0.996**	**0.513**	**3.96**	**0.984**

4 CONCLUSION

The adsorption behavior of acetic acid on activated carbon was studied as a function of the adsorbent dose, concentration of the adsorbate, contact time and nature of adsorbent. Analysis of the results shows that the acetic acid adsorption process on activated carbon was increased as the initial concentration of acetic acid increased. Furthermore amount of adsorbed solute increases the adsorption also increases at constant concentration. The effect of contact time was conducted and the balance time was achieved at 30 minute. But adsorption capacity of acetic acid decreases with increases the amount of adsorbent dose. From this study, the adsorption isotherm studies were performed and from this the Langmuir separation factor is between 0 and 1 and hence the process of acetic acid adsorption on activated carbon is well fitted with the Langmuir adsorption isotherm. However the Freundlich adsorption intensity 1/n is greater than one and the Freundlich constant K_F is less than one, which indicates unfavorable adsorption.

ACKNOWLEDGMENTS

The authors are grateful to Mr. Nibret Belay (Chemistry Department, UoG) for his kindly cooperation in facilitating conditions and resources throughout our study and University of Gondar for its provision of all resources necessary to accomplish the study by providing the necessary ingredients.

REFERENCES

[1] S. G. Anagho, J. M. Ketcha, A. M. Kammegne, J. N. Ndi, N. G. Ndifor-Angwafor and D. R. T. Tchuifon, Der Chemica Sinica, (2013). Equilibrium, kinetic and thermodynamic studies of phosphoric acid adsorption onto activated carbon 4(3):58-68.

[2] D.L. Erwing, Industrial Chemical Process Design; McGraw-Hill, New York, 2002, 621-622.

[3] E.G. Furuya, H.T. Chang, Y.Miura and K.E. Noll; J. Sep. P. Tech., (1996), A fundamental analysis of the isotherm for the adsorption of phenolic compounds an activated carbon, 11, 69-78.

[4] A. A. Abia and E. D. Asuquo, African Journal of Biotechnology, (2006). Lead (II) and nickel (II) adsorption kinetics from aqueous metal solutions using chemically modified and unmodified agricultural adsorbents. Vol. 5 (16), 1475-1482.

[5] M, Shrimali, K. P. Singh, Environmental Pollution (2001). New methods of nitrate removal from water. 112: 351-359.

[6] Z. Abbasi and M. Alikarami, Biochemistry and Bioinformatics (2012), Kinetics and thermodynamics studies of acetic acid adsorption from aqueous solution by peels of banana, Vol. 1 (1), 001 -007.

[7] F. Vander, P. G. Lettinga, and J. A. Filed, Chemosphere (2001). Azo dye decolorization by anaerobic granular sludge. 44: 1169-1176.

[8] S. Zaheer, H. N. Bhatti, S. Sadaf, Y. Safa, and M. Zia-ur-Rehman, The Journal of Animal & Plant Sciences, (2014). Biosorption characteristics of sugarcane bagasse for the removal of foron blue e-bl dye from aqueous solutions. 24(1): 272-279.

[9] H. Patel, R. T. Vashi, World Academy of Science, Engineering & Technology, (2010), A study on removal of toluidine blue dye from aqueous solution by adsorption onto neem leaf powder", 47, **831.**

[10] P. Sharma and H. Kaur, Applied Water Science, (2011), "Sugarcane bagasse for the removal of erythrosin B and methylene blue from aqueous waste", 1, **135–145.**

International Journal of Innovation and Scientific Research
ISSN 2351-8014 Vol. 17 No. 2 Aug. 2015, pp. 451-465
© 2015 Innovative Space of Scientific Research Journals
http://www.ijisr.issr-journals.org/

Assessing Innovation Practices in Project Management: The case of Palestinian Construction Projects

Rawan Ghaben[1] and Ayham A.M. Jaaron[2]

[1]Engineering Management Division, Faculty of Graduate Studies,
An-Najah National University,
Nablus, West Bank, Palestine

[2]Industrial Engineering Department, Faculty of Engineering and Information Technology,
An-Najah National University,
Nablus, West Bank, Palestine

Copyright © 2015 ISSR Journals. This is an open access article distributed under the ***Creative Commons Attribution License***, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT: Project management is regarded as one of the most important tools that have been used to maximize the probability of having a successful project. Nevertheless, most projects fail to achieve their goals, and this is to the detriment of the organizational competitive advantage. In this dilemma, innovation practices have become the engine through which methods, relationships, and processes of project management can be enhanced to increase project successfulness and competitive advantage. The purpose of this study is to investigate the innovation practices in the construction project management process in the Palestinian construction sector. A mixed methods methodology has been used in this research using semi-structured interviews with key project managers and questionnaire deployment. A total of 365 questionnaires were conducted in the consulting and contracting firms that operate in the construction projects sector in Palestine, with an overall response rate of 52.4.%, allowing the testing of a number of theoretical hypotheses. The analysis of the results showed that there is a statistically significant relationship at a significant level ($\alpha \leq 0.05$) between five innovation practices: (1) Strategic Management, (2) Internal Innovative Working Environment, (3) External Innovative Working Environment, (4) Stakeholders Management, and (5) Project Management. The value of this research is the identification of the main innovative practices being used in the construction projects in the context of a developing country like Palestine, and the extent to which these practices are being applied.

KEYWORDS: Project Management; Innovation; Construction Industry; Palestine; Mixed Methodology.

1 INTRODUCTION

Nowadays, the construction industry has been built on the need of the world's inhabitants to provide shelter, harness energy, and create public access [1]. The Construction industry is that part of the economy that deals with the design, construction, maintenance, and utilization as well as with the modulation, modification and demolition or deconstruction of constructs[2]. Construction is a unique environment and by definition is a creative industry [3]. It is a powerful sector that provides jobs and stimulating growth for other construction-related economic activities, such as: factories of ready mix concrete, stone saws, brick, and tiles. However, it is a tough business with a very demanding and stressful process [4]. It is often viewed as being stubborn, risk averse and old-fashioned [5]. It is also characterized by having many players of multiple disciplines who are brought together at various stages throughout a single project [6]. Compared to most other industries, construction projects involve relatively intensive labor use, and consume large amount of materials and physical tools [7]. They are also subject to a variety of laws and regulations that aim to ensure public safety and minimize environmental impacts [8]. All these characteristics suggest that this industry is confronted by "wicked problems" [9].

Corresponding Author: Ayham A.M. Jaaron

Construction plays a significant role in developing countries, including the Palestine's economy. According to PCBS [10], it contributes around 15.4% to Palestine GDP and it constitutes about 14.9% of its workforce. However, like the construction industry in other developing countries, where projects are highly uncertain, and operate in a highly unstable, unpredictable and poorly resourced environment [7], the construction industry in Palestine is in a crisis and challenged by many problems, such as: the stakeholders are less experienced in project management and strategic management, lack of internal and external innovative working environment, construction workers are almost unskilled and with little education, no social security benefits for workers, and the connectivity of Palestine's economy to the Israeli economy that is a fatal threat to the industry.

The local construction industry is one of the main economic engine sectors that supports the Palestinian national economy. Nevertheless, the construction sector has long been suffering from its lack of innovation that has negative effects on project management, capability of organizations and creativity of the employees. This research inquiry is based on the hypothesis that the construction project management, when integrated with innovation, can offer potential solutions to construction wicked problems and can, at the end, lead to really successful construction projects, from a point of view of all stakeholders involved to complete a specific project. Thus, the overall aim of this study is to explore the innovation practices used in the Palestinian construction project management, and then assessing to what extent these practices are being implemented. Such evaluation is very important to assist firms in understanding their strengths and weakness, and to enhance their ability to move from survival strategies to innovative culture with a long- term sustainability.

In response to this, Tushman and Nadler [11] stressed that organizations can gain competitive advantage only by managing effectively for today while simultaneously creating innovation for tomorrow. Moreover, Hamel [12] stated, while not every innovation practice will result in competitive advantage, it is not an excuse not to innovate because the more you are innovative, the greater the chance of reaping a huge return.

The desire for innovation in the construction has been recognized by different authors. Barrett et al. [13] remarked that successful innovation enables construction firms to better satisfy the aspirations and needs of society and clients. Eaton [14] declared, without innovation a business does not have a rational source of competitive advantage in construction. In addition, Gann [15] stated that construction firms need to improve their capabilities in managing innovation if they are to build reputations for technical excellence that set them apart from more traditional players. According to Blayse and Manley [16],organizations need to innovate to win projects. However, a major dilemma is how innovation can be stimulated in the construction sector.Kavanagh and Naughton [17] argued that project management can drive a nation's capability of innovation. Project management is one of the most important tools that have been used to maximize the probability of having a successful construction project. It plays important roles in planning, coordination, control and execution of construction projects, and it has provided efficient tools and many techniques for engineering and construction firms.

2 INNOVATION PRACTICES IN CONSTRUCTION PROJECT MANAGEMENT

Project management today is a matter of survival for many organizations. Today, organizations do not have the choice whether or not to adapt project management approach, but on how well project management is implemented [20]. Project management involves the application of knowledge, skills, tools and techniques to project activities in order to meet or exceed stakeholders' needs and expectations from a project [21]. According to Hendrickson [22], the Project Management Institute focuses on nine distinct areas requiring project manager knowledge and attention: (1) *Project integration management* to ensure that the various project elements are effectively coordinated, (2) *Project scope management* to ensure that all the work required (and only the required work) is included, (3) *Project time management* to provide an effective project schedule, (4) *Project cost management* to identify needed resources and maintain budget control, (5) *Project quality management* to ensure functional requirements are met, (6) *Project human resource management* to development and effectively employ project personnel, (7) *Project communications management* to ensure effective internal and external communications, (8) *Project risk management* to analyze and mitigate potential risks, and (9) *Project procurement management* to obtain necessary resources from external sources. The summary of the nine areas form the basis of the Project Management Institute is shown in Fig. 1. From a construction industry perspective, Casey [23] defined construction management as delivering a product according to specification and stakeholder expectations. While, Walker [24] defined construction management as the planning, co-ordination and control of a project from conception to completion on behalf of a client requiring the identification of the client's objectives in terms of utility, function, quality, time and cost, and the establishment of relationships between resources, integrating, monitoring and controlling the contributors to the project and their output, and evaluating and selecting alternatives in pursuit of the client's satisfaction with the project outcome.

