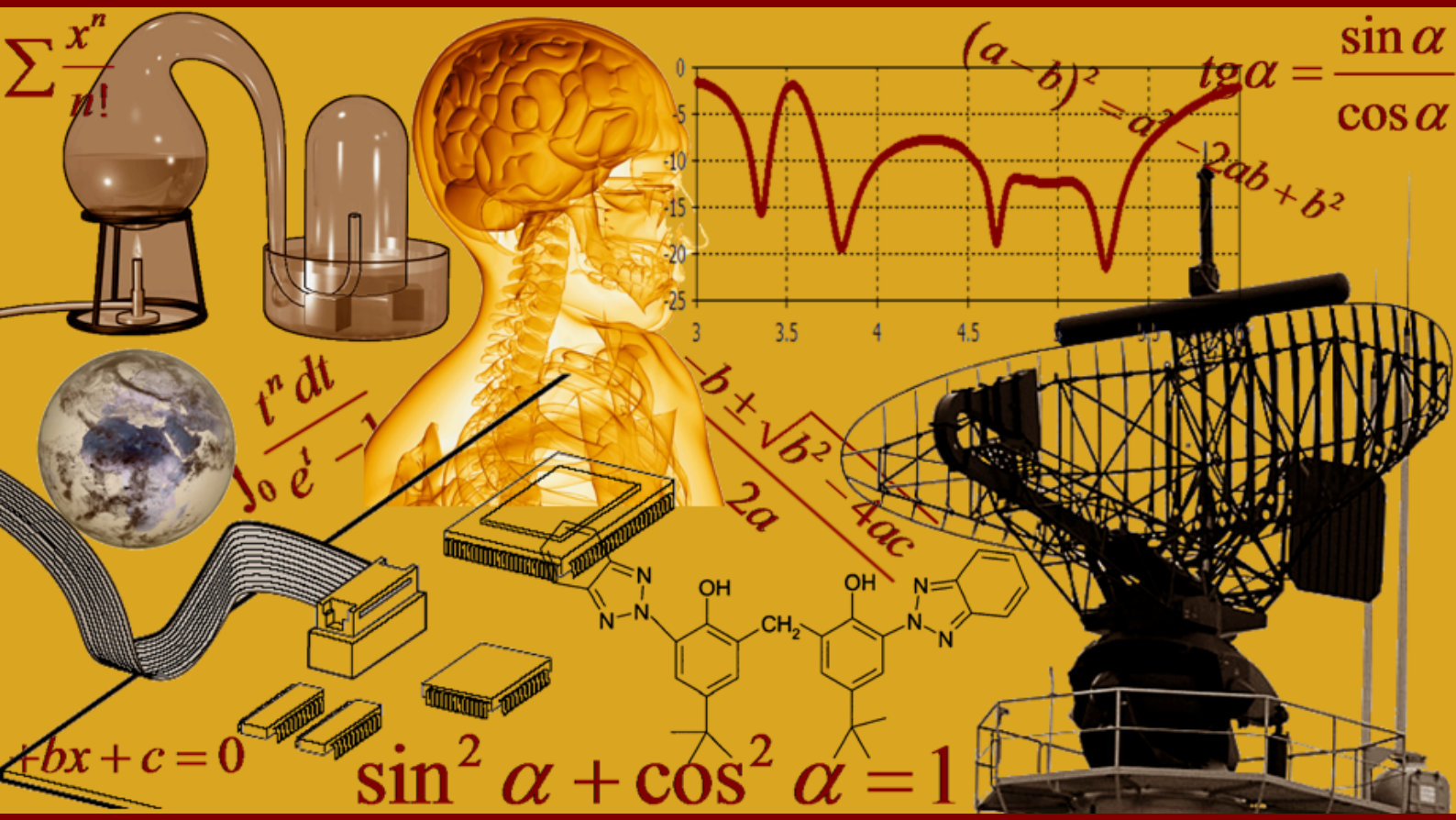
ISSN: 2351-8014 Impact Factor: 2.095

INTERNATIONAL JOURNAL OF INNOVATION AND SCIENTIFIC RESEARCH

Vol. 10 N. 1 October 2014



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. 10 No. 1 Oct. 2014, pp. 1-5

http://www.ijisr.issr-journals.org/

A Survey on Data Mining Techniques

M. Suganthi

School of Computer Science and Engineering, Bharathidasan University, Trichy, India

ABSTRACT: This paper provides a survey of various data mining techniques. These techniques include Association rule, Fuzzy logic, Decision tree and neural network. The concept of data mining was summarized and its significance towards its methodologies was illustrated. This paper also conducts a formal review of the area of rule extraction from Association rule and Fuzzy Logic. This survey paper also conducts a formal review of the applications of data mining such as the education sector, marketing, fraud detection, manufacturing and telecommunication. This paper discusses the topic based on past survey paper and also studies the data mining techniques.

KEYWORDS: Data Mining, Neural Network, Decision Tree, Association Rule and Fuzzy Logic.

1 INTRODUCTION

Data mining refers to extracting or mining the knowledge from large amount of data. The term data mining is appropriately named as 'Knowledge mining from data' or "Knowledge mining". Data collection and storage technology has made it possible for organizations to accumulate huge amounts of data at lower cost. Exploiting this stored data, in order to extract useful and actionable information, is the overall goal of the generic activity termed as data mining.

Data mining is an interdisciplinary subfield of computer science which involves computational process of large data sets' patterns discovery. The goal of this advanced analysis process is to extract information from a data set and transform it into an understandable structure for further use. The methods used are at the juncture of artificial intelligence, machine learning, statistics, database systems and business intelligence. Data Mining is about solving problems by analyzing data already present in databases [2]. Data mining is also stated as essential process where intelligent methods are applied in order to extract the data patterns. Data mining consists of five major elements:

- Extract, transform, and load transaction data onto the data warehouse system.
- Store and manage the data in a multidimensional database system.
- Provide data access to business analysts and information technology professionals.
- Analyze the data by application software.
- Present the data in a useful format, such as a graph or table.

Data mining functionalities are used to specify the kind of patterns to be found in data mining tasks. Data mining tasks can be classified in two categories-descriptive and predictive. Descriptive mining tasks characterize the general properties of the data in database. Predictive mining tasks perform inference on the current data in order to make predictions. The purpose of a data mining effort is normally either to create a descriptive model or a predictive model. A **descriptivemodel** presents, in concise form, the main characteristics of the data set. It is essentially a summary of the data points, making it possible to study important aspects of the data set. Typically, a descriptive model is found through undirected data mining; i.e. a bottom-up approach where the data "speaks for itself". Undirected data mining finds patterns in the data set but leaves the interpretation of the patterns to the data miner. The purpose of a **predictive model** is to allow the data miner to predict an unknown (often future) value of a specific variable; the target variable. If the target value is one of a predefined number of discrete (class) labels, the data mining task is called classification. If the target variable is a real number, the task is regression. The predictive model is thus created from given known values of variables, possibly including previous values of

Corresponding Author: M. Suganthi

the target variable. The training data consists of pairs of measurements, each consisting of an input vector x (i) with a corresponding target value y(i). The predictive model is an estimation of the function y=f(x; q) able to predict a value y, given an input vector of measured values x and a set of estimated parameters q for the model f. The process of finding the best q values is the core of the data mining technique [3].

At the core of the data mining process is the use of a data mining technique. Some data mining techniques directly obtain the information by performing a descriptive partitioning of the data. More often, however, data mining techniques utilize stored data in order to build predictive models. From a general perspective, there is strong agreement among both researchers and executives about the criteria that all data mining techniques must meet. Most importantly, the techniques should have high performance. This criterion is, for predictive modeling, understood to mean that the technique should produce models that will generalize well, i.e. models having high accuracy when performing predictions based on novel data.

Classification and prediction are two forms of data analysis that can be used to extract models describing the important data classes or to predict the future data trends. Such analysis can help to provide us with a better understanding of the data at large. The classification predicts categorical (discrete, unordered) labels, prediction model, and continuous valued function.

2 METHODOLOGIES OF DATA MINING

2.1 ARTIFICIAL NEURAL NETWORK

Neural Network or an artificial neural network is a biological system that detects patterns and makes predictions. The greatest breakthroughs in neural network in recent years are in their application to real world problems like customer response prediction, fraud detection etc. Data mining techniques such as neural networks are able to model the relationships that exist in data collections and can therefore be used for increasing business intelligence across a variety of business applications [4]. This powerful predictive modeling technique creates very complex models that are really difficult to understand by even experts. Neural Networks are used in a variety of applications. It is shown in fig.1. Artificial neural network have become a powerful tool in tasks like pattern recognition, decision problem or predication applications. It is one of the newest signals processing technology. ANN is an adaptive, nonlinearsystem that learns to perform a function from data and that adaptive phase is normally training phase where system parameter is change during operations. After the training is complete the parameter are fixed. If there are lots of data and problem is poorly understandable then using ANN model is accurate, the nonlinear characteristics of ANN provide it lots of flexibility to achieve input output map. Artificial Neural Networks, provide user the capabilities to select the network topology, performance parameter, learning rule and stopping criteria.

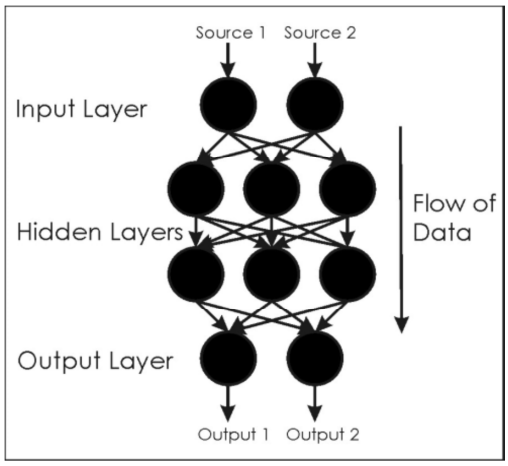


Fig.1. Neural Network with hidden layers

2.2 DECISION TREES

A decision tree is a flow chart like structure where each node denotes a test on an attribute value, each branch represents an outcome of the test and tree leaves represent classes or class distribution. A decision tree is a predictive model most often used for classification. Decision trees partition the input space into cells where each cell belongs to one class. The

partitioning is represented as a sequence of tests. Each interior node in the decision tree tests the value of some input variable, and the branches from the node are labelled with the possible results of the test. The leaf nodes represent the cells and specify the class to return if that leaf node is reached. The classification of a specific input instance is thus performed by starting at the root node and, depending on the results of the tests, following the appropriate branches until a leaf node is reached [5].Decision tree is represented in figure 2.

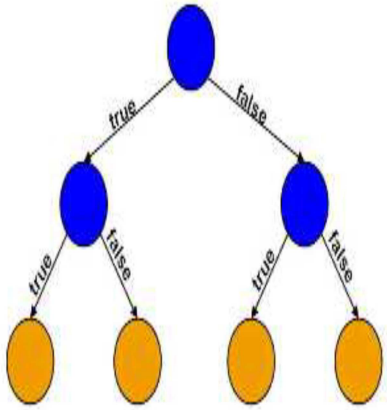


Fig.2. Decision tree

Decision tree is a predictive model that can be viewed as a tree where each branch of the tree is a classification question and leaves represent the partition of the data set with their classification. The author defines a Decision Tree as a schematic tree-shaped diagram used to determine a course of action or show a statistical probability [6]. Decision trees can be viewed from the business perspective as creating a segmentation of the original data set. Thus marketing managers make use of segmentation of customers, products and sales region for predictive study. These predictive segments derived from the decision tree also come with a description of the characteristics that define the predictive segment. Because of their tree structure and skill to easily generate rules the method is a favored technique for building understandable models.

2.3 ASSOCIATION RULE

Association rule discovery from large databases is one of the tedious tasks in data mining. Association rule mining has a wide range of applicability such as market basket analysis, suspicious e-mail detection, library management and many areas. The conventional algorithm of association rules discovery proceeds in two steps. All frequent item sets are found in the first step. The frequent item set is the item set that is included in at least minimum support transactions. The association rules with the confidence at least minimum confident are generated in the second step. Apriori algorithm uses transaction data set and uses a user interested support and confidence value and produce the association rule set. These association rule sets are discrete and continue therefore weak rule set are required to prune [7].