1. Integration Management 1.1 Project Plan Development 1.2 Project Plan Execution 1.3 Integrated Change Control	**2. Scope Management** 2.1 Initiation 2.2 Scope Planning 2.3 Scope Definition 2.4 Scope Verification 2.5 Scope Change Control	**3. Time Management** 3.1 Activity Definition 3.2 Activity Sequencing 3.3 Activity Duration Estimating 3.4 Schedule Development 3.5 Schedule Control
4. Cost Management 4.1 Resource Planning 4.2 Cost Estimating 4.3 Cost Budgeting 4.4 Cost Control	**5. Quality Management** 5.1 Quality Planning 5.2 Quality Assurance 5.3 Quality Control	**6. HR Management** 6.1 Organizational Planning 6.2 Staff Acquisition 6.3 Team Development
7. Communications Management 7.1 Communications Planning 7.2 Information Distribution 7.3 Performance Reporting 7.4 Administrative	**8. Risk Management** 8.1 Risk Identification 8.2 Quantitative Risk Analysis 8.3 Risk Response Planning 8.4 Risk Monitoring and Control	**9. Procurement Management** 9.1 Procurement Planning 9.2 Solicitation Planning 9.3 Solicitation 9.4 Source Selection 9.5 Contract Administration 9.6 Contract Closeout

Fig. 1.PMI's Nine Project Management knowledge Areas

Unfortunately, management in the construction industry has been characterized as being weak, insufficient, nebulous, backward and slow to react to changing conditions [25].Thus, the project management need to be more dynamic and flexible to cope with challenges. As mentioned by Newton [26], construction innovation may become a fourth performance dimension in the future in addition added to the traditional dimensions of cost, quality and time.

When defining innovation it is necessary to recognize that innovation is not invention [27]. Invention is a new product, innovation is a new customer benefit, invention is the conversion of cash into ideas and innovation is the conversion of ideas into cash. Projects are vehicles of the transition from invention to innovation [28]. Galbraith [29] defines innovation as the application of a new idea to create a new process or product that can differentiate a company and maintain it fit as environmental forces and competitors' strategies change. Drucker [30] explained that innovation is the process that creates markets that nobody before even imagined. Zuckerman Committee [31] defined innovation as a series of technical, industrial and commercial steps. Whereas Pinchot and Pinchot [32] enlarged the scope of the term by relating it to the methods, relationships and processes of the organization. In general, DOC [33] defined innovation as the design, development, and implementation of new or altered products, services, processes, organizational structures, and business models to create value for the customer and financial returns for the firm practicing innovation. In order to stimulate innovation in construction sector, it is important to recognize that innovation in construction is not confined to new technological inventions [34]. According to CERF and Washington [35], innovation in construction is perceived as: *"The act of introducing and using new ideas, technologies, products and/or processes aimed to solve problems, viewing things differently, improving efficiency and effectiveness, or enhancing the standard of living".*

An increased interest has been placed on understanding which practices affect more substantially the innovation capability of the company [36]. Based on experiences in innovation consulting for different branches, Kearney [36] has developed the "House of Innovation" model. This model depicts the most important building blocks of successful innovation management. It tests innovation practices, according to four dimensions: (1) An innovation strategy that is aligned with the business strategy, (2) An organization that drives innovation by its structure and culture, (3) A product-life-cycle process that continually develops the capabilities for idea generation, and (4) Enabling factors for innovation management. In the same context, Neely and Hii [38]posit that the innovation capacity of a firm regards three interrelated perspectives: (1) culture, (2) internal processes and (3) external environment.

From a construction perspective, Seaden and Manseau[39] argued that innovation in construction regards the linkages between four important factors: (1) business environment, (2) business strategy, (3) innovative practices, and (4) business outcomes. While, Dikmen et al. [40]argued in their conceptual framework that innovation in construction regards the linkages between other four distinguished factors that are: (1) objectives, (2) strategies, (3) environmental barriers/drivers, and (4) organizational factors. According to the extensive literature review, and as shown in Table 1, 26 factors that may affect innovation in construction were identified. Factors of similar nature were grouped together; giving rise to four main

groups, that are: (1) Strategic Management, (2) Internal Innovative Work Environment, (3) External Innovative Work Environment and (4) Stakeholder Management. It is assumed that organizations wanting to enhance project management competencies and improve their innovation performance should consider adopting similar practices.

Table 1. Innovation Practices in the Construction Project Management

Strategic Management	**Stakeholder's Management**
1. Establishing a vision which embraces innovation 2. Establishing SMART objectives 3. Formulating Strategies 4. Conducting internal audit "Strength & Weakness" 5. Conducting external audit "Opportunities & Threats"	1. Identifying Stakeholders 2. Exploring stakeholders' needs and constraints to projects 3. Analyzing conflicts among stakeholders 4. Ensuring effective communication between stakeholders 5. Evaluation the stakeholder satisfaction 6. Stakeholder involvement in decision-making 7. Keeping and promoting an ongoing relationship with stakeholders
Internal Innovative Work Environment	**External Innovative Work Environment**
1. Employee motivation and job satisfaction 2. Provide appropriate internal conditions for workers in terms of ventilation, lighting, services, tools, etc. 3. Provide innovative culture in the organization 4. Dynamic, open minded and supportive top management 5. Provide rewards and recognition for creative work 6. Workloads are managed to ensure staff have sufficient time to pursue innovation 7. Provide training for employees	1. Responding to change in customer needs 2. Utilization of new technology 3. Dealing with social and environmental variables 4. Dealing with the economic and political variables 5. Collaborate and communicate with competitors 6. Collaborate and communicate with suppliers 7. Reacting to market changes and consequently competitiveness

2.1 STRATEGIC MANAGEMENT

Strategic management consists of the analysis, decisions, and actions an organization undertakes in order to create and sustain competitive advantages [41]. Strategic management consists of two parts of the analysis: the analysis of strategic goals and the analysis of the internal and external environment of the organization. To make strategic analysis, this requires managers to define the corporate vision & mission, specify SMART objectives and develop realistic strategies. Without a vision of where the company is going, often there can be limited success in innovation [42]. While the identification of a clear mission for a project is widely considered essential for the effective management of stakeholders [43]. In addition, objectives should be stated as action verbs and appropriate strategy is needed to state how the organization will achieve its objectives. On the other side, to make environmental analysis, SWOT (Strengths, Weaknesses, Opportunities and Threats)analysis is the most important environmental scanning technique [44]. A good SWOT analysis can help a company cope with change in both external and internal environments. The above is articulated more formally in the following hypothesis:

H1: There is a positive relationship between strategic management and project management.

2.2 INTERNAL INNOVATIVE WORK ENVIRONMENT

Prather [45] agrees that human factors are critically important in the innovation process, but adds that they need the right work environment. Innovation needs a good atmosphere in which to develop [42]. Innovation cannot flourish in a climate of job dissatisfaction where people do the minimum to keep their jobs [46]. For innovation to flourish, people need to be intrinsically motivated to perform [45]. There are a number of key internal factors to the construction firm that influence innovation, including the organizational climate for innovation, skills and capabilities of the workforce, availability of resources, top level commitment, and company strategy [47]. According to Ahmed [48], organizational culture is a major determinant of innovation. While Hana [49] stated that innovations could only turn out to be successful if they are supported by top management and if an innovative creative team is developed and composed of people that may be considered knowledge employees. In addition, Baldwin [42] argued that the better everyone in the company understands the goals and objectives of the company, the better this process of innovation should be. Based on this, the following hypothesis has been formulated:

H2: There is a positive relationship between internal innovative work environment and project management.

2.3 EXTERNAL INNOVATIVE WORK ENVIRONMENT

A critical component of successful innovation is the ability of a firm to exploit and utilize external knowledge from different sources of innovation [50]. The generation and utilization of knowledge depend on the frequency and density of the interactions with external sources of innovation and the firm's openness to external knowledge [51]. Organizations that do not recognize the impact of various innovations and have not adapted to changing environments have justifiably been forced out of the mainstream of construction activities [22].

Milliken [52] argued that the environmental uncertainty arises from the organization's inability to predict its environment, or in other words, to predict the factors that characterize its environment. According to Bourgeois [53], these factors are usually classified into two groups, general and task external business environment factors. The general environment is typically composed of factors such as social values, educational, political, economic, legal, behavioral, demographic, natural environment, natural resources, and technological [54]. Asheghian and Ebrahimi [55] argued further that the task environment is the closest environment of the organization and the elements that made it is influencing the organization directly. This environment is made up of factors such as consumers, competitors, suppliers, labor market, industrial and financial resources.

The construction literature provides insight into a number of possible variables from the external environment. According to Hana [49], in the process of innovation, knowledge is an essential element to help gain an advantage over other organizations. Gann [15] stated that government has a key role to play in promoting and supporting innovation in the production of the built environment. While Tatum [56] argued that development and effective use of new technology can provide important competitive advantages for engineering and construction firms. Articulated more formally as:

H3: There is a positive relationship between external innovative work environment and project management.

2.4 STAKEHOLDER MANAGEMENT

Project Management Institute [57] defined project stakeholders as individuals and organizations who are actively involved in the project, or whose interests may be positively or negatively affected as a result of project execution or successful project completion. The checklist of stakeholders in a construction project is often large and would include the owners, project managers, designers, contractors, subcontractors, legal authorities, employees, suppliers, competitors, banks, etc. [58]. To ensure a successful project, the project team must identify the stakeholders, determine their requirements and expectations, and manage their influence in relation to the requirements [59]. An increasing number of studies have identified the importance of stakeholder management in construction projects. Freeman et al. [60] stated that identifying stakeholder interests is an important task to assess stakeholders and they also consider analyzing the conflicts and coalitions among stakeholders is an important step for stakeholder management. In the same context, Walker et al. [61] considered identifying stakeholder, prioritizing stakeholders, visualizing stakeholders, engaging stakeholders, and monitoring effectiveness of communication as the basic steps for stakeholder management. The leads to formulating the following hypothesis:

H4: There is a positive relationship between stakeholder management and project management.

The conceptual model, shown in Fig. 2, has been used to identify research hypotheses. In addition to the above four hypotheses, another five hypotheses were developed based on literature review presented above, to explore the relationships among the four practices that are:

H5: There is a positive relationship between strategic management and internal innovative work environment.

H6: There is a positive relationship between internal innovative work environment and external innovative work environment.

H7: There is a positive relationship between external innovative work environment and stakeholder management.

H8: There is a positive relationship between strategic management and external innovative work environment.

H9: There is a positive relationship between internal innovative work environment and stakeholder management.