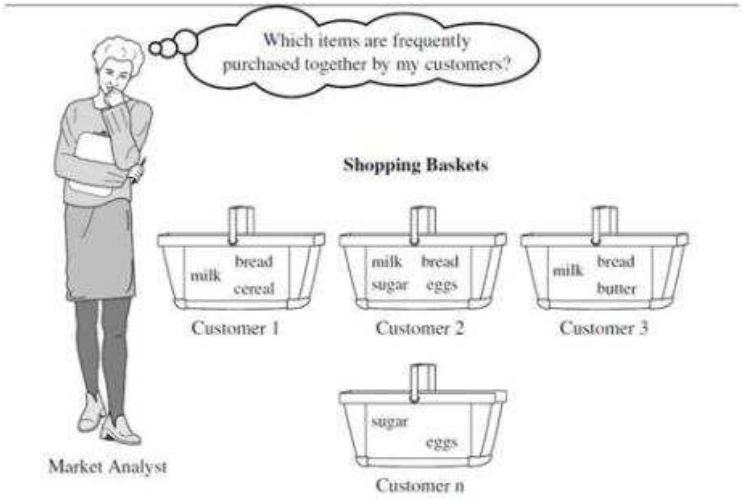


Fig.3. Market Based Analysis

A broadly-used example of association rule mining is market basket analysis. In Market Basket Databases consist of a large no. of records and in each record all items bought by a customer on a single purchase transaction are listed. Managers would be paying attention to know that which groups of items are constantly purchased together. This data is used by them to adjust store layouts (placing items optimally with respect to each other), to cross-sell, to promotions, to catalog design and to identify customer segments based on buying patterns [5]. For example, suppose a shop database has 200,000 point-of-sale transactions, out of which 4,0000 include both items A and B and 1600 of these include item C, the association rule "If A and B are purchased then C is purchased on the same trip" has a support of 1600 transactions (alternatively 0.8% = 1600/200,000) and a confidence of 4% (=1600/4,0000). The probability of a randomly selected transaction from the database will contain all items in the antecedent and the consequent is known as support, whereas the conditional probability of a randomly selected transaction will include all the items in the consequent given that the transaction includes all the items in the antecedent is known as confidence. Now a day's products are coming with bar codes. A large amount of sales data is produced by the software supporting these barcode based purchasing/ordering system which is typically captured in "baskets". Commercial organizations are interested in discovering "association rules" that identify patterns of purchases, such that the presence of one item in a basket will imply the presence of one or more additional items. This "market basket analysis" result can be used to suggest combinations of products for special promotions or sales[8]. Market Based Analysis shown in figure 3.

2.4 FUZZY LOGIC

Fuzzy set theory is an extension of conventional set theory that deals with the concept of partial truth. Fuzzy logic aims to model the vagueness and ambiguity in complex systems. In many image processing applications, expert knowledge must be used for applications such as object recognition and scene analysis. Fuzzy set theory and fuzzy logic provide powerful tools to represent and process human knowledge in the form of fuzzy IF-THEN rules[9].

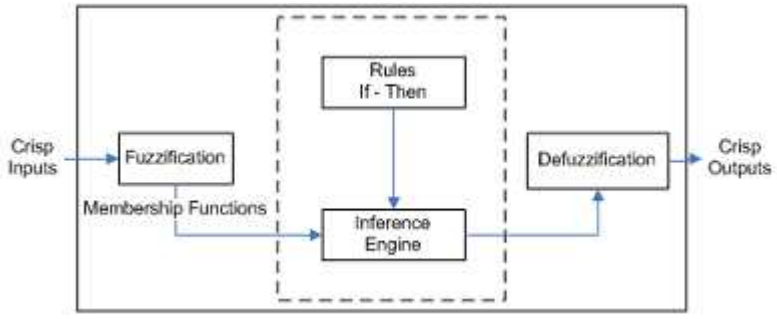


Fig 4 Fuzzy Logic- IF-Then

Over the past few decades, fuzzy logic has been used in a wide range of problem domains. The areas of applications are very wide: process control, management and decision making, operations research, economies and pattern recognition and classification. In the lack of precise mathematical model which will describe behavior of the system, Fuzzy Logic is a good "weapon" to solve the problem: it allows using logic if-then rules to describe the system's behavior [10].

Rules are a good way of representing information or bits of knowledge. A rule-based classifier uses a set of IF-THEN rules for classification. An IF-THEN rule is an expression of the form. IF condition THEN conclusion. Example is R1, R1: IF age=youth AND student = yes THEN buys computer=yes. The "IF" part of a rule is known as the rule antecedent or precondition. The "THEN"part is the rule consequent. In this rule antecedent, the condition consists of one or more attribute tests (such as age=youth, and student=yes) that are logically AND. The rule's consequent contains a class prediction (we predicting whether a customer will buy a computer). R1 can also be written as R1: (age=youth)^(student=yes)=>(buy computer=yes). If the condition in a rule antecedent holds true for a given tuple, we says that the rule antecedent is satisfied and that the rule covers the tuple.

A rule R can be assessed by its coverage and accuracy. Given a tuple, X, from a class labeled data set, D, let n_{covers} be the number of tuple covered by R; $n_{correct}$ be the number of tuple correctly classified by R; and |D| be the number of tuple in D. we can define the coverage and accuracy of R as

$$\text{Coverage}(R) = n_{covers/} |D|$$
$$\text{Accuracy}(R) = n_{correct}/ n_{covers}$$

That is, a rule's coverage is the percentage of tuples that are covered by the rule. For a rule's accuracy, we look at the tuple that it cover and see what percentage of them the rule can correctly classify. The Fuzzy logic IF-THEN process shown in figure 4.

3 CONCLUSION

If the conception of computer algorithms being based on the evolutionary of the organism is surprising, the extensiveness with which these methodologies are applied in so many areas is no less than astonishing. At present data mining is a new and important area of research. In this survey paper shows that association mining and fuzzy logic gives a accurate solution then other two techniques.

REFERENCES

[1] Xingquan Zhu, Ian Davidson, "Knowledge Discovery and Data Mining: Challenges and Realities", ISBN 978- 1-59904-252, Hershey, New York, 2007.

[2] Joseph, Zernik, "Data Mining as a Civic Duty – Online Public Prisoners Registration Systems", International Journal on Social Media: Monitoring, Measurement, Mining, vol. - 1, no.-1, pp. 84-96, September2010.

[3] Zhao, Kaidi and Liu, Bing, Tirpark, M Thomas. and Weimin, Xiao. "A Visual Data Mining Framework for Convenient Identification of Useful Knowledge", ICDM '05 Proceedings of the Fifth IEEE International Conference on Data Mining, vol.-1, no.-1,pp.- 530- 537,Dec 2005.

[4] R. Andrews, J. Diederich, A. B. Tickle," A survey and critique of techniques for extracting rules from trained artificial neural networks", Knowledge-Based Systems,vol.- 8,no.-6, pp.-378-389,1995.

[5] Lior Rokach and Oded Maimon,"Data Mining with Decision Trees: Theory and Applications(Series in Machine Perception and Artificial Intelligence)", ISBN: 981-2771-719, World Scientific Publishing Company, , 2008.

[6] M. Venkatadri and Lokanatha C. Reddy ,"A comparative study on decision tree classification algorithm in data mining" , International Journal Of Computer Applications In Engineering ,Technology And Sciences (IJCAETS), Vol.- 2 ,no.- 2 , pp. 24- 29 , Sept 2010.

[7] K. Saravana kumar, R. Manicka chezia, "A Survey on Association rule mining using Apriori Algorithm", International Journal of Computer Application(IJCA), vol-45 No:5.May 2005.

[8] Nikita jain, Vishal Srivastava, "Data Mining Techniques: A Survey paper", IJRET ISSN:2319-1163, vol-02 Issue:11, Nov 2013.

[9] S. Sanjeev Sannakki, S. Vijay Rajpurohit, S. Arunkumar, "A Survey on Application of Fuzzy logic in Agriculture",Journal of Computer Applications (JCA) ISSN: 0974-1925, Volume IV, Issue 1, 2011.

[10] Jorge Ropero, Carlos León, Alejandro Carrasco, Ariel Gómez, Octavio Rivera," Fuzzy Logic Applications for Knowledge Discovery: a Survey", International Journal of Advancements in Computing Technology Volume 3, Number 6, July 2011.

International Journal of Innovation and Scientific Research
ISSN 2351-8014 Vol. 10 No. 1 Oct. 2014, pp. 6-18

http://www.ijisr.issr-journals.org/

An Efficient Blind Signature Authentication for Wireless Sensor Networks Using HECC

T. Gomathi, V. Manju, and N. Anuradha

Department of ETCE,
Sathyabama University,
Chennai, Tamilnadu, India

ABSTRACT: The challenging issue in the design and deployment of Wireless Sensor Networks (WSNs) is the key management and authentication scheme due to the constraints in the sensor networks. The major constraints in Wireless Sensor Networks are large memory storage, more computational complexity and limited resource. Hence, in order to overcome these constraints and to achieve secure communication between sensor nodes, it is important to establish an efficient key predistribution mechanism. Inspite of the fact that many elegant and clever solutions have been proposed, no practical efficient key predistribution has emerged. The existing key management scheme in WSN using ECC provides a predistribution scheme with bigger key sizes and increased memory overhead. The computational complexity is also high which increases the processing time. The recent progress and research on HECC provides new opportunities to utilize public-key cryptography in Wireless Sensor Networks. The key generation for HECC polynomial using genus-2 curve was performed. The encryption and decryption algorithm for HECC was formulated. The key predistribution using HECC and ECC were implemented in wireless sensor network and simulated using NS2 simulator. The various performance analysis namely delay, throughput and power for both HECC and ECC were performed and the results are shown. It is inferred from the results that the proposed HECC scheme outperforms the existing ECC scheme. Further in this project work, the Blind Signature using HECC and Digital Signature using HECC has been implemented in WSN using NS2. The various performance metrics for both the signature schemes have been obtained and the results were compared.

KEYWORDS: WSN, Key predistribution, HECC, ECC, DS, BS.

1 INTRODUCTION

A wireless sensor network (WSN) consists of spatially distributed autonomous sensors to monitor physical or environmental conditions, such as temperature, sound, vibration, pressure, motion or pollutants and to cooperatively pass their data through the network to a main location. The development of wireless sensor networks was motivated by military applications such as battlefield surveillance; today such networks are used in many industrial and consumer applications, such as industrial process monitoring and control, machine health monitoring, and so on. The major constraints in WSN are power consumption, memory, computational capability. Hence the appropriate encryption scheme should be selected considering these considerations. If more security is needed for some applications then accordingly the encryption algorithm has to be selected.

1.1 PUBLIC KEY CRYPTOGRAPHY

Asymmetric algorithms rely on one key for encryption and a different but related key for decryption. These algorithms have the following important characteristics: It is computationally infeasible to determine the decryption key given only knowledge of the cryptographic algorithm and the encryption key. One of the first approach to public key encryption is the RSA scheme. It is the most widely accepted and implemented general purpose approach to public- key encryption. The key length for secure RSA has been increasing and this put a heavier processing load on applications using RSA. This burden has

Corresponding Author: T. Gomathi

ramifications especially for electronic commerce sites that conduct large numbers of secure transactions. Recently a competing system has begun to challenge RSA: Elliptic curve cryptography (ECC).

The principle attraction of ECC, compared to RSA, is that it appears to offer equal security for a far smaller key size, thereby reducing processing overhead. Thus there is a computational advantage of using ECC with a shorter key length than a comparably secure RSA. The key length of ECC is 120 bits. Cryptanalysts have founded Hyper Elliptic Curve Cryptography which is also a public key cryptography whose key length is very much lesser than that of Elliptic Curve Cryptography (ECC).The key length of HECC is 80 bits. Hence by reducing the key length the computational time is decreased, which in turn increases the processing speed that leads to increased throughput. [1]

1.2 KEY DISTRIBUTION SCHEME

Key distribution is an important issue in wireless sensor network (WSN) design. It is a newly developing field due to the recent improvements in wireless communications. Key predistribution is the method of distribution of keys onto nodes before deployment. Therefore, the nodes build up the network using their secret keys after deployment, that is, when they reach their target position. Key predistribution schemes are various methods that have been developed by academicians for a better maintenance of key management in WSNs. Basically a key predistribution scheme has 3 phases:

- Key distribution
- Shared key discovery
- Path-key establishment

During these phases, secret keys are generated, placed in sensor nodes, and each sensor node searches the area in its communication range to find another node to communicate. A secure link is established when two nodes discover one or more common keys (this differs in each scheme), and communication is done on that link between those two nodes. Afterwards, paths are established connecting these links, to create a connected graph. The result is a wireless communication network functioning in its own way, according to the key predistribution scheme used in creation.