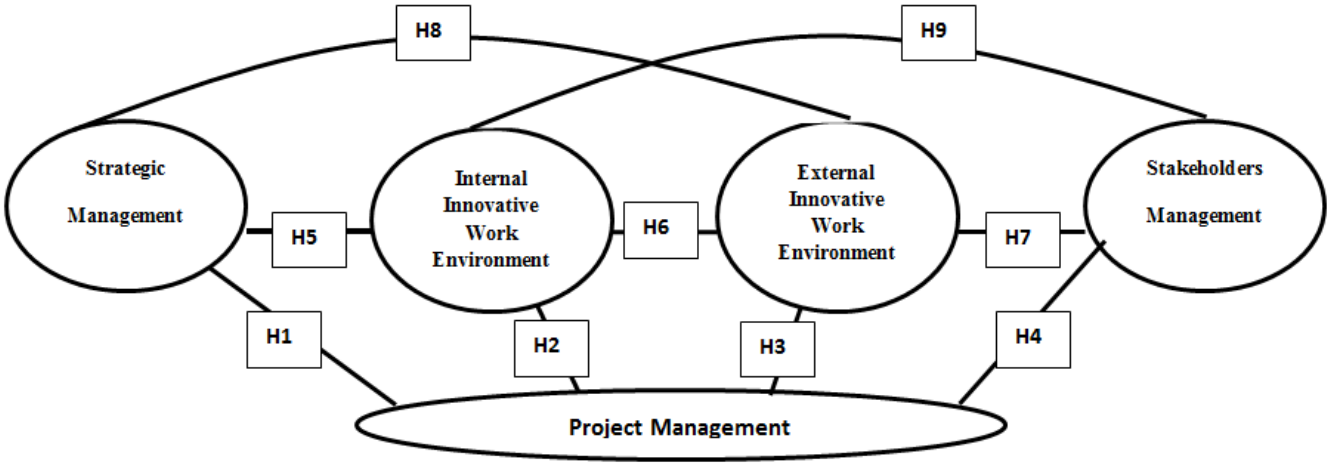


Fig. 2.Research Conceptual Model

3 RESEARCH METHODOLOGY

An exploratory research inquiry was used to identify and analyze the practices related to innovation in construction project management. Mixed methodology that combines both qualitative and quantitative data collection methods was used exploiting two different tools for data collection; questionnaire and semi-structured interviews. The questionnaire was used to get valid data needed to complete the quantitative analysis, and the semi-structured interviews were conducted with experts to generate themes of available practices of innovation in an effort to strengthen the findings of one data by using findings from the other.The target population of this study was the consulting and contracting firms that operate in Palestine. The selected contracting firms had a valid registration according to the Palestinian Contractors Union (PCU) under the 1st and 2nd classes. The selected consultanting firms consist of all consulting offices that had a valid membership of the Engineering Association in Palestine. According to the targeted area, the total number of available population is 697 (220 construction firms and 477 consulting firms). To obtain statistically representative sample size of the population, the following equation was used:

$$n = \frac{m}{1 + \frac{m-1}{N}}$$

Where

- n = correction for limited population
- N= population
- m = sample size, m, is calculated by using the following equation:

$$m = \frac{z^2 * p * (1-p)}{\varepsilon^2}$$

Where

- Z = value related to the confidence level (e.g. 1.96 to 95% confidence level)
- P = degree of variance between the elements of population (0.5)
- ε = maximum error (0.05)

Based on the results of sample size computation, the study needed 360 participants to complete the survey. For this study, more than 1000 postal and electronic questionnaires were distributed among managers of the participating organizations. However, the total number returned and useable was only 365 questionnaires. This represented a valid response rate of 52.4%.

At a first stage, data was collected from a focus group of seven experts working in the construction industry and have an experience in their companies ranging from 20 to 25 years. This method was used for eliciting ideas, thoughts and perceptions from experts and also to understand the problems they are facing during managing their construction works. The collected ideas were then used, in addition to literature review findings, in formulating the questionnaire. After conducting the second stage of data collection through questionnaires, explained below, a final stage of data collection comprised of

semi-structured interviews to verify and investigate the level of innovation in construction project management. For this purpose, seven interviews were conducted with professionals working in construction and engineering firms to explain and verify the results. Notes have been made during each interview and patterns were matched with quantitative data analysis.

The questionnaires were comprised of two major parts. Part one was mainly designed to obtain general information regarding the participants' gender, type of organization, years of experience, and respondents' position. Part two of the questionnaire illustrates the factors influencing innovation practices. This part asked the respondents to rate their organization's performance in implementing these practices. All items in this section were measured with a five-point Likert scale ranging from 1 (not at all) to 5 (very large extent).The structure validity test was used to evaluate the validity of the questionnaire. Table 2 clarifies the Spearman correlation coefficient for each item of the practices and the total of the field. The P-values are less than 0.05, so the correlation coefficients are significant at $\alpha = 0.05$. Therefore, it can be said that the data are consistent and valid to be measured.

Table 2. Correlation Coefficient

Item	Number of Items	Spearman Correlation Coefficient	P-Value (Sig.)
Strategic Management	5	0.828	0.000*
Stakeholders' Management	7	0.848	0.000*
Internal Innovative Environmental work	7	0.853	0.000*
External Innovative Environmental work	7	0.729	0.000*
Project Management	9	0.852	0.000*

For ensuring the internal consistency of Likert scale of the questionnaire, Cronbach's Alpha test was used as shown in Table 3. For most purposes, the reliability coefficients above 0.7 are considered satisfactory [62]. The total reliability of the questionnaire is 0.939 that is excellent. As well as the values of the Cronbach's Alpha for all the variables are ranging between 0.732 and 0.943, which is good.

Table 3. Cronbach's Alpha Test

tem	Number of Items	Spearman Correlation Coefficient	P-Value (Sig.)
Strategic Management	5	0.905	Excellent
Stakeholders' Management	7	0.902	Excellent
Internal Innovative Environmental work	7	0.918	Excellent
External Innovative Environmental work	7	0.902	Excellent
Project Management	9	0.943	Excellent
Total	35	0.939	Excellent

4 DATA ANALYSIS AND RESULTS

Analysis of the questionnaire generated a number of insights about the construction industry and their project management in Palestine. Gender distribution confirms that the Palestinian construction industry is traditionally male-dominated sector, (66.6%) survey participants were men and (33.4%) of the participants were women. Moreover, 60% of the respondents have been working in consulting organizations while 40% have been working in contracting organizations. Also, 62% of the respondents have more than 15 years of experience, and only 3% of the respondents have less than 5 years of experience, while 14% have between 5 and 10 years of experience and 21% have between 5 and 10 years of experience. The results also show that 21% of the consultant participants are engineers, 18% are project managers, and 61% are firm managers. On the other hand, 13% of the contractor participants are engineers, 23% are project managers and 63% are firm managers. Thus, this is an indication that the questionnaire respondents are key persons in their firms. As shown previously in Fig. 2, the research conceptual model consists of nine hypotheses. These hypotheses were tested in two sets of correlations. The first one tests the correlation among the four innovation practices, presented in Table 1, and the second

one tests the correlation between project management and each one of the innovation practices. The bivariate correlations were calculated using the Spearman's correlation coefficient test. This test is based on assuming the null hypothesis (Ho) of existence of no significant relationship between the different groups.

Table 4. Correlation Coefficient among innovation practices

Innovation Practices	Spearman's Correlation	Strategic Management	Stakeholders' Management	Internal Innovative Work Environment	External Innovative Work Environment
Strategic Management	Correlation Coefficient	1.000*			
	P-value (Sig.)	0.000			
Stakeholders' Management	Correlation Coefficient	**0.705***	1.000*		
	P-value (Sig.)	0.000	0.000		
Internal Innovative Work Environment	Correlation Coefficient	**0.634***	**0.697***	1.000*	
	P-value (Sig.)	0.000	0.000	0.000	
External Innovative Work Environment	Correlation Coefficient	**0.529***	**0.568***	**0.542***	1.000*
	P-value (Sig.)	0.000	0.000	0.000	0.000

* Spearman's Correlation is significant at the 0.05 level

4.1 TESTING THE CORRELATION AMONG THE INNOVATION PRACTICES

This section discusses the first set of correlations that describes the relationship among the four innovation practices: (1) strategic management, (2) internal innovative work environment, (3) external innovative work environment and (4) stakeholder management. As shown in Table 4, all of the P-values are below$\propto = 0.05$, which means the rejection of (Ho) and the existence of significant relationships among the four innovation practices. Furthermore, the results show that "strategic management" and "stakeholders' management" have the greatest correlation (0.705). This result was also verified by Morrison and Wilson [63]. They argued that to create a favorable future, organization's stakeholders must be involved in envisioning the most desirable future and then in working together to make this vision a reality. Morrison and Wilson [63] also mentioned that the key to strategic management is to understand that people communicating and working together will create this future, not some words written down on paper.

4.2 TESTING THE CORRELATION BETWEEN PROJECT MANAGEMENT AND INNOVATION PRACTICES

This section discusses the second set of correlations that describes the relationship between project management and each one of the innovation practices. Kavanagh and Naughton [64] also addressed the link between innovation and project management. The finding entails that increasing levels of project management positively correlate with increasing level of innovations, that effectively supporting an existence of a link between innovation and project management. However, after a certain threshold, very high levels of project management become negatively correlated with innovation. As an explanation of this phenomenon, Kavanagh and Naughton[17] suggest that formal methods of project management can facilitate exploitation of existing knowledge, but hinder the exploration of new one. As shown in Table 5, all of the P-values are below$\propto = 0.05$, which means the rejection of (Ho) and that all innovation practices are positively related to project management. Moreover, the results show that "stakeholder management" and "project management" have the greatest correlation (0.661), which means that successful project management requires effective controlling and alignment with stakeholder management, especially in the construction sector. Both "Guidelines to the Project Management Body of Knowledge" [21], and "Guidelines to Quality in Project Management" [64] have also emphasized the importance of identifying and managing all relevant stakeholders in order to ensure the success of a project.

Table 5.Correlation Coefficient among innovation PM practices

Innovation Practices	Spearman's Correlation	Project Management
Strategic Management	Correlation Coefficient	0.629*
	P-value (Sig.)	0.000
Stakeholders' Management	Correlation Coefficient	0.661*
	P-value (Sig.)	0.000
Internal Innovative Work Environment	Correlation Coefficient	0.641*
	P-value (Sig.)	0.000
External Innovative Work Environment	Correlation Coefficient	0.550*
	P-value (Sig.)	0.000

* Spearman's Correlation is significant at the 0.05 level

In general, the correlation coefficients reported for both sets of correlations indicate the significance of innovation practices and project management. Therefore, the nine proposed hypotheses in the research conceptual model are accepted and their results are summarized in Fig. 3.

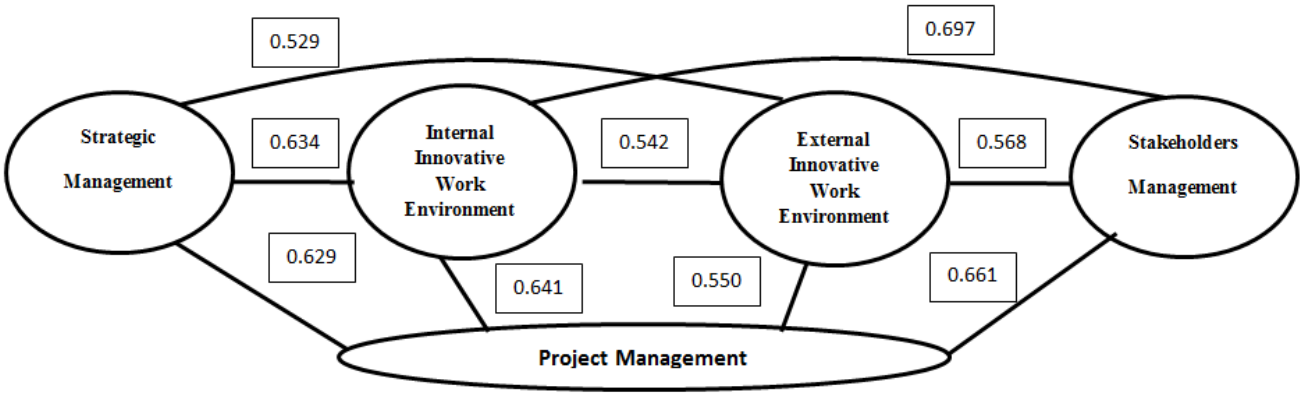


Fig. 3.Hypotheses Testing Results

5 INNOVATION ASSESSMENT

To assess to what extent do construction and engineering firms apply the innovation practices in Palestine, respondents were asked to rank the degree to which each survey item was practiced at their companies using a five- point likert scale. Respondents chose one of each of the following responses for each survey item: (1) not at all, (2) to a slight degree, (3) to a moderate extent, (4) to a great extent, and (5) to a very great extent. As shown in Table 6, descriptive statistics as well as Mann Whitney U statistic were used to show if there is a significant degree of agreement among the construction and engineering firms. In light of the above analysis, it can be noticed that the total average response to the innovation is (3.60) out of (5.00) which is considered high. Therefore, we can say that there is a high degree of innovation in the construction industry in Palestine. All the five (5) practices are incidentally accepted since they all have mean scores greater than (3.4) on a 5-point Likert scale. The findings reveal that the practice for which companies are most appropriate for the implementation is "stakeholders' management". Followed in order by "external innovative working environment", "project management", "strategic management", and "internal innovative working environment". Unfortunately, the findings show that the factors that contribute most to the causes of lack of innovation are internal work environmental related, such as: innovative culture, top management support, training for employees, motivation and reward systems. As a result, creating the appropriate conditions for employees is one means by which innovation can be fostered in organizations. By the interpretation of the P-values, it is observed that the P-values for all practices are greater than $\alpha = 0.05$, except the P-value of "stakeholders

management", it is smaller than α = 0.05. Thus, there is sufficient information to accept the Null Hypothesis and to declare that there is almost no difference between the two groups in terms of applying innovation practices in Palestinian construction sector.

Table 6. Application Degree for Innovation Practices

Rank	Innovation practices	Mean	Standard Deviation	Application Degree	P-Value (Sig.)
1	Stakeholder Management	3.78	0.767	High	(0.002)
2	External Innovative Working Environment	3.69	0.732	High	0.157
3	Project Management	3.60	0.897	High	0.613
4	Strategic Management	3.52	0.888	High	0.121
5	Internal Innovative Working Environment	3.42	0.971	High	0.700
	Total	3.60	0.704	High	0.119

Table 7 outlines the means of the all practices under their related groups. These practices were selected in order to measure the innovation behavior of the construction and engineering firms. From the findings, it can be observed that the top five practices that have been applied in Palestinian construction sectors are: (1) Dealing with social and environmental variables, (2) Identifying stakeholders, (3) Ensuring effective communication between stakeholders, (4) Evaluation the stakeholders' satisfaction, and (5) Exploring stakeholders' needs and constraints to projects. It can be noticed that most of these factors are related to stakeholders' management group. On the other side, the least five practices have been applied in Palestinian construction sectors are: (1) Dynamic, open minded and supportive top management, (2) Conducting internal audit "Strength & Weakness", (3) Conducting external audit "Opportunities & Threats", (4) Provide rewards and recognition for creative work, and (5) Provide training for employees. It can be noticed that the least five practices are related to both strategic management and internal innovative work environment groups.

Based on the results of the semi-structured interviews, most of interviewers argued that the degree of application of innovative practices is to some extent low and the state of project management in the construction needs to be strengthened. This is because construction industry has complexity in its nature and contains a large number of stakeholders. As well as, the construction industry consistently scored poorly against standard practices of innovation that may enhance the process of construction project management. All interviewees agreed that there is a strong relationship between project management and innovation. Moreover, they argued that high level of innovation would lead to reduce deficiencies in construction project management. Further, most of the interviewers commented that internal innovative work environment, especially top management support as the most powerful practice for innovation. On the other side, some found that strategic management is the most critical factor for the successful construction projects. All interviewees argued that strong cooperation between the engineer, contractor and construction client is recognized as important to facilitate innovativeness and that construction client is perceived as having the greatest influence on innovativeness. They also argued that through training and development, employees could acquire the knowledge and skills needed for doing their particular job. It also increases their commitment, motivation, job satisfaction and reduced employee turnover.

Table 7. Application Degree for Innovation Practices

Innovation Project Management Practices	
Strategic Management	**Mean**
Establishing a vision which embraces innovation	3.81
Establishing SMART objectives	3.62
Formulating Strategies	3.84
Conducting internal audit "Strength & Weakness"	3.36
Conducting external audit "Opportunities & Threats"	3.35
Total	**3.52**

Internal Innovative Working Environment	Mean	External Innovative Working Environment	Mean
Provide rewards and recognition for creative work	3.17	Dealing with economic and political variables	3.81
Dynamic, open minded and supportive top management	3.38	Responding to change in customer needs	3.64
Provide innovative culture	3.52	Utilization of new technology	3.56
Provide appropriate internal conditions for workers	3.61	Dealing with social and environmental variables	3.95
Provide training for employees	3.16	Communicate with competitors	3.61
Workloads are managed	3.46	Reacting to market changes	3.58
Employee motivation and job satisfaction	3.64	Collaborate and communicate with suppliers	3.69
Total	**3.42**	**Total**	**3.69**

Project Management	Mean	Stakeholder's Management	Mean
Integration Management	3.84	Identifying Stakeholders	3.90
Quality Management	3.71	Exploring stakeholders' needs and constraints to projects	3.82
Cost Management	3.73	Analyzing conflicts among stakeholders	3.66
Time Management	3.66	Ensuring effective communication	3.85
Scope Management	3.54	Evaluation the stakeholder satisfaction	3.84
Communication Management	3.51	Stakeholder involvement in decision-making	3.69
Procurement Management	3.68	Keeping and promoting an ongoing relationship with stakeholders	3.67
HR Management	3.55		
Crisis Management	3.53		
Total	**3.60**	**Total**	**3.78**

6 DISCUSSION AND FRAMEWORK DEVELOPMENT

Based on this research findings and literature reviews, a framework for enhancing innovation practices in the construction industry has been devised. The framework is intended to be an effective management tool for supporting innovation in construction project management. It gives the potential for the managers to enhance their project management process and enables them to cope with change and development in external and internal environments. To stimulate innovation in the construction project management, successful innovation requires more than just putting creative people in a room and hoping they come up with valuable new products or processes [65]. So as shown in Fig. 4, the framework rests on a foundation of five building blocks comprise four main levels for achieving innovation in construction project management. These levels are explained below.

Level 1: Strategic Management

At the beginning, each organization, whatever its business, should focus on specific areas of interest by making strategic management. Without a clear vision, mission and objectives, organizations cannot survive in such turbulent environment, especially the construction environment. Therefore, organizations need to have a clear vision that embraces innovation besides defining the optimal desired future state to what an organization is focused on achieving in five, ten, or more years.

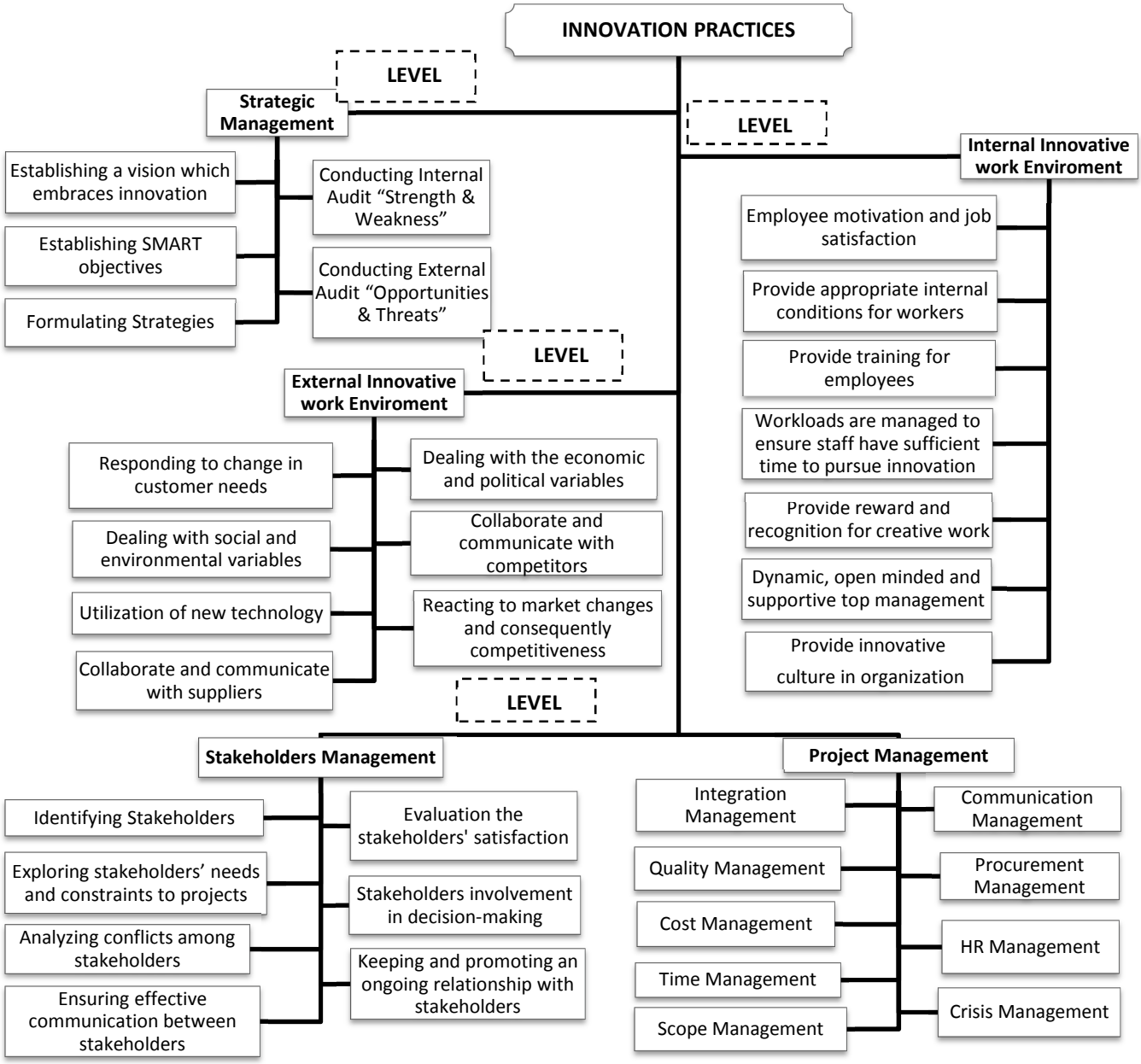


Fig. 4. Conceptual Framework for Project Management Innovation

Level 2: Internal Innovative Work Environment

After doing strategic management and before looking for enhancing the external environment, top managers have to provide an internal innovative work environment for all individuals within the organization. Research has shown that enhancing construction industry requires a good internal atmosphere and innovative culture to motivate staff to think in creative ways and requires also open minded and supportive top management to create the challenge and push people to think out of the box. Moreover, for continuous improvement, organizations need to provide reward and recognition for creative work besides offering the sufficient requirements and training for their employees.