The paper is organized as follows: Section II gives an idea about the existing scheme, Section III deals with the proposed key predistribution scheme. Section IV discusses th performance analysis and comparison of existing and proposed key predistribution. Section v deals with the conclusion

2 EXISTING SCHEME

The existing key predistribution uses ECC in wireless sensor networks.ECC is also a public key cryptography .This encryption algorithm has been implemented on WSN. Elliptic curve cryptography (ECC) is an approach to public-key cryptography based on the algebraic structure of elliptic curves over finite fields. Elliptic curves are also used in several integer factorization algorithms that have applications in cryptography, such as Lenstra elliptic curve factorization. ECC devices require less storage, less power, less memory, and less bandwidth than other systems. This allows us to implement cryptography in platforms that are constrained, such as wireless devices, handheld computers, smart cards, and thin-clients.

3 PROPOSED SCHEME

To overcome the above limitations, this project work proposes an efficient key predistribution scheme which establishes shared keys between sensor nodes using Hyper Elliptic Curve Cryptography (HECC) in WSN. By this proposed method, greater security, stronger resilience, low energy consumption and less memory storage can be achieved. HECC is a typical fast public key cryptosystem with high efficiency and security. Hyper Elliptic Curve Cryptosystem [2],[3]is the natural generalization of Elliptic curve Cryptosystem. In HECC a secure Jacobian group with large prime number order can be constructed on a relatively smaller basic field. HECC can acquire the same security level with shorter operating parameters. If the basic finite field is 60 bits, the security level of HECC is equivalent to that of Elliptic Curve Cryptography with 180 bits, and it is far secured than RSA with1024 bits. In cryptography a blind signature as introduced by David Chaum, is a form of digital signature in which the content of a message is disguised (blinded) before it is signed. The resulting blind signature can be publicly verified against the original, 7nblended message in the manner of a regular digital signature. Blind signatures are typically employed in privacy-related protocols where the signer and message author are different parties. Examples include cryptographic election systems and digital cash schemes.

The recent progress and research on HECC provides new opportunities to utilize public-key cryptography in Wireless Sensor Networks. The key generation for HECC polynomial using genus-2 curve was performed.

3.1 KEY PREDISTRIBUTION IN WSN USING HECC

The key predistribution in WSN is done using HECC [4],[5]. The private key and identity are given to each and every sensor nodes during manufacturing process itself. Whenever nodes want to communicate between each other then the server will give a key for that particular session to those nodes. With the help of that session key and their private keys , the nodes will generate the secret common key for them to establish communication. Thus by using the common secret key the nodes can communicate the message securely.The algorithm for generating the public and private key generation for HECC is as follows:

Step 1: Select a hyper elliptic curve C, prime number p and divisor D.
Step 2: Choose a prime random number a_A that belongs to a group N.
Step 3: Generate the public key $P_{A =} a_A$ * D.
Step 4: Return the public key P_A and the private key a_A.

3.2 DIGITAL SIGNATURE

A digital signature [6],[7] is an electronic signature used to authenticate the identity of the sender of a message or the signer of a document, and possibly to ensure that the original content of the message or document that has been sent is unchanged. It can be used with any kind of message, whether it is encrypted or not, simply so that the receiver can be sure of the sender's identity and that the message arrived intact. Digital Signature Certificates [8], [9], [10] can be used for eFiling of Income Tax Returns, eTendering in India on Government Websites such as Indian Railway

4 PERFORMANCE ANALYSIS OF EXISTING SCHEME

The performance characteristics of the proposed scheme and the existing scheme were simulated and compared. The various performance metrics namely delay, throughput and power consumption are analyzed for the proposed scheme and the existing scheme. The proposed algorithm ensures successful data delivery, less delay, greater throughput, optimal power consumption and increased efficiency. The simulation is performed using Network Simulator 2 (NS2) software.

The Elliptic Curve Cryptography is implemented in WSN and its various performance metrics namely delay, throughput and power are calculated. The results are tabulated and discussed.

4.1 AVERAGE DELAY ANALYSIS FOR ECC

The simulation result of average delay analysis is shown in Figure 1 for ECC. It is inferred from the graph that the average delay for each and every node is very high and it ranges in the range of 19 ms. The reason is that the computational time for the existing scheme is very high which in turn increases the delay.

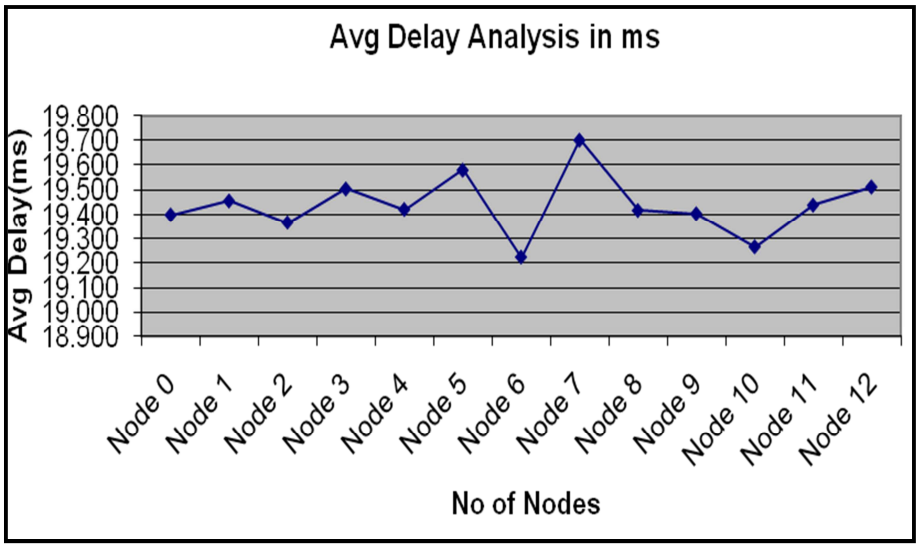


Fig.1 Average Delay Analysis for ECC

4.2 AVERAGE THROUGHPUT ANALYSIS FOR ECC

The simulation result of average throughput analysis is shown in Fig 2 for ECC. The graph shows that the throughput in each and every node is low for the proposed scheme. The throughput for each node is in the range of 77 % for ECC. Hence there is a lesser throughput because of more delay. Thus the computational time is increased which in turn reduces the throughput for the existing ECC scheme.

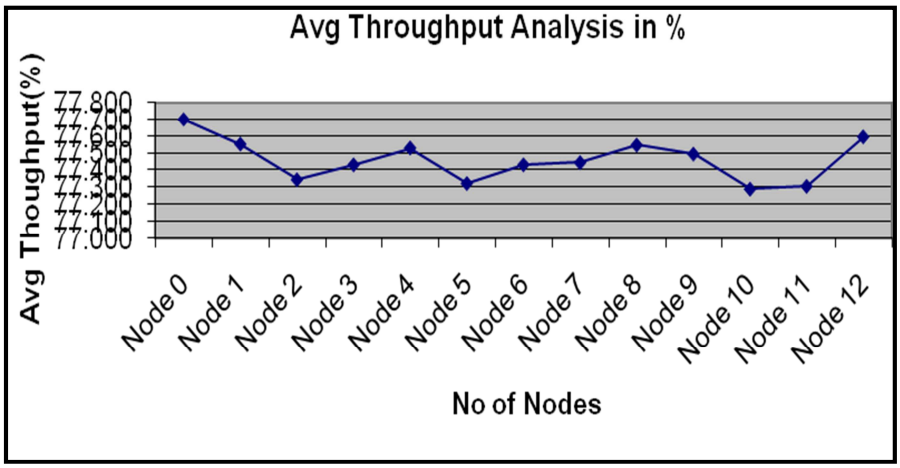


Fig. 2 Average Throughput analysis for ECC

4.3 AVERAGE POWER ANALYSIS FOR ECC

The simulation result of average power analysis is shown in Fig 3 for ECC. The graph shows that the power consumed by each and every node is more for the proposed scheme. The power is the major constraint in case of sensor networks. If a scheme consumes more power then it will not be an optimal scheme for implementing in WSN. The power consumed by each node for the existing Elliptic Curve Cryptography is in the range of 257mW.

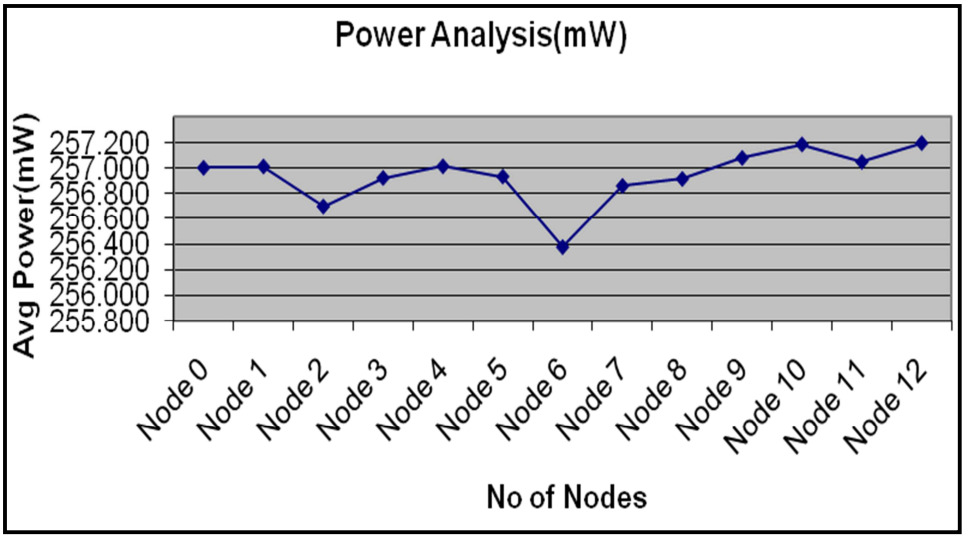


Fig. 3 Average Power for ECC

5 PERFORMANCE ANALYSIS OF PROPOSED SCHEME IN WSN

Genus 2 Jacobian hyper elliptic curve has been taken and implemented in WSN. The various metrics are analyzed for the proposed HECC scheme. The results are tabulated and discussed.

5.1 AVERAGE DELAY ANALYSIS FOR HECC

The simulation result of average delay analysis is shown in Fig 4 for HECC. It is inferred from the graph that the average delay for each and every node is very less and it ranges in the range of 11 ms. The reason is that the computational time for the proposed scheme is very less which in turn reduces the delay.

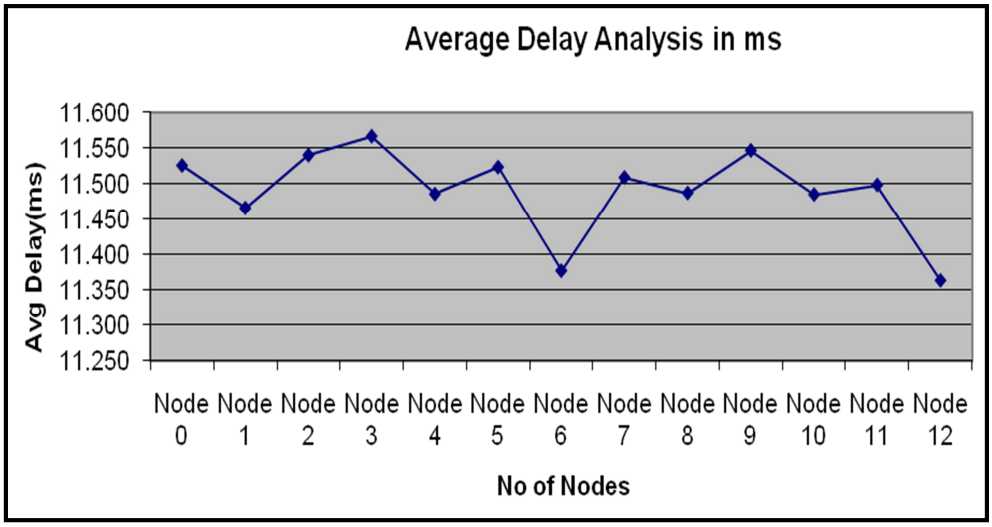


Fig. 4 Average Delay Analysis for HECC

5.2 AVERAGE THROUGHPUT ANALYSIS FOR HECC

The simulation result of average throughput analysis is shown in Fig.5 for HECC. The graph shows that the throughput in each and every node is high for the proposed scheme. The throughput for each node is in the range of 87 % for HECC. Hence there is a greater throughput because of lesser delay. Thus by reducing the computational time the throughput is increased for the proposed HECC scheme.

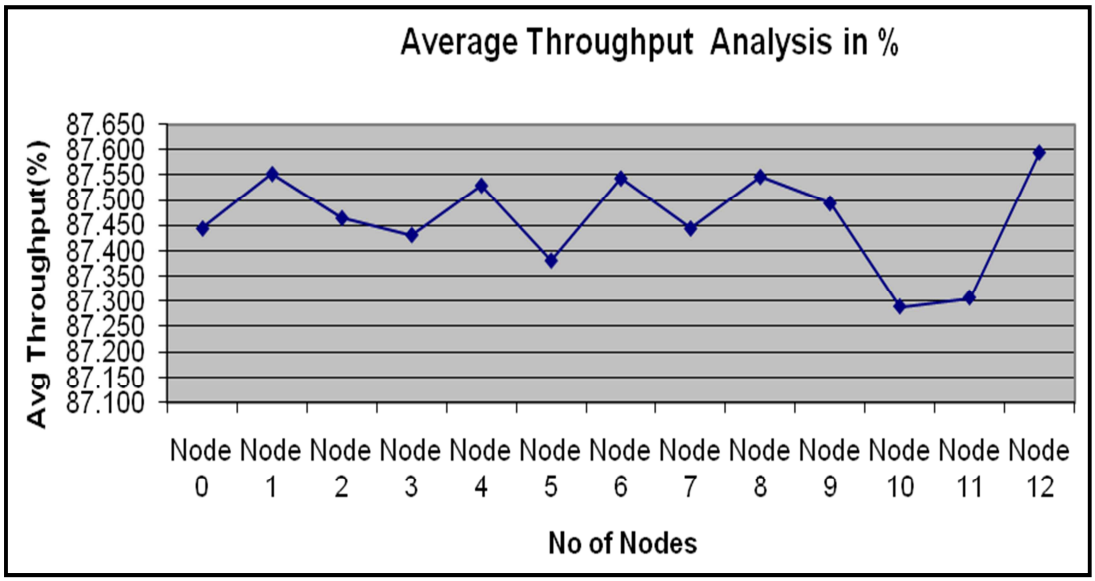


Fig.5 Average Throughput Analysis for HECC

5.3 AVERAGE POWER ANALYSIS FOR HECC

The simulation result of average power analysis is shown in Fig 6 for HECC. The graph shows that the power consumed by each and every node is less for the proposed scheme. The power is the major constraint in case of sensor networks. If a

scheme consumes less power then it will be definitely an optimal scheme that can be used in WSN. The power consumed by each node for the proposed Hyper Elliptic Curve Cryptography is in the range of 248mW.

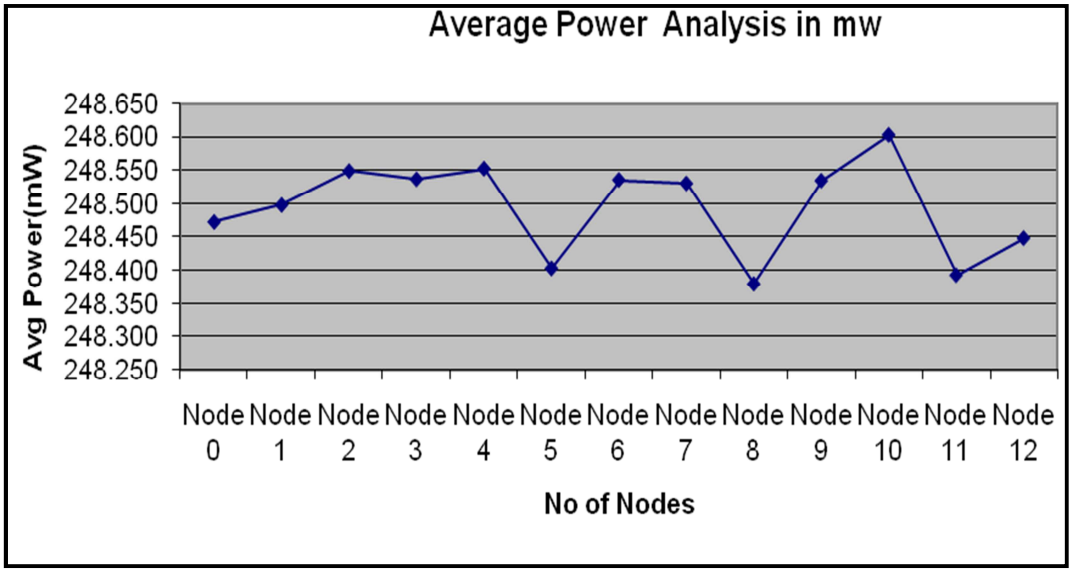


Fig. 6 Average Power for HECC

5.4 COMPARISON OF HECC AND ECC

The performance analysis of both the existing HECC and the proposed ECC schemes are compared and their performance metrics are analyzed. The parameters namely delay, throughput and power are compared for both the schemes. The results are tabulated and discussed.

5.4.1 DELAY ANALYSIS COMPARISON OF HECC AND ECC

The simulated result for delay analysis comparison is shown in Figure 4.7 for the existing and the proposed scheme. It is inferred from the graph that the delay is more in the existing Elliptic Curve Cryptographic scheme than the proposed Hyper Elliptic Curve Cryptographic scheme.

The delay is in the range of 11ms for HECC and for ECC the delay is in the range of 19ms.It is inferred from the graph that the computational time increases which in turn increases the delay for the existing scheme whereas the computational time is less which decreases the delay for the proposed scheme.

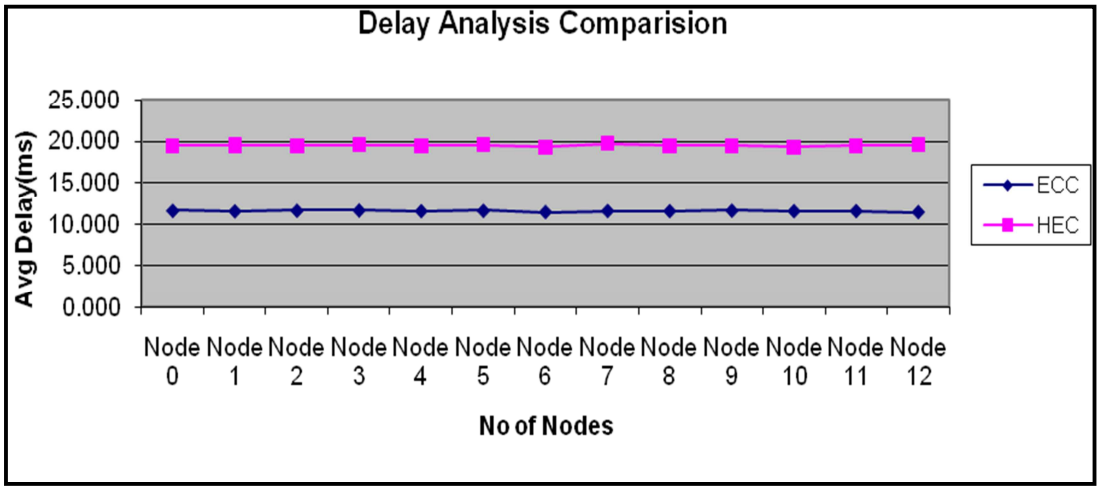


Fig. 7 Delay Analysis Comparison of HECC and ECC

5.4.2 THROUGHPUT ANALYSIS COMPARISON OF HECC AND ECC

The simulated result for throughput analysis comparison is shown in Figure 4.8 for the existing and the proposed scheme. It is inferred from the graph that the throughput is lesser in the existing Elliptic Curve Cryptographic scheme than the proposed Hyper Elliptic Curve Cryptographic scheme. The throughput is in the range of 87% for HECC and for ECC the throughput is in the range of 77%.It is inferred from the graph that the computational time increases which in turn decreases the throughput for the existing scheme whereas the computational time is less which increases the throughput for the proposed scheme.

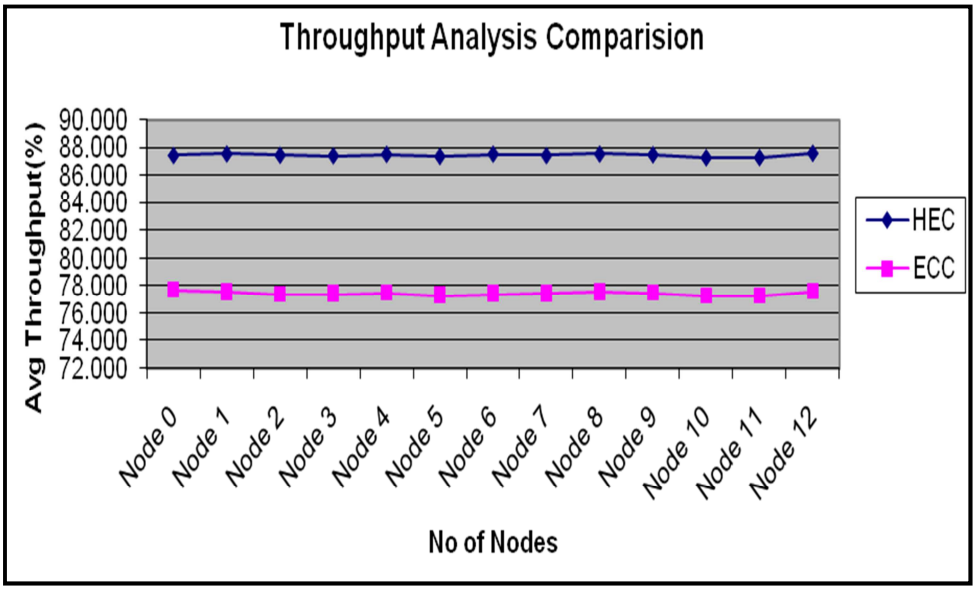


Fig. 8 Throughput Analysis Comparison of HECC and ECC

5.4.3 POWER ANALYSIS COMPARISON OF HECC AND ECC

The simulated result for power analysis comparison is shown in Figure 4.9 for the existing and the proposed scheme. It is inferred from the graph that the energy consumed is more in the existing Elliptic Curve Cryptographic scheme than the proposed Hyper Elliptic Curve Cryptographic scheme. The power is in the range of 248 for HECC and for ECC the throughput is in the range of 257Mw. It is inferred from the graph that the computational time increases which in turn increases the power consumption for the existing scheme whereas the computational time is less which decreases the power consumption for the proposed scheme. Thus the proposed scheme is optimal that can be implemented in WSN more efficiently and effectively.

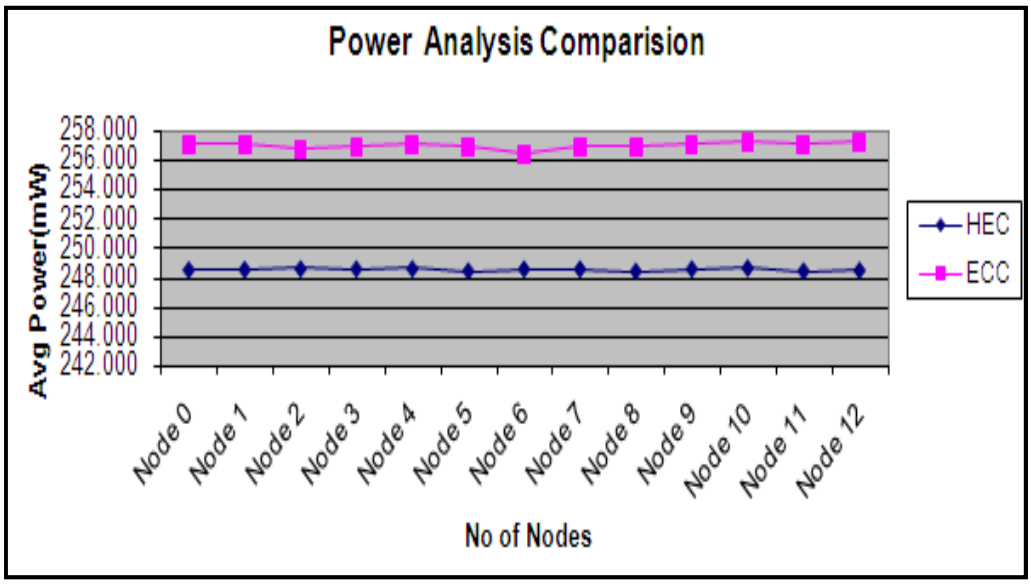


Fig. 9 Power Analysis Comparison of HECC and ECC

6 PERFORMANCE ANALYSIS OF DIGITAL SIGNATURE USING HECC

Digital Signature (DS) using HECC is implemented in WSN and its various performance metrics namely signing time, verification time, packet loss and throughput are calculated. The results are tabulated and discussed.

The simulation result of average signing time analysis is shown in Fig 10 for Digital Signature. It is inferred from the graph that the maximum average signing time for a node is very high and it ranges in the range of 1.59 sec. The reason is that the signing time is very high which in turn increases the delay.