Level 3: External Innovative Work Environment

To make tangible improvements and to be competitive in the market, where technology is changing fast and customers become more sophisticated; companies need to create external innovative work environment. They need continually to cope with change and react to the external forces of change, such as customers, competitors, suppliers, technology, economic, social, environmental and political variables.

Level 4: Effective Stakeholder Management and Project Management

Project management and stakeholders' management must be working in an integrated manner to ensure success. Project managers must have a capability in managing both in parallel. Project management provides project managers with the capabilities needed to manage the scope, time, cost, quality, risk and procurement necessary to accomplish all interrelated tasks. It also provides a guide for integration management, as well as human resource management and communications management to identify the most suitable approach to complete projects. However, project success is tied to effectively communicate and managing relationships with the various stakeholders of the project. This makes stakeholder management an important issue in project management [66]. Effective communication creates a bridge between diverse stakeholders involved in a project, connecting various cultural and organizational backgrounds, different levels of expertise, and various perspectives and interests in the project execution or outcome [67]. Thus, in order to ensure the success of construction projects, challenging project management, including innovation, should be integrated with effective stakeholder management.

7 CONCLUSIONS

The main aim of this paper was to explore the implementation of innovation practices in the construction project management in Palestine. The findings of the study present four practices that can be combined with project management, that are: (1) Strategic Management, (2) Internal Innovative Working Environment, (3) External Innovative Working Environment, and (4) Stakeholders Management. The current research inquiry shows that innovation needs a true involvement of all stakeholders in a construction project. Thus, top managers must be aware about the positive impacts of innovation and actively participate in its implementation rather than resist it. In addition, to make tangible improvements, organizations need to develop an innovative strategy and recognize that improving innovation requires both internal and external innovative environmental work. It is also necessary for organizations to continually evaluate their level of innovation. Such evaluation is very important to assist them in understanding their strengths and weakness.

One of the main limitations of this research was the lack of prior research studies on innovation practices in construction project management, which is considered relatively new to the construction industry. This presents an important opportunity for other researchers interested in the subject to explore more innovation practices in other countries and in other industries where comparisons can then be made. In addition, the assessment of innovation was limited to the selected sample of the private consulting and contracting firms. It is recommended that future researches expand the study for projects conducted in the public sector.

REFERENCES

[1] L. O. Oyewobi, B. O. Ganiyu, A. A. Oke, A. W. Ola-Awo and A. A. Shittu, "Determinants of Unethical Performance in Nigerian Construction Industry," *Journal of Sustainable Development,* vol. 4, no. 4, 2011.

[2] V. Rußig, S. Deutsch and A. Spillner, "Branchenbild Bauwirtschaft: Entwicklung und Lage des Baugewerbes sowie Einflussgrößen und Perspektiven der Bautätigkeit in Deutschland," 1996.

[3] J. Dale, "Innovation in Construction: Ideas are the Currency of the Future," *CIOB Survey*, 2007.

[4] H. Lingard and A. Sublet, "The Impact of Job and Organizational Demands on Marital or Relationship Satisfaction and Construction Among Australian Civil Engineers," *Construction Management and Economics*, vol. 20, no. 6, pp. 507–521, 2002.

[5] S. Barthorpe, R. Duncan and C. Miller, "The Pluralistic Facets of Culture and its Impact on Construction," *Property Management*, vol. 18, no. 5, pp. 335 - 351, 2000.

[6] T. Froese, J. Rankin, K. Yu, "Project Management Application Models and Computer Assisted Construction Planning in Total Project Systems, "*International Journal of Construction Information Technology*, vol. 5, no. 1, pp. 39-62, 1997.

[7] W. Jekale, "Performance for Public Construction Projects in Developing Countries: Federal Road and Educational Building Projects in Ethiopia," Norwegian University of Science and Technology, 2004.

[8] Bennett, *The management of Construction: A Project Life Cycle Approach*, 1st Ed. Burlington: Butterworth-Heinemann, 2003.

[9] S.D. Green, "A Participative Research Strategy for Propagating Soft Methodologies in Value Management Practice," *Construction Management and Economics*, vol. 17, no. 3, pp. 329-340, 1999.

[10] Palestinian Central Bureau of Statistics PCBS, "Labor Force Survey," Round, Q2, Revised Press Report on the Labor Force Survey Results, Ramallah – Palestine, 2014.

[11] M. Tushman and D. Nadle, "Organizing for Innovation," *California Management Review*, vol. 28, no. 3, pp. 74-92, 1986.

[12] G. Hamel, "The Why, What, and How of Management Innovation," *Harvard Business Review*, vol. 84, no. 2, pp. 72–84, 2006.

[13] P.S. Barrett, M.G. Sexton, M. Miozzo, A. Wharton and E. Leho, "Base Report: Innovation in Small Construction Firms," *University of Salford: Salford, UK*, 2001.

[14] D. Eaton, "A temporal Typology for Innovation within the Construction Industry," *Construction Innovation*, vol. 1, no. 3, pp. 165 – 179, 2001.

[15] D. M. Gann, "Building Innovation: Complex Constructs in a Changing World," *Thomas Telford Publishing*, London, ISBN: 0-7277-2673-0, 2000.

[16] A. Blayse and K. Manley, "Key Influences on Construction Innovation," *Construction Innovation*, vol. 4, no. 3, pp. 143-154, 2004.

[17] D. Kavanagh and E. Naughton, "Innovation and Project Management – Exploring the Links," *PM World Today*, vol. XI, no. IV, pp. 1-7, 2009.

[18] M.R. Wideman, "Criteria for a Project Management Body of Knowledge," *International Journal of Project Management*, vol. 13, no. 2, pp. 71-75, 1995.

[19] P. Stadnick, "Project Portfolio Management Practices for Innovation – A Case Study at ABN AMRO – Brazil," Master Thesis, 2007.

[20] R. Levi, "Innovative Approaches in Project Management for Personnel in the Educational and Public Administration Fields," SzentIstván University, Faculty of Applied and Professional Arts, 2009.

[21] PMBOK, *A Guide to the Project Management Body of Knowledge*, Pennsylvania: Project Management Institute, 2004.

[22] Hendrickson, *Project Management for Construction: Fundamental Concepts for Owners, Engineers, Architects and Builders*, 2nd ed. Department of Civil and Environmental Engineering, Carnegie Mellon University, Pittsburgh, PA l52l3 Copyright C. Hendrickson, 1998.

[23] D. M. Casey, "A Journey to Legitimacy: The Historical Development of Distance Ducation through Technology," *TechTrends, vol. 52, no.* 2, pp. 45–51, 2008.

[24] A. Walker, *Project Management in Construction*, Oxford: Blackwell, 2007.

[25] A. E. Raftery, D. Madigan and J. A. Hoeting, "Bayesian Model Averaging for Regression Models," *American Statistical Association*, vol. 92, no. 437, pp. 179-191, 1997.

[26] P.W. Newton, *Modeling Innovation in AEC: Understanding the Fourth Dimension of Competition*, 1999. [Online] Available: http://www.ce.berkeley.edu/~tommelein/CEMworkshop/Newton.pdf (July 15, 2014)

[27] M. Burmester, P. Henry and L. Kermes, "Tracking Cyberstalkers: A Cryptographic Approach," *ACM SIGCAS Computers and Society*, vol. 35, no. 3, 2005.

[28] J. Fagerberg, D.C. Mowery and R.R. Nelson, "The Oxford Handbook of Innovations," Eds. Oxford: Oxford University Press, 2004.

[29] J.R. Galbraith, "Human Resource Policies for Innovating Organizations," *Strategic Human Resource Management*, edited by Noel Tichy, Charles Fombrum, and Mary Ann Devanna, Wiley 1984.

[30] P. Drucker, "Innovation and Entrepreneurship," Butterworth- Heinemann, Oxford, 1985.

[31] H. A. Zuckerman, "Patterns of Name Ordering Among Authors of Scientific Papers: A study of Social Symbolism and its Ambiguity," *American Journal of Sociology*, vol. 74, pp. 276–291, 1968.

[32] E. Pinchot and G. Pinchot, "Five Drivers of Innovation," *Berrett-Koehler*, 1996.

[33] Department of Commerce DOC, "Advisory Committee on Measuring Innovation in the 21st Century Economy," Report to the Secretary of Commerce, 2008.

[34] E. S. Slaughter, "Implementation of Construction Innovations," *Building Research and Information*, vol. 28, no. 1, pp. 2-17, 2000.

[35] CERF and D.C. Washington, "Guidelines for Moving Innovations into Practice," *International Symposium and Innovative Technology*, 2000.

[36] A. Verhaeghe and R. Kfir, "Managing Innovation in a Knowledge Intensive Organization," *R&D Management*, vol. 32, pp. 409-417, 2002.

[37] A.T. Kearney, "FDI Confidence Index Volume 8, " *Alexandra, VA: A.T. Kearney*, 2006.

[38] A. Neely and J. Hii, "Innovation and Business Performance: A Literature Review," *The Judge Institute of Management Studies, University of Cambridge: 0-65, 1998*.

[39] G. Seaden and A. Manseau, "Public Policy and Construction Innovation," *Building Research and Information*, vol. 29, no. 3, pp. 182-96, 2011.

[40] I. Dikmen, M.T. Birgonul and U. Artuk, "Integrated Framework to Investigate Value Innovations," *Journal of Management in Engineering*, vol. 21, no. 2, pp. 81-90, 2005.

[41] Dess, Lumpkin and Taylor, *Strategic Management*, 3rd Ed. New York: McGraw-Hill Irwin, 2005.

[42] D. Baldwin, "Creating an Environment for Innovation," *Center for Simplified Strategic Planning, Inc*., 2014.

[43] G. Winch, "Global Construction Business Systems," *Building Research & Information*, vol. 30, no. 6, pp. 390–391, 2002.
[44] D. Huiru, "The Importance of Strategic Management: Case Study of H&M," *International Business*, 2011.
[45] C. Prather, "Manager's Guide to Fostering Innovation and Creativity in Teams," New York: McGraw Hill, 2010.
[46] C.J. Chen and J.W. Huang, "Strategic Human Resource Practices and Innovation Performance – The Mediating Role of Knowledge Management Capacity," *Journal of Business Research*, vol. 62, no. 1, pp. 104–114, 2009.
[47] C.H. Nam and C.B. Tatum,"Leaders and Champions for Construction Innovation," *Construction Management and Economics*, vol. 15, no. 3, pp. 259-270, 1997.
[48] P.K. Ahmed, "Culture and Climate for Innovation," *European Journal of Innovation Management*, vol. 1, no. 1, pp. 30-43, 1998.
[49] U. Hana, "Competitive Advantage Achievement through Innovation and Knowledge," *Journal of Competitiveness*, vol. 5, no. 1, pp. 82-96, 2013.
[50] C. Lin, B. Tan and S. Chang, "The Critical Factors for Technology Absorptive Capacity," *Industrial Management and Data Systems*, vol. 6, no. 102 pp. 300-308, 2002.
[51] Y. Caloghirou, I. Kastelli and A. Tsakanika, "Internal Capabilities and External Knowledge Sources: Complements or Substitutes for Innovative Performance," *Technovation* vol. 24, pp. 29-39, 2004.
[52] F.J. Milliken, "Three Types of Perceived Uncertainty About Environment: State, Effect, and Response Uncertainty," *Academy of Management Review*, vol. 12, pp. 133-143, 1987.
[53] L.I. Bourgeois, "Strategy and Environment: A Conceptual Integration," *Academy of Management Review*, vol. 5, no. 1, pp. 25-39, 1980.
[54] Grant, *Contemporary Strategy Analysis*, 2nd Ed. Oxford: Blackwell Publishers, 1999.
[55] H.P. Asheghian and P. Ebrahimi, "International Business," New York: Harper Collins, 1990.
[56] C.B. Tatum, "Incentives for Technological Innovation in Construction," Preparing for Construction in the 21st Century – Proceedings of the Construction Conference, New York, ASCE, pp. 447-52, 1991.
[57] Project Management Insitute PMI, *A Guide to the Project Management Body of Knowledge, PMBOK 3rd Ed.* Project Management Institute Inc., 2004.
[58] R. Newcombe, "From Client to Project Stakeholders: A Stakeholder Mapping Approach," *Construction Management and Economics*, vol. 22, no. 8, pp. 762-784, 2003.
[59] A. Othman and M. Abdellatif, "Partnership for Integrating the Corporate Social Responsibility of Project Stakeholders Towards Affordable Housing Development: A South African Perspective," *Journal of Engineering Design and Technology*, vol. 9, no. 3, pp. 273 – 295, 2011.
[60] Freeman, Harrison and Wicks, *Managing for Stakeholders –Survival, Reputation, and Success*, The Business Roundtable Institute for Corporate Ethics Series in Ethics and Leadership, 2007.
[61] D.H.T. Walker, L.M. Bourne and A. Shelley, "Influence, Stakeholder Mapping and Visualization," *Construction Management & Economics*, vol. 26, no. 6 , pp. 645-658, 2008.
[62] Burns and Grove, *Understanding Nursing Research*, 3rd Ed. Philadelphia: Saunders, 2003.
[63] Morrison, Wilson, The Strategic Management Response to the Challenge of Global Change, 1996. [online] Available: http://horizon.unc.edu/courses/papers/Scenario_wksp.html (May 8, 2014)
[64] Swedish Standard, SS-ISO 10006, *Quality management – Guidelines to Quality in Project Management*, Swedish Standard Institution (SIS), Stockholm, 1998.
[65] T. Levitt, "Creativity is Not Enough," *Harvard Business Review*, vol. 80, no. 8, pp. 137–144, 2002.
[66] R. Assudani and T.J. Kloppenborg, "Managing Stakeholders for Project Management Success: An Emergent Model of Stakeholders," *General Management*, vol. 35, no. 3, pp. 67-80, 2010.
[67] K. Čulo and V. Skendrović, "Communication Management is Critical for Project Success,". *Informatologia*, vol. 43, no. 3, pp. 228-235, 2010.

International Journal of Innovation and Scientific Research
ISSN 2351-8014 Vol. 17 No. 2 Aug. 2015, pp. 466-473
© 2015 Innovative Space of Scientific Research Journals
http://www.ijisr.issr-journals.org/

ANALYSIS OF AGRICULTURAL PRODUCTION AND PROGRAMS IN ARMENIA

Davit Alaverdyan[1], Olagunju Kehinde[1], and Ira Panosyan[2]

[1]Faculty of Economics and Social Sciences,
Szent Istvan University,
Godollo, Hungary

[2]Department of Extension and Agricultural Policy,
Armenian National Agrarian University,
Yerevan, Armenia

Copyright © 2015 ISSR Journals. This is an open access article distributed under the ***Creative Commons Attribution License***, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT: Agricultural sector plays a very important role in Armenian economy as it employs large share of the entire population and also has a large contribution to the national GDP while it agriculture employs large proportion of the population. In governmental projects and budgets the sector is given high priority. Despite this, the sector is encounters various challenges. This study attempts to examine the trends of agricultural production and to review the agricultural policies, programmes and projects implemented over a period of time in Armenia using a secondary data from various statistical agencies. Policies and projects implemented over the last decades had their big contribution to the overall agricultural output. It was found that there has been a considerable increase in agricultural output from both crop and livestock subsectors in Armenia. Despite this, the study found that Armenian agriculture is yet to attain its potential in crop production and animal husbandry in feeding the growing population and also attending to international market. Therefore, it is recommended that agricultural policies planning and implementation should be participatory and should be directed at supporting and encouraging farmers on export oriented products, application of new technologies and seed varieties. Also, an effective link should be established between research institutions and farmers with the help of agricultural extension services while farmers should also have access to credit facilities.

KEYWORDS: Agriculture, Planning, Projects, Production, Armenia.

1 INTRODUCTION

Historically, Armenia´s economy has been based on agricultural production, especially in fresh and processed vegetables and fruits. In Soviet times, the Country managed to internally satisfy milk and meat demand both for primary use and processing. Armenia was also well known for its leather and shoes production, the raw material of which was mainly supplied locally. After the dissolution of the Soviet Union, the central market economy collapsed, large Soviet Kolkhoz and Sovkhoz were broken up into small farm plots, input drivers became increasingly more expensive, and supply lines to international demand were broken [1]. Combining these factors with the degradation of irrigation systems throughout the country led to a decrease in domestic production. This made it necessary to rely upon imported products from abroad, during those periods. Out of total 915 communities of Armenia 866 are rural (around 36.0% of the country population resides in villages), hence agriculture plays an important strategic role also in terms of rural area development. As of 2012, agriculture employs 457.4 thousand people, which accounts for 38.9% of the country's total employment and 75.2% of rural area employment [2]. In the foreign trade turnover structure the share of agricultural-origin and processed food products in 2013 was 21.1%, and in the structure of exported goods- 28.5%. In 2013 the value added of agricultural sector in GDP of Armenia amounted to 19.54%. This figure has started to increase since 2009. The average share of Agriculture in GDP during the period of 2010-2013 was about 19% [2].

Corresponding Author: Davit Alaverdyan

In agricultural sector the most active Marzes(provinces) of Armenia are Armavir, Ararat and Gegharkunik, the cumulative gross production of which in 2013 constituted 464.9 billion Armenian drams, which makes 50.6 percent of gross agricultural output of Armenia [1].

However, the sector is experience significant challenges, not only in production, but also in market access and competitiveness. There is a lack of economies of scale, increased input costs, and Armenian farmers have not invested in the appropriate food safety certifications, such as Global GAP, that would allow them to enter higher-value markets like the EU [1]. As cited by [1], Armenian farmers are also facing increased regional competition from other CIS and Eastern European countries. Other factors conditioning the limitation of Armenian agricultural products are:

- Price of raw materials and fertilizers
- Technological limitations
- Lack of highly qualified personnel
- Lack of irrigation systems
- Lack of infrastructure (on harvesting and further stages, storage/ cold storage, processing, etc.)
- Interruption of supplies, seasonality.
- Absence of insurance from natural disasters, etc. The development of agriculture is hindered also due to the following factors:
- There are problems with coordinated and targeted use of natural feeding areas particularly pastures and hayfields.
- Poor use of arable lands is essentially dependent on the lack of financial resources of businesses employed in agriculture, low profitability, difficult access to machine works, fragmented land parcels, difficulties in marketing agricultural products, etc. In some boarder communities, designated use of arable lands is affected by dangers associated with borderline land cultivation.
- Due to a number of factors, marketing of agricultural products continues being a problem. The level of agricultural product marketability during the past years varies around 56%. The existing situation is the result of the lack of agencies responsible for marketing of agricultural products or their imperfect activities.
- Currently, around 95% of agricultural machinery has expired term of use, which resulted in low functioning and productivity and high maintenance costs.

Further to the socio-economics and environmental challenges limiting against increased agricultural production and associating sectors are highlighted below:

- Environmental risks (misuse of resources, cutting forests, land degradation).
- Migration from rural areas.
- Closed borders and road obstacles for export.
- Unequal development of rural areas (adverse demographic dynamic).
- Less developed infrastructure of public institutions.
- Separated land areas.
- Natural diseases: droughts, frost and hail.

1.1 AGRICULTURAL PRODUCTION AND STRATEGIC POLICY DOCUMENTS IN ARMENIA

Taking into account the importance of agriculture for the country's economy as well as its crucial role for the country's food safety issues, Armenian Government emphasizes the importance of State support for agriculture. Besides, recognizing agriculture as a priority sector is dwelled on two principle reasons.

In order to improve and develop a more efficient and sustainable agriculture, the Ministry of Agriculture, together with FAO, designed a "Strategy for Sustainable Agricultural Development" [3]. This document laid the ground for adopting the "2010-2020 Sustainable Strategy Program for Agricultural and Rural Development" by the Government of Armenia and the Ministry of Agriculture which is aimed at the restoration of the financial crisis circumstances and through formulation of anti-crisis mechanisms contributes to the modernization of the agri-food system and raise its competitiveness [4].

Agriculture and rural development vision of GoA includes but not limited to:

1. Development of commercial agricultural organizations, cooperatives and family farms integrated with market infrastructures through application of intensive technologies;
2. Stable food security of the population and meeting demands of agriculture processing raw materials through realistic combination of food security interests and comparative advantage of external trade of agriculture and food products;

3. Increase of gross product in agriculture due to increase of labor productivity, comparative reduction of the number of people employed in agriculture and use of part of surplus workforce in non-agriculture sphere through agriculture service and trainings.
4. Processing of produced agriculture raw materials at SME production units;
5. Domination of production of agriculture products with high added value in the plant cultivation and animal husbandry intra-branch structure;
6. High level of food security of the country population, ensuring self-sustainability for basic foodstuffs, reduction of rural poverty and migration.

The focuses of the strategic policy document are:

1. Overcome the consequences of financial crisis and apply new anti-crisis mechanisms
2. Deepen agrarian reforms and develop agricultural cooperatives
3. High level of food safety in the country, self-sustainability in the vital food products
4. Increase the competitiveness of domestic products and development of export-oriented products
5. Sectorial specialization and the optimal distribution of products
6. Increase the land use efficiency
7. Development of organic agriculture
8. Development of crop production:
    - Investment of advanced technologies
    - Prevalence of value added agricultural products within the crop production
    - Development of seed production and selection systems, investment of new mechanisms for seed quality control
    - Crop protection and implementation of quarantines
    - Genetical diversity of crops and protection of wild spices
9. Development of animal husbandry:
    - Support for efficient and rational allocation of couples in livestock sectors,
    - Breeding development and implementation of complex activities for flock reproduction
    - Improvement the efficiency of veterinary projects and services
    - Development of animal feed base by creating small feed production units in all regions of Armenia
    - Support to the development of livestock trade organizations
    - Conservation genetic diversity of farm animal races
10. Processing of agricultural raw materials:
    - Development of the sphere by optimal distribution of processing companies
    - Application of advanced technologies and improvement of the products' competitiveness
    - Market support and development of contract relations among processing companies
    - Development of production technologies
11. Development of social infrastructures in rural areas
12. Reduction of risks in Agriculture
13. Improvement of access to credit facilities in agriculture
14. Improvement of knowledge, science and advisory system
15. Improvement of agricultural farm record system [5].