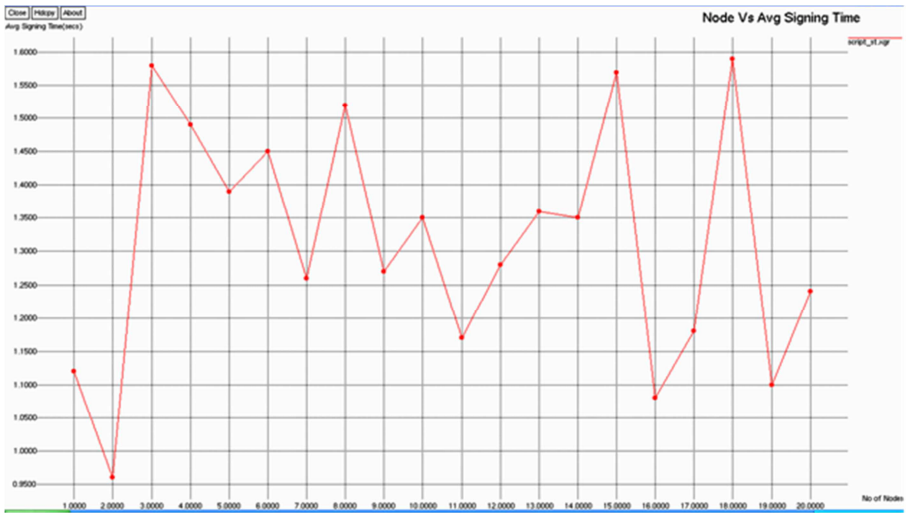


Fig 10 Average Signing Time Analysis for DS

6.1 AVERAGE VERIFICATION TIME ANALYSIS FOR DS

The simulation result of average verification analysis is shown in Fig 11 for Digital Signature. The graph shows that the average verification time for each and every node varies between 1.3 sec and 1.62 sec for the existing scheme. Hence there is a lesser throughput because of more delay. Thus the computational time is increased which in turn reduces the throughput for the existing digital signature scheme.

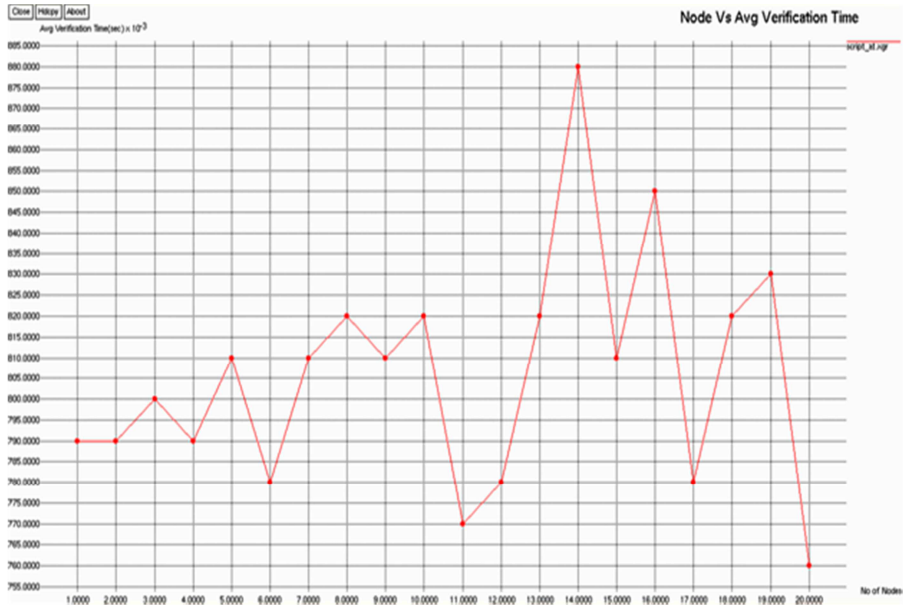


Fig 11 Average Verification Time Analysis for DS

6.2 AVERAGE PACKET LOSS ANALYSIS FOR DS

The simulation result of average packet analysis is shown in Fig 12 for digital signature using HECC. The graph shows that the packet loss for each and every node varies between 15.5 % and 19.5 % for the existing scheme. The signing time and verification time for the existing scheme is more which in turn increases the packet loss.

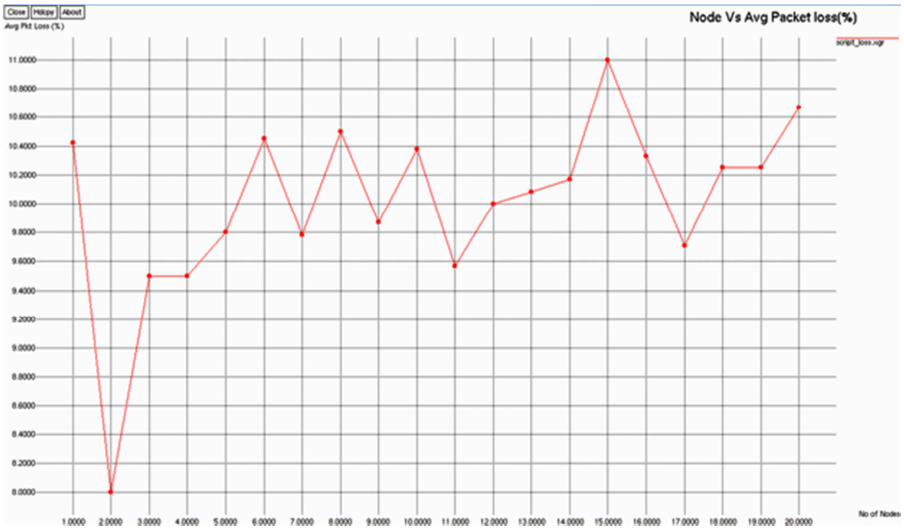


Fig 12 Average Packet Loss Analysis for DS

6.3 AVERAGE THROUGHPUT ANALYSIS FOR DIGITAL SIGNATURE

The simulation result of average throughput analysis is shown in Fig 13 for the existing digital signature. The graph shows that the throughput at each and every node is less for the existing scheme. The throughput at each node for the existing digital signature is in the range of 73 % to 79%.

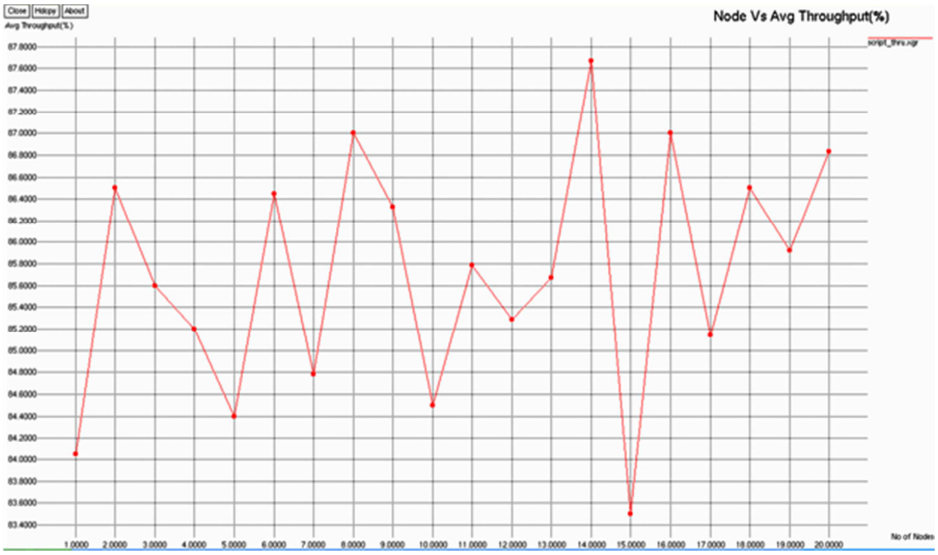


Fig 13 Average Throughput Analysis for DS

7 PERFORMANCE ANALYSIS OF BLIND SIGNATURE USING HECC

Genus 2 Jacobian hyper elliptic curve has been taken and implemented in WSN. The various metrics are analyzed for the proposed Blind Signature (BS) authentication scheme. The results are tabulated and discussed.

7.1 AVERAGE SIGNING TIME ANALYSIS FOR BS

The simulation result of average delay analysis is shown in Fig 14 for blind signature using HECC. It is inferred from the graph that the average delay for each and every node is very less and it ranges between 0.66 sec and 0.88 sec. The reason is that the signing time for the proposed scheme is very less which in turn reduces the delay.

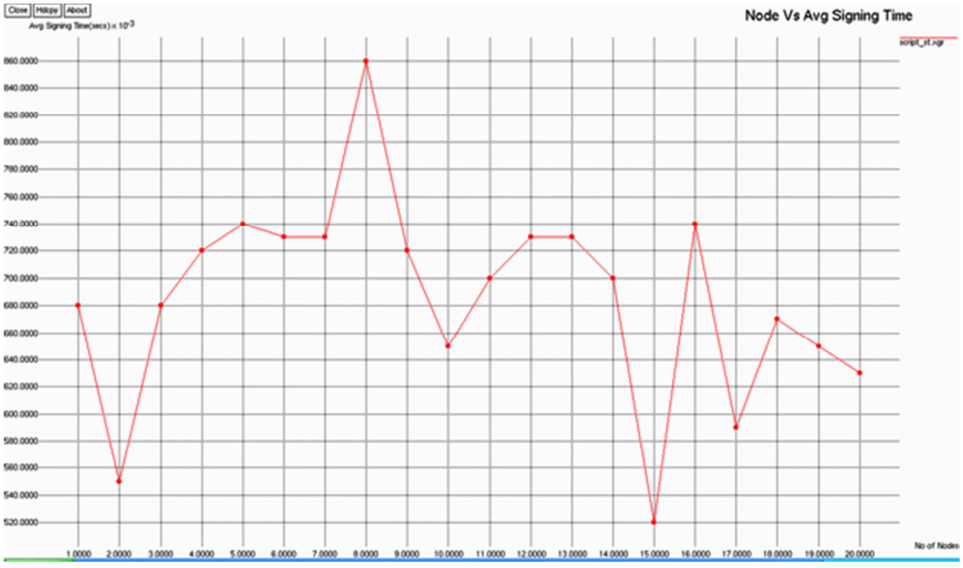


Fig 14 Average Signing Time Analysis for BS

7.2 AVERAGE VERIFICATION TIME ANALYSIS FOR BLIND SIGNATURE

The simulation result of average verification time analysis is shown in Fig 15 for blind signature using HECC. The graph shows that the verification time for each and every node is less for the proposed scheme. The verification time for each node

varies between 0.76 sec and 0.88 sec for the proposed scheme. Hence there is a greater throughput because of lesser delay. Thus by reducing the verification time the throughput is increased for the proposed Blind Signature scheme.

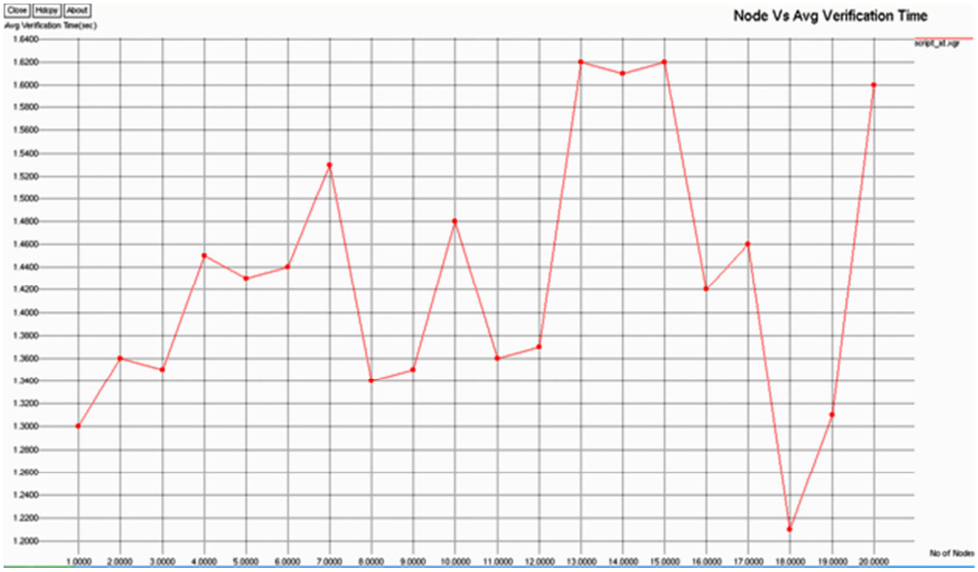


Fig 15 Average Verification Time Analysis for BS

7.3 AVERAGE PACKET LOSS ANALYSIS FOR BS

The simulation result of average packet loss analysis is shown in Fig 16 for blind signature using HECC. The graph shows that the packet loss at each and every node is less for the proposed scheme. Since the signing time and verification time are optimal for the proposed scheme the delay will be less which in turn reduces the packet loss. The packet loss for each node varies between 10.4% and 11%.

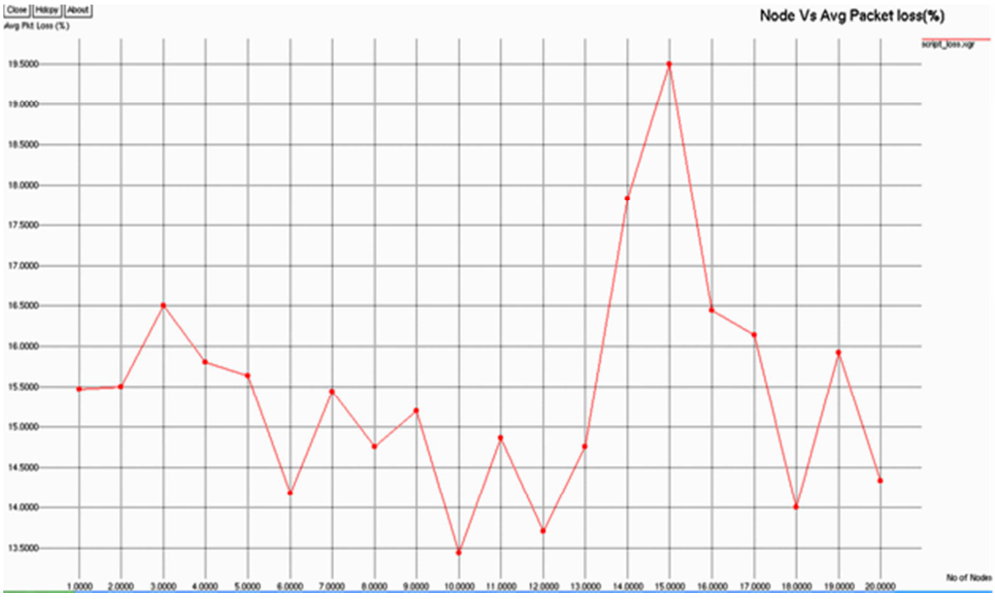


Fig 16 Average Packet Loss Analysis for BS

7.4 AVERAGE THROUGHPUT ANALYSIS FOR BS

The simulation result of average throughput analysis is shown in Fig 17 for blind signature using HECC. The graph shows that the throughput for each and every node is greater for the proposed scheme. The signing time and verification time are optimal for the proposed blind signature scheme using HECC in WSN which in turn increases the throughput for the proposed scheme. The throughput ranges between 83 % and 87.8 %.

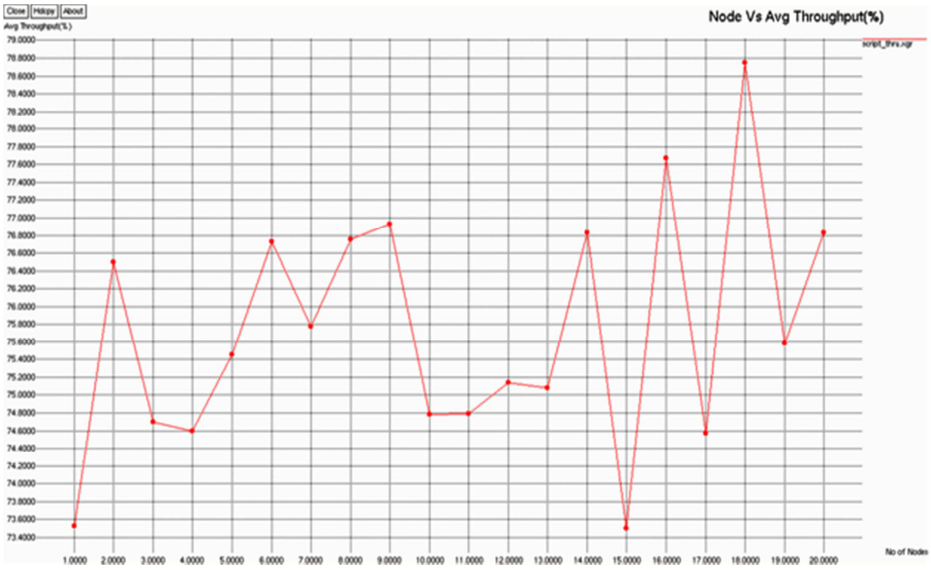


Fig 17 Average Throughput Analysis for BS

7.5 COMPARISON TABULAR COLUMN OF BOTH BS AND DS

The performance analysis of the proposed and the existing scheme is given in Table 3.The various performance metrics namely signing time, verification time, packet loss and throughput of both the schemes are tabulated herewith. The signing and verification time for each and every node is lesser for blind signature than digital signature. Hence the throughput is better for the proposed HECC blind signature in WSN. The packet loss is lesser for the proposed authentication scheme.

Table 1. Comparison of Performance Analysis for BS and DS

NO	PERFORMANCE METRICS	PROPOSED BS SCHEME	EXISTING DS SCHEME	PERCENTAGE OF SAVING BY THE PROPOSED SCHEME
1.	A Average Signing Time	0.66 Sec	1.58 Sec	0.92 sec
2.	Average Verification Time	0.88 Sec	1.62 Sec	0.74 sec
3.	Packet Loss	11 %	19.5 %	8.5 %
4.	Average Throughput	87.8 %	78.8 %	9 %

8 CONCLUSION

An efficient key predistribution and authentication scheme is proposed for wireless sensor networks considering the constraints in WSN. The proposed scheme using genus 2 curve Hyper Elliptic Curve Cryptography has been implemented in wireless sensor network which decreases the computational time thereby increasing the throughput.

The power consumption is a major constraint in case of wireless sensor networks. Thus the proposed scheme reduces the power consumption in WSN. The various performance analysis namely delay, throughput and power consumption have been analyzed and compared with the existing Elliptic Curve Cryptography scheme. The delay is more in the existing scheme. Hence the computational time is also more which leads to reduction in the throughput. It also consumes more power than the proposed scheme.

Thus the proposed scheme provides a better performance which has greater throughput, lesser delay and efficient utilization of power. There is a proportionate increase in throughput by 10% for HECC than the existing scheme. The delay reduces greatly by 8ms and the average power consumed by HECC is reduced by 10 mW. It is inferred from the results that the proposed HECC scheme outperforms the existing ECC scheme. The various performance analysis namely signing time, verification time, packet loss and throughput have been analyzed and compared with the existing authentication scheme. The delay is more in the existing scheme which in turn increases the packet loss also. The computational time for the existing scheme is also more which leads to reduction in the throughput. It also consumes more time for signing and verification than the proposed scheme.

The analysis of the proposed blind signature using Hyper Elliptic Curve has shown that the throughput of the scheme has been increased by decreasing the signing time and verification time. Since the signing and verification time is less there is an efficient usage of energy. The existing scheme has more delay which reduces the throughput to a greater extent which has been overcome by the proposed scheme. There is a decrease in the average signing time and verification time by 0.92 sec and 0.74 sec respectively. The throughput shows an increase by 9 % for the proposed scheme than the existing scheme. There is a proportional reduction in verification time by for the proposed scheme. The appropriate inferences pertaining to the results were discussed. It is inferred from the results that the proposed blind signature using HECC scheme outperforms the existing digital signature HECC scheme.

9 SCOPE OF FUTURE WORK

The main contribution of this project is the implementation of key predistribution scheme and authentication by a proposed algorithm using genus 2 curve. Further work is to propose an efficient ID-based partially blind signature scheme for mobile e-commerce applications in order to improve efficiency and to reduce the computational time by the usage of genus 3 and genus 4 curves. Methods to analyze the higher degree curves have to be developed. In this case, these methods should be capable of decreasing the computational time, delay and power consumption.

REFERENCES

[1] Qing Chang, Yong-ping ZHANG, Lin-lin Qin, "A Node Authentication Protocol based on ECC in WSN," International *Conference on Computer Design and Applications (ICCDA 2010)*, vol. 20, no. 6, August 2010.

[2] Nivethaa Shree.K and Dr.Latha Parthiban, "Knapsack-Based Elliptic Curve Cryptography Using Stern Series for Digital Signature Authentication," *International Conference on* E*merging Trends in Electrical and Computer Technology (ICETECT),*vol. 12, no. 1, March 2011.

[3] Deng Jian-zhi, Cheng Xiao-hui, and Gui Qiong, "Design of Hyper Elliptic Curve Digital Signature, " International Conference on Information Technology and Computer Science, vol. 2 , no. 3, pp. 45-47, July 2009.

[4] Nizamuddin, Shehzad Ashraf Ch., Waqas Nasar, and Qaisar Javaid, "Efficient Signcryption Schemes based on Hyperelliptic Curve Cryptosystem," *Journal on Applied Mechanics and Materials*, vol.1, no.7, pp. 546 – 552, September 2011.

[5] Xuanwu and Zhou, "Improved Ring Signature Scheme Based on Hyper-elliptic Curves, " *Second International Conference on Future Information Technology and Management Engineering,* vol. 3, no. 2, pp. 373- 376, December 2009.

[6] Dae Hyun Yum, Jin Seok Kim, Sung Je Hong, and Pil Joong Lee, "Distance Bounding Protocol for Mutual Authentication, " *IEEE Transactions on Wireless Communications*, vol. 10, no. 2, February 2011.

[7] Lein Harn and Jian Ren, "Generalized Digital Certificate for User Authentication and Key Establishment for Secure Communications," *IEEE Transactions on Wireless Communications*, vol. 10, no. 7, July 2011

[8] Xuanwu Zhou and Xiaoyuan Yang, "Hyper-elliptic Curves Cryptosystem Based Blind Signature," IEEE *Transactions Wireless Communication,* vol. 9, pp. 168-174, January 2009.

[9] Caimu Tang, *Member, Dapeng Oliver Wu,* Anthony T. Chronopoulos *and Cauligi S. Raghavendra,* "Efficient Multi-Party Digital Signature using Adaptive Secret Sharing for Low-Power Devices in Wireless Networks," *IEEE Transactions on Wireless Communications*, vol. 8, no. 2, Feb. 2009.

[10] Manik Lal Das, "Two-Factor User Authentication in Wireless Sensor Networks," *IEEE Transactions on Wireless Communications*, vol. 8, no. 3, March 2009.

International Journal of Innovation and Scientific Research
ISSN 2351-8014 Vol. 10 No. 1 Oct. 2014, pp. 19-26

http://www.ijisr.issr-journals.org/

Entropy Functional Based Auto Adaptive Wildfire Detection Using Fuzzy Logic

S. Poonguzhali, N. Anuradha, and T. Gomathi

Department of ETCE,
Sathyabama University,
Chennai, Tamilnadu, India

ABSTRACT: Nowadays digital camera technology and video processing techniques are increased worldwide. Due to this, the conventional fire detection methods are going to be replaced by computer vision based systems. The computer vision based systems detection has a significant role with surveillance system. Most of the algorithms used in the existing techniques propose spectral, spatial, temporal and other low level features of fire for distinguishing it from other objects in video sequences. This paper proposes a new approach to computational vision-based fire and flame detection by using a fuzzy logic edge detection and motion detection with ANN-SVM classifier as classification tool. The edge detection using fuzzy canny edge detection technique and the motion detection using motion estimation are use for fire and flame detection and ANN-SVM classifier is useful for the final classification. Finally, it decided whether the objects that have changed in that video are flame or not. Therefore, this method detects both smoke and flame effectively and obtain high accuracy by reduce false alarm rate.

KEYWORDS: Fuzzy canny edge detection, motion estimation, wildfire detection using video, SVM-ANN classifier, features extraction.

1 INTRODUCTION

Forest fires are one of the most important disasters which create great environmental problems for Nature. They are detectable but it is an unusual visual phenomenon, unlike normal object. Also it has both statical and dynamic texture. Some of the low level distinctive features of fire regions are Color, shape, motion, growth, smoke behavior, and flickering etc... Due to its frequent shape and size changes, computational vision-based systems are used for the fire and flame detection. For the vision based detection systems, the detection algorithms are depends on multi-feature-based approaches [1].

Surveillance cameras have significant role in many fields such as law enforcement, security, and protection of the environment. The computer vision based system has significant attention with the Surveillance cameras. According to the number of surveillance cameras being installed in various fields increased, conventional vision based object detection has become vital worldwide. The computer vision based detection is the method for finding a given object in a video sequence. Several signal and image processing techniques are developed for the detection of different objects from images and video sequences. The vision based object detection is used for the detection of fire, flame and smoke and is mainly a useful technique in the implementation of both indoor and outdoor fire alerts. It made more advantages over the traditional methods.