1.2 OBJECTIVES OF THE STUDY

The overall goal of the research study is to examine the trends of agricultural production and growth overtime and also to review agricultural policies, programs and projects in RA. The specific objectives of this study are:

- to describe various agricultural projects and their successful implementation
- to review agricultural policies and strategies design to address current agricultural policies
- to examine the trend of agricultural production, food import and export under the projects implemented over the last decades.

2 MATERIALS AND METHODS

The data used in the study was basically from secondary sources over the period of 2001-2013 (12 years), mainly from the statistical bulletin of Armenian National Statistical Service(NSS), State Service for Food Safety(SSFS) and Agricultural Support Republican Centre(ASRC). The selected years for the studies was chosen due to the scope of the study which is directed at agricultural production, the period of implementation of the program which spanned through 2001-2013 and availability of data. The publication is designed to serve as an easy reference for statistical information and sources. The dataset provides detailed records on total agricultural output, agricultural crops, livestock and poultry products, heads, land area for crop production, food import and food export. Descriptive statistics such as graphical illustrations, percentages, frequencies and pie charts were used to describe and examine the trends of the above mentioned parameters over the years understudy. Furthermore, we employed narratives to describe the trends of agricultural production and various effects of the polices on agricultural sector in RA.

3 RESULTS AND DISCUSSION

3.1 STATISTICAL PRESENTATION (TREND) OF AGRICULTURAL PRODUCTION IN RA

As illustrated in Figure 1, agricultural crop production in RA experienced fluctuation in growth patterns from 2001-2013. Among main cultivated crops in Armenia, the highest growth was marked in vegetable production. In contrast, water melon showed slight increase by showing the lowest production. Main production falls happened during the period of 2010-2011. Only the grape production did not show sharp fluctuations during the last decade and grew steadily. In all, crop production sub-sector experienced an increase in the level of output across the years. This increase is largely connected with the high adoption of innovative technologies such as high yeald seed varieties, insectisides, pesticides and bio-fartilizers, which improved farmers' output in RA as contained as one of the major thrust of Rural Enterprise and Small-Scale Commercial Agriculture Development Project (RESCAD) and Technology Evaluation Program implemented in from 2001-2014, with the objective introducing innovative technologies and improved seed varieties to the farmers[6], [7].

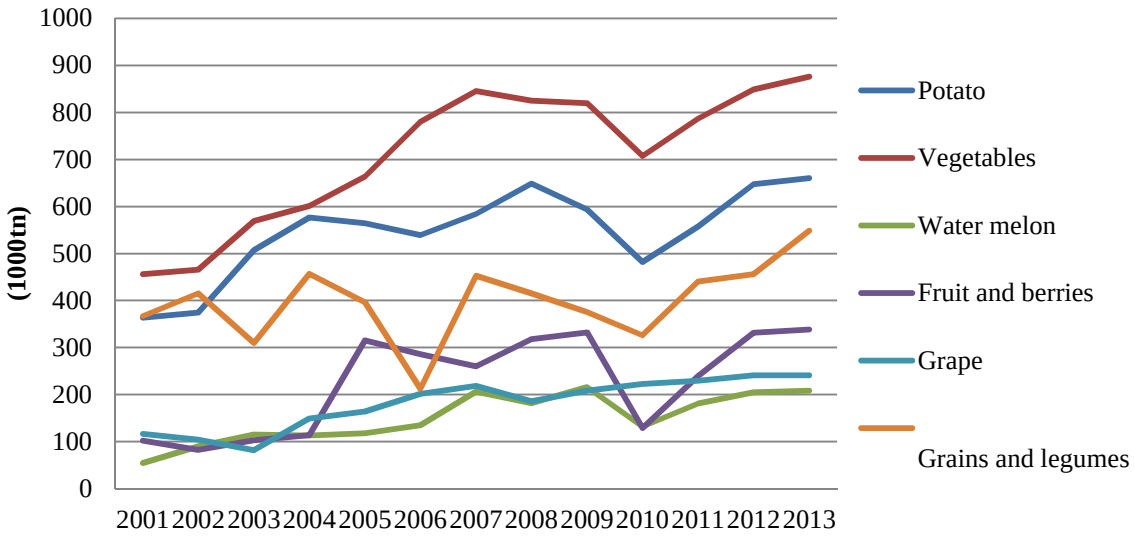


Figure 1 Trend of Agricultural crops in RA (2001-2013)

Source: Authors' editing, 2015; [2]

Armenia is a country with lots of mountainous areas with lack of land resources. As a result of this condition, implemented projects made available various less-water demanding seed varieties that can be cultivated in sub-mountainous and mountainous areas feasible, therefore maximizing the use of available arable land area for agricultural purposes.

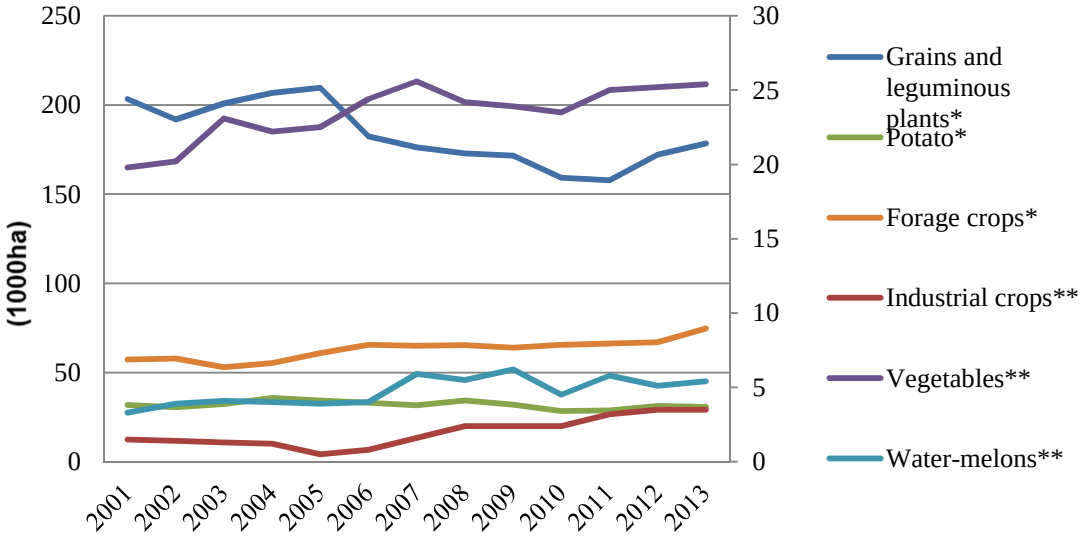


Figure 2 Land area for crop production in RA (2001-2013)

Source: Authors' editing, 2015; [2]
**left vertical axis; **right vertical axis*

Figure 3 shows the trend of livestock and poultry heads across the project years. The number of poultry at the beginning of the project years grew at an increasingly proportion. There is a slight increase in the numbers of sheep, goat and cattle, while the number of pigs remained nearly the same. This considerable improvement in livestock sub-sector is as a result of ongoing Community Agricultural Resource Management and Competitiveness (CARMAC) project, which has aim to increase livestock productivity and efficiency of communal pasture management[8], [9]. As a result of lack of adoption by farmers, the number of horses does not record any significant change. In summary, variation in the growth of different animals in the livestock sub-sector is significantly affected by the rate of implemented projects.

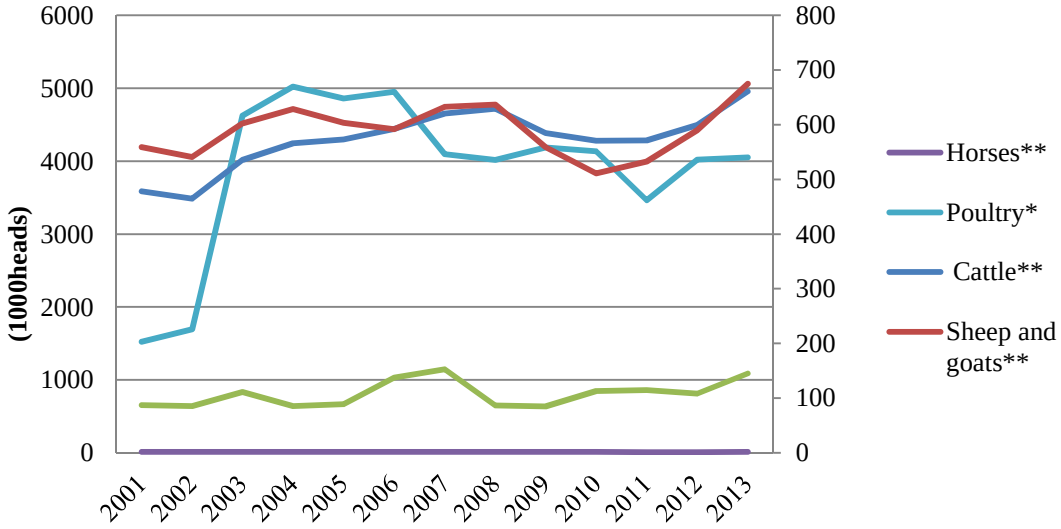


Figure 3 Trends of Livestock and Poultry heads in RA (2001-2013)

Source: Authors' editing, 2015; [2]
**left vertical axis; **right vertical axis*

Figure 4 shows that there is considerable growth in the major products and by-products from livestock and poultry from the beginning of the project years and beyond. This increase can be attributed to the innovative technologies offered in the scope of different projects which were adopted by livestock farmers in all regions of Armenia.