This paper presents the approach followed for fire detection by a fuzzy logic. The objective is to determine the location and the position of both potential fire and smoke and also extracting static and dynamic characteristic to reduce the number of false alarms. The paper deals mainly with both fire detection algorithms using edge detection and motion detection. Results from experiments with small controlled fires are presented. The paper is organized as follows. Section II presents the previous techniques for fire detection. Section III describes how to obtain the fire detection using the proposed technique. Section IV presents the experiments and the results obtained. The conclusions in section V complete the paper.

Corresponding Author: S. Poonguzhali

2 RELATED WORKS

W. Phillips, M. Shah, and N. Lobo. [2] proposes a system that detect the fire by using motion and color information from video sequences. The technique is used to detect fire reliably under normal conditions. But it have lack of hardware implementation, high false alarm rate, distance limited and fails in Open or large spaces.

Che-Bin Liu and Narendra Ahuja [3] propose a Vision based fire detection technique. In this paper, the spectral, spatial and temporal models of fire regions in visual image sequences are presented. The spectral model was represented in terms of the color probability density of fire pixels. The spatial model detects the spatial structure within a fire region. The temporal signatures of the fire region are used as the temporal changes in the Fourier Coefficient. It has following disadvantage. Since the spatial quantization errors for small regions are likely to introduce considerable noise in the FD, we place a threshold to eliminate regions of small size. We are also excluding large but thin regions. Consequently, this algorithm does not used to detect very small or far away fire.

Toreyin, B.U., Dedeoglu, Y., Cetin, A.E., [4] was proposed a technique based on Markov models to detect flames in video. In this technique, the flame and flame colored ordinary moving objects is detected by generating a Markov model. The spatial color variations in flame had also evaluated by the same Markov models. Final decision is made by combining this information. Due to the spreading characteristics of flame depend on the strength of the wind, it was impossible to use the same location within a fixed time to model the periodic behavior of flame boundaries.

Osman Gunay et. al. [5] proposes an entropy-functional-based online adaptive decision fusion (EADF) framework for image analysis and computer vision applications. In this framework, the compound algorithm consisting of several sub-algorithms. They are: slow video moving pixel algorithm, smoke colored region detection, wavelet transform based smoothness region detection, shadow detection and elimination and covariance matrix based region detection. Each sub-algorithm had a decision associated with it and the weights are updated online according to the each decision of sub algorithms. It has the following disadvantage. It is computationally expensive and runs slow. It is not accurate to detect the exact region of input flame against the background image. Also decision algorithm produce false alarm and is time consuming.

3 PROPOSED METHODOLOGY

For the better enhancement of related works, a new approach to computational vision-based fire and flame detection by using a fuzzy logic edge detection and motion detection with ANN-SVM classifier as classification tool is proposed. The edge detection using fuzzy canny edge detection technique and the motion detection using motion estimation are use for fire and flame detection and ANN-SVM classifier is useful for the final classification. This approach is to improve the accuracy of fire and flame detection in videos and to reduce the false alarm rate to a great extent. The methodologies used:

1- 2D Preprocessing using Median Filtering
2- Edge detection using Fuzzy canny edge detection algorithm
3- Color detection using Color histogram
4- Motion detection using Adaptive rood pattern search
5- Feature classification using SVM & ANN Classifier

In this approach, first the video is converting into frames. After converting into frames, the noise is removed from the frames using median filter. Then the edge of both fire and smoke is mapped using fuzzy canny edge detection algorithm. After the edge map, the color of the edge map region is detected. Then we detect the motion of the region using motion detection. In this, motion estimation using Adaptive rood pattern search algorithm is done. In that, the first detected frame is stored and then compares with the next frame. Whether the fire or smoke is detected, then the alarm is buffered for the region. In this, feature extraction is also do ne by using SVM-ANN Classifier. Fig. 1 shows the flow diagram of proposed system

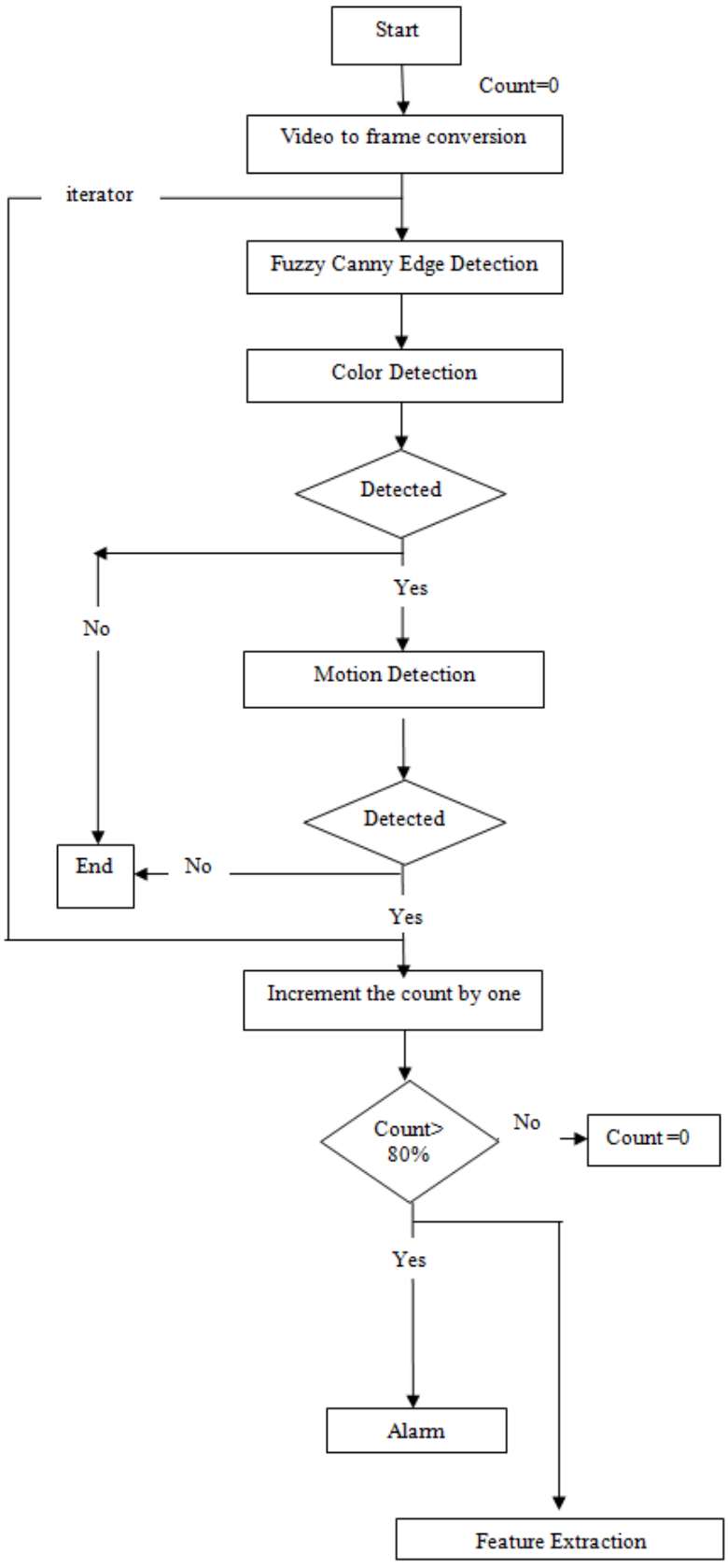


Fig. 1. Flow diagram of proposed system

3.1 PRE-PROCESSING USING MEDIAN FILTER

Once the video is obtained as input, then the video to frame conversion is done. After conversion, it is given for pre-processing to remove the noise. Mainly the video consists of salt and pepper noise. So the pre-processing is done by using median filter.

3.2 DETECTION USING FUZZY CANNY EDGE DETECTION ALGORITHM

After the pre-processing, the edge detection process is taking place to map the region where the fire and smoke obtained. The edge detection method is the recent technique to digital image for segmenting and improves the quality of the images. In this, it extracting some data with the structural properties i.e., edges in the image and discarded the unwanted data. In the recent years, so many edge detection methods have been done to improve the accuracy. Some of the previous operators used for edge detection are Prewitt, Sobel, Log filter, Robert and canny operator. These methods uses local gradient method for detection but it is not sufficient to control the noise. So the result is blurred image. Also it has some Malfunctioning at the corners, curves and the location where the gray level intensity function varies. Complex Computations, False zero crossing, and Time consuming also occurs. To eliminate the disadvantage of previous technique, we are introducing a new approach of edge detection based on fuzzy canny edge detection. This method identifies the edges of the flames correctly by removing all the noises in the flames. The proposed method identifies the continuous and clear edges of the flame/fire and produces the alarms accordingly. This process detects outlines of an object and boundaries between fire region and the background in the image.

In the fuzzy canny edge detection [6], the two basic phases of edge detection i.e. global contrast intensification and local fuzzy edge detection are first explained and is then merged with fuzzy canny operator for the better results specially for the noisy images and low contrast images. This method works on both local and global gradient information of images. Firstly, we are obtaining each pixel in the fuzzy domain. After that, the first phase that is a universal contrariety intensification operator is introduced for improves the quality of image. Due to this phase, more edginess is enhanced and discards less edginess. After this, the second phase that is local fuzzy edge detection involves edge detection with local information of images by using a fuzzy mask. After this, simple thresholding is done which is followed the canny edge detection to link the edges. The algorithm steps for the fuzzy canny edge detection are discussed below:

1) **Universal Contrast Intensification**
   a) Flame and fire image representation using fuzzy logic

2) **Edge Detection in local edges**
   a) Mask edge detector in local edges
   b) Removal of strong edges and noise
   c) Edge image thresholding

3) **Canny edge detection Algorithm**
   a) Smoothening the image with the derivation of a Gaussian
   b) Finding the gradient magnitude and gradient direction.
   c) Then taking the non-maxima suppression for the gradient magnitude image
   d) By using the two thresholds T1 > T2 :
      Then Class = {edge if magnitude > T1
      Candidate if magnitude > T2}
   e) Edge tracking is done by hysteresis

After the edge detection, color mapping is done for the detected region by marking feature points.

3.3 MOTION DETECTION USING ADAPTIVE ROOD PATTERN SEARCH

Once the color region is detected, then the motion of the region is finding by using the motion estimation. The motion estimation computes the difference between the current frame and the stored past frame that is the reference frame. The immediate fast frame is taken as the reference frame. The difference in position between the current frame and their similarity with the reference frame is defined as motion vector.

The algorithms have been implemented for the motion estimation are Exhaustive Search, Three Step Search, New Three Step Search, Simple and Efficient TSS, Four Step Search and Diamond Search. It has some following disadvantages. It has high computational cost and less PSNR value. Also they are too complex. Due to this reason, we are using adaptive rood pattern search (ARPS) algorithm [7] for the motion detection. It has less computation cost and high PSNR value. The algorithm steps used for the adaptive rood pattern search are discussed below:

a) Uses the motion vector of the macro block to its immediate left to predict its own motion vector.
b) After predicting the motion vector, checks at a rood pattern distributed points where they are at a step size of S = Max (|X|, |Y|).
c) It directly puts the search in an area where there is a high probability of finding a good matching block by using the equation (1). By using this equation , we are finding the difference between the current frame and the reference frame and then finding the proper match for detecting the motion of the fire region .

$$MAD = \frac{1}{N^2} \sum_{i=0}^{N-1} \sum_{j=0}^{N-1} |C_{ij} - R_{ij}| \quad (1)$$

Where MAD is the mean average difference, N is the size of macro block, Cij is the current block, Rij is the reference block.
d) The point that has the least weight becomes the origin for subsequent search step
e) The search pattern is obtained.
f) The procedure keeps on doing until least weighted point is found to be at the centre.

After motion detection, an alarm is buffered that showing the detection of more intensity region i.e.., fire or smoke with the motion of the region. If it is fire, then it shows a message box of fire. If it is no fire then it shows a message of no fore

3.4 FEATURE EXTRACTION USING SVM-ANN CLASSIFIER

After the detection of the fire region, we are extracting the features of that region. To obtain high accuracy in detection, the features also extracting. Some of the traditional methods used for feature extraction are kNN classifier, SVM classifier etc.., Due to the large timing of previous method, we are using SVM-ANN classifier. In this we are extracting twenty one features for studying the behaviour of the region.