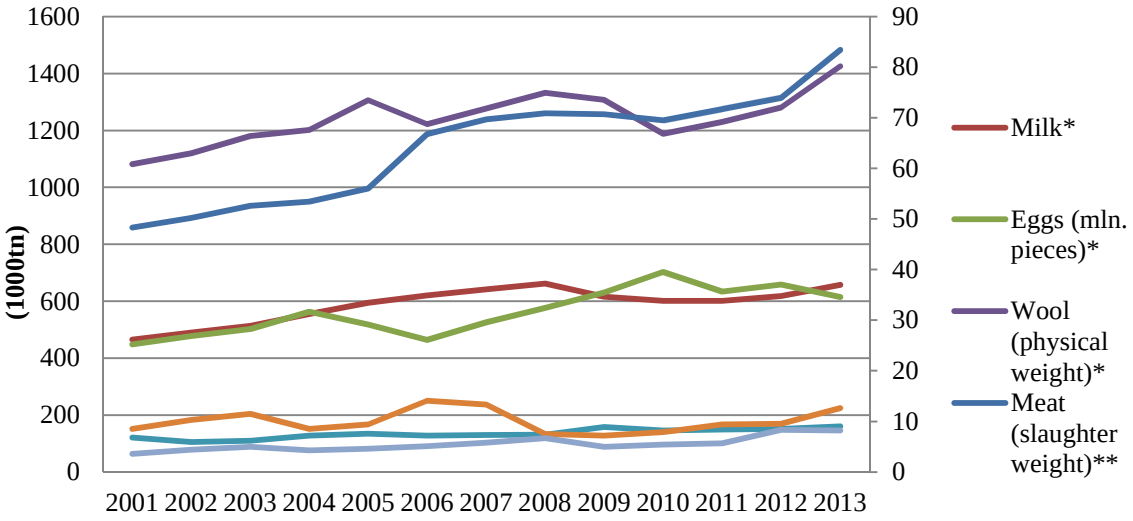
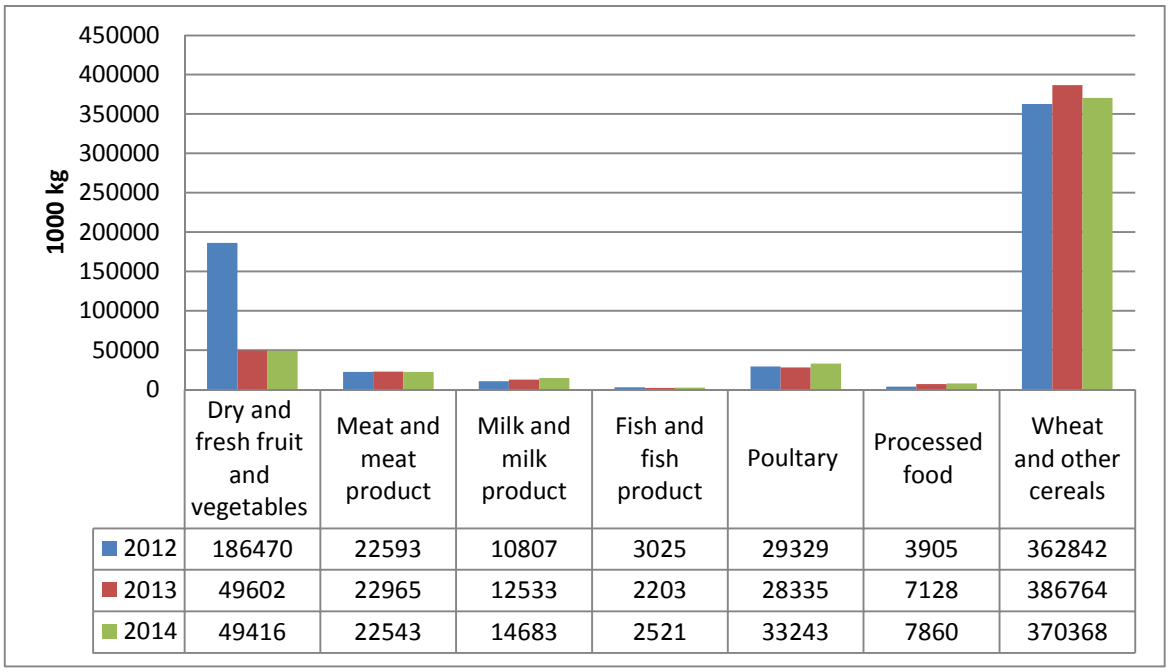


Figure 4 Trend of Livestock and Poultry products in RA (2001-2013)

Source: Authors' editing, 2015; [2]
**left vertical axis; **right vertical axis*

Figure 5 shows that the import of wheat and other cereals constitute the largest proportion of food imports in Armenia. This is attributed to the fact that Armenia is not self-sufficient in wheat and other cereals production as improved seed varieties are not available. However, it is estimated that the household consumption and industrial use of cereals is very high, which necessitates import in order to satisfy this increasing demand. In order to reduce the import of cereals the Ministry of Agriculture included in the strategic policy for agricultural development the self-sufficiency of the cereals as a priority. It is predicted that Armenia will be 80% self-sufficient in cereal production by 2020. In the last 3 year, a sharp reduction in the import of fruit and vegetables was recorded due to huge investment of advanced technologies, which led to improvement in domestic production levels. In the same vein, the import of meat, milk, fish and processed products has not significantly changed as a result of consistent domestic production by local farmers.

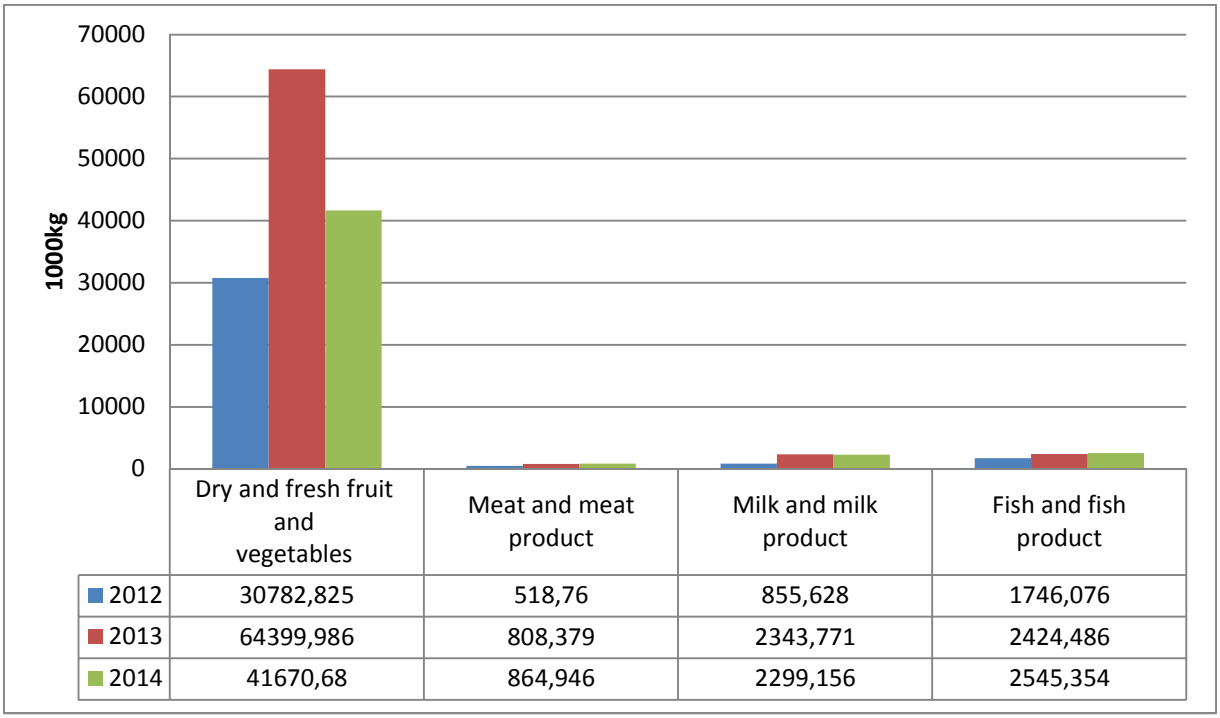


	Dry and fresh fruit and vegetables	Meat and meat product	Milk and milk product	Fish and fish product	Poultary	Processed food	Wheat and other cereals
2012	186470	22593	10807	3025	29329	3905	362842
2013	49602	22965	12533	2203	28335	7128	386764
2014	49416	22543	14683	2521	33243	7860	370368

Figure 5. Import of the main agricultural products

Source: Authors' editing, 2015; [10]

Dry and fresh fruit and vegetables show the highest quantity of agricultural products being exported across the years. In contrast export of meat and meat products have the lowest quantity over the years, because the quantity produced is only enough to serve the local consumers, therefore there is enough available for export.



	Dry and fresh fruit and vegetables	Meat and meat product	Milk and milk product	Fish and fish product
2012	30782,825	518,76	855,628	1746,076
2013	64399,986	808,379	2343,771	2424,486
2014	41670,68	864,946	2299,156	2545,354

Figure 6. Export of the main agricultural products

Source: Authors' editing, 2015; [10]

4 CONCLUSION AND RECOMMENDATION

Agricultural sector plays a very important role in Armenian economy as it employs large share of the entire population and also has its big contribution to the national GDP. In governmental projects and budgets the sector is given high priority. Despite this, the sector is encounters various challenges. Over the last decades government established relationship with international bodies and organizations to overcome obstacles of the sphere, which informs several policies, programs and projects aimed at addressing this challenges. Policies and projects implemented over the last decades had their big contribution to the overall agricultural output. However, Armenian agricultural sector has yet to attain its potential in crop production and animal husbandry in feeding the growing population and also attending to international market. Therefore, based on our findings the following recommendations are made to further improve this sector:

- Development of infrastructure in agricultural institutions in order to create a good structure and environment for research and development.
- In order to create a strong network among farmers and consumer the government should provide a marketing platform that is affordable for the farmers.
- To improve the knowledge and skills of farmers a strong link should be established between research institutions and farmers with the help of effective agricultural extension services.
- Policies should be directed at supporting and encouraging farmers on export oriented products, application of new technologies and seed varieties.
- Access to credit facilities and low interest loans should be made available to farmers, particularly farmers that produce export oriented products and products that Armenia has comparative advantage, such as Armenian Apricot, grapes etc.
- Farmers located in isolated areas should have easy access to city markets in order to ensure effective marketing and stable production.

REFERENCES

[1] Avenue Consulting Report. Agriculture in Armenia Snapshot, 2014. [Online] Available at: http://www.avenueconsulting.am/resources/avenue//uploads/pdf/aafab24852e8b106fd66818c0349bf8e.pdf on 01/04/2015 (April 1, 2015).

[2] RA National Statistical Service Reports(NSS), 2014. [Online] Available at: www.armstat.am (December 15, 2014)

[3] Ministry of Agriculture(MoA), (updated in 2006). A Strategy for Sustainable Agricultural Development. Consistent with the Government program on “Poverty Reduction Strategy Paper”, 2004.

[4] Government of Armenia(GoA), “2010-2020 Sustainable Strategy Program for Agricultural and Rural Development”, 2010.

[5] ARLIS 2010-2020 Strategy of sustainable development of rural areas and agriculture: The act of Government of Armenia, 2010. [Online] Available at: http://www.arlis.am/DocumentView.aspx?DocID=63109 (December 1, 2014).

[6] Agricultural Project Implementation Unit-APIU: Report on RESCAD project, 2013. [Online] Available at: http://www.arspiu.com/RESCAD.45.0.html?&L=0, (November 8, 2014).

[7] Agricultural Support Republican Centre-ASRC. Official bulleting of Technology Evaluation Program 2014. [Online] Available from: http://asrc.am/index.php?id=4151, (November 1, 2014)

[8] Agricultural Project Implementation Unit-APIU: Report on CARMAC project 2013. [Online] Available at: http://www.arspiu.com/CARMAC.17.0.html?&L=0, November 8, 2014).

[9] Agricultural Project Implementation Unit-APIU: Report on CARMAC II project. [Online] Available at: http://www.arspiu.com/CARMAC-II-PROJECT.55.0.html?&L=0, November 8, 2014).

[10] State Service for Food Safety (SSFS), Report on export and import, 2015. [Online] Available at: http://ssfs.am/en (February 7, 2015)