4 EXPERIMENTAL RESULT

The videos of fire, smoke and no fire are recorded from video recorder. This video recorder is mounted on the device pan/tilt and it is stationary. Our input video of fire is in mp4 format with 640x360 resolutions and frame rate 30frame/second. The size of the video is 613kbs. This video is converted into number of frames. The resolution of each frame is 640x360. These image frames has file extension name to JPEG. We use 25 image frames from the input video for the experiment. Our program is implemented using MATLAB. Figure 2 shows the one of the input frame. Figure 3 gives the edge detection output of the input video. Figure 4 gives motion detection. After this, an alarm is buffered and extracts 21 features to improve the accuracy.. Figure 5 gives the graph of comparison of the proposed with existing. We are calculating the accuracy by using the equation (2). Figure 6 showing the accuracy of the fire and no fire video.

$$\text{Accuracy} = (TP+TN)/(TP+FP+TN+FN) \quad (2)$$

Where TP is the true positive, TN is the true negative, FP is the false positive and FN is the false negative.

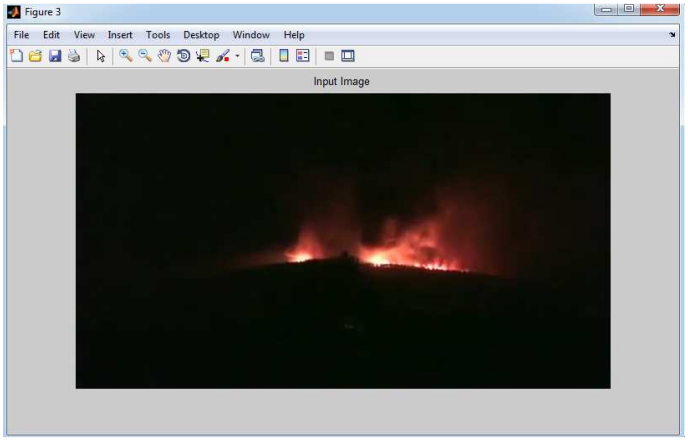


Fig. 2. One frame of the input video

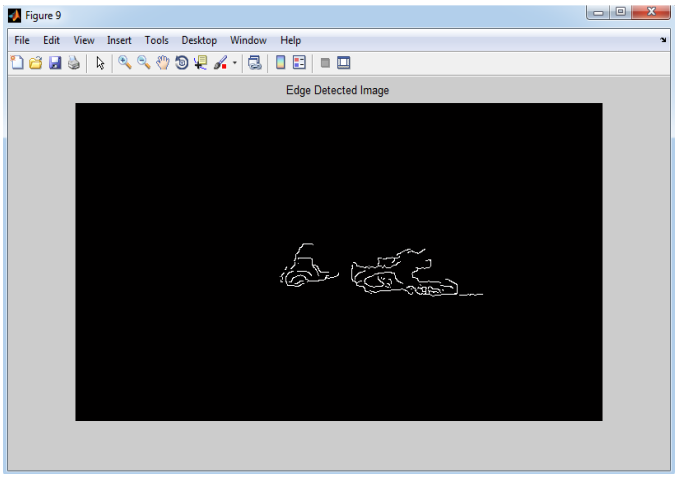


Fig. 3. Edge detection output using fuzzy canny algorithm

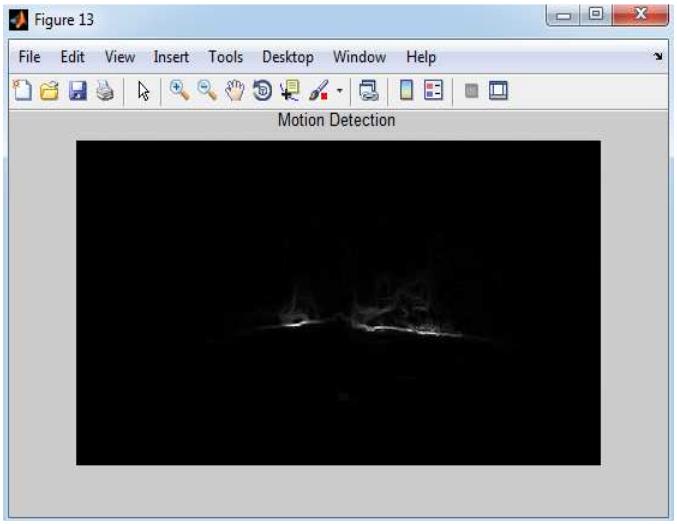


Fig. 4. Motion Detection output

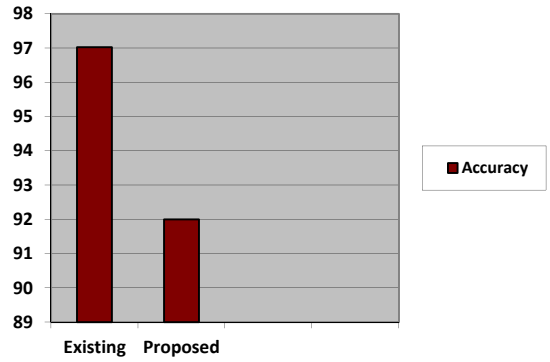


Fig.5. Graph showing the comparison of existing and proposed system

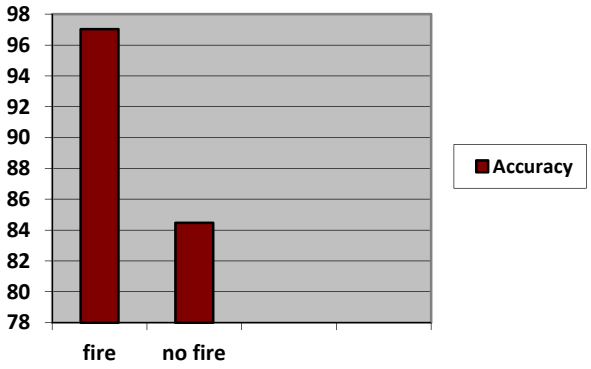


Fig. 6. Showing the accuracy of fire and non fire video

5 CONCLUSION

The vision-based detection system is used for finding the presence of fire regions in an image or video sequence. It has made significant attention in the past decade with camera surveillance systems. Most of the algorithms used in the existing techniques propose spectral, spatial, temporal and other low level features of fire for distinguishing it from other objects in video sequences. In the proposed system, a new approach to computational vision-based fire and flame detection by using a fuzzy logic edge detection and motion detection with ANN-SVM classifier as classification tool. The edge detection using fuzzy canny edge detection technique and the motion detection using motion estimation are use for fire and flame detection and ANN-SVM classifier is useful for the final classification. This technique is to improve the accuracy of fire and smoke detection in videos and to reduce the false alarm rate.

REFERENCES

[1] Behcet Ugur Toreyin, “Fire Detection Algorithms Using Multimodal Signal and Image Analysis,” Ph.D Thesis, January, 2009

[2] W. Phillips, M. Shah, and N. Lobo, “Flame Recognition in Video,” Fifth IEEE Workshop on Applications of Computer Vision, 2000.

[3] Che-Bin.Liu and N.Ahuja, “Vision based fire detection,” Inter- national Conference on Pattern Recognition, vol. 4, pp. 134–137, August 2004

[4] Toreyin, B.U., Dedeoglu, Y., Cetin, A.E., “Flame Detection In Video Using Hidden Markov Models,” IEEE International Conference on Image Processing, ICIP 2005.. .

[5] Osman Gunay, Behçet Ugur Toreyin, Kivanc Kose, and A. Enis Cetin, “Entropy-Functional-Based Online Adaptive Decision Fusion Framework With Application to Wildfire Detection in Video,” IEEE Transactions on Image Processing, Vol. 21, No. 5, May 2012.

[6] Hitesh Kapoor et al, Parikshit Singla, "Implementation of Magnified Edge Detection using Fuzzy-Canny Logic", International Journal of Computer Science & Communication Networks,Vol 2(3), 425-429,2012.
[7] Aroh Barjatya, Student Member, IEEE,"Matching Algorithms For Motion Estimation" DIP 6620 Spring 2012.

International Journal of Innovation and Scientific Research
ISSN 2351-8014 Vol. 10 No. 1 Oct. 2014, pp. 27-34

http://www.ijisr.issr-journals.org/

Current Control Strategies for Active Filter for Harmonic Mitigation

Anita Choudhary[1] and Prerna Gaur[2]

[1]Departmentof EEE,
GGSIP University, GTBIT Institute,
Rajouri Garden, Delhi, India

[2]Department of I&C,
Delhi University, NSIT Institute,
Dwarka, Delhi, India

ABSTRACT: An effective way for harmonic suppression is the harmonic compensation by using active power filter. This paper presents a comprehensive survey of active power filter (APF) control strategies put forward recently. The control strategies applied to active power filters play a very important role on the improvement of the performance and stability of APF. In this paper, the control strategies applied to active power filters are reviewed and analyzed. The characteristics and applicability obtained from the analysis can become the reference to the design of the APF. This paper presents the possible trends of the control strategies based on Artificial Intelligence applied to active filters.

KEYWORDS: Active power filter, hysteresis current controller, *Predicative Current Control*, fuzzy logic, reference current generator.

1 INTRODUCTION

The Energy crisis, globalization and competitiveness have forced the industries to produce the quality product using minimum energy at minimal cost. For the desired quality product and minimum utilization of electric energy need is to operate the process plant, machines and equipments at desired operative point. These devices and microcontrollers form a nonlinear system and overall nonlinear loads, thereby generate harmonics, noise, spikes, voltage sag and poor power factor of overall system and also enter other end-users system. These non linear loads draw non-sinusoidal currents due to the current harmonics generated by them. Non Linear loads which include adjustable-speed motor drives, electronic power supplies, DC motor drives, battery chargers, electronic ballasts are responsible for the rise in PQ related problems [1],[2]. These nonlinear loads appear to be prime sources of harmonic distortion in a power distribution system. Harmonic currents produced by nonlinear loads are injected back into power distribution systems through the point of common coupling (PCC). As the harmonic currents pass through the line impedance of the system, harmonic voltages appear, causing distortion at the PCC. These harmonic currents can also cause interferences with telecommunication lines and errors in metering devices [3]-[4]. Because of the adverse effects that harmonics have on PQ, Standard has been developed to define a reasonable framework for harmonic control conventionally passive L–C filters were used and also capacitors were employed to improve the power factor of the ac loads Limitations of Passive Filters like fixed compensation or harmonic mitigation, large size and possible resonance with supply system impedance at fundamental and/or other harmonic frequencies lead to other alternative i.e. Active power filters. The Active power filters rely on active power conditioning to compensate for undesirable harmonic currents[5]. They actually replace the portion of the sine wave that is missing in the non linear load current and use power electronic switching devices to inject harmonic current with complimentary magnitudes, frequencies and face shifts into the power system. They are particularly useful for large non linear loads such as arc furnace, paper mill and rolling mills.

Corresponding Author: Anita Choudhary

The main advantage of shunt active filter over passive filters is their fine response to the changing loads and harmonic variations. This paper presents a review of the state-of-the-art control techniques in active filters and reactive power.

2 STATE-OF-THE-ART CONTROL TECHNIQUES

The main component in the Active Power Filter is the control unit. Controlling of APF is implemented in *three stages:* First stage can be called as the *signal conditioning stage*. The essential voltage and current signals could be sensed using power transformers, Hall Effect sensors and isolation amplifiers to gather accurate system information. The instantaneous voltage and current signals are useful to monitor, measure and record various performance indexes such as Total Harmonic Distortion(THD), Power factor, active and reactive power, crest factor, etc,.

Second stage is the *derivation of compensation signals* stage. In this stage compensating commands in terms of current or voltage levels are derived based on control methods and APF configurations. The third stage is the *generation of gating signals* to the device of Active filters. The main component of APF is the solid state devices. Earlier BJTs and MOSFETs were used. Now-a-days IGBTs are used for medium ratings and GTOs are used for high ratings. The gating pulses are generated by current control technique like sinusoidal pulse width modulation (SPWM), triangular PWM, hysteresis current control technique , Space Vector current controller.

The models of APF have been developed by various methods, and the behavior of reference signal tracking has been improved with help of advanced control approaches. .Compensation in frequency domain is based on Fourier analysis of distorted signal. In time domain a number of control strategies such as instantaneous reactive power theory (*p-q* theory)initially developed by Akagi et al[5]. , synchronous frame d–q theory , synchronous detection method , notch filter and fuzzy logic controller method , sliding mode controller,etc..are used in the development of three-phase AFs .Out of these theories, more than 60%research works consider using p-q theory and d-q theory due to their accuracy, robustness and easy calculation Different control methods and harmonic suppression approaches for APF have been investigated.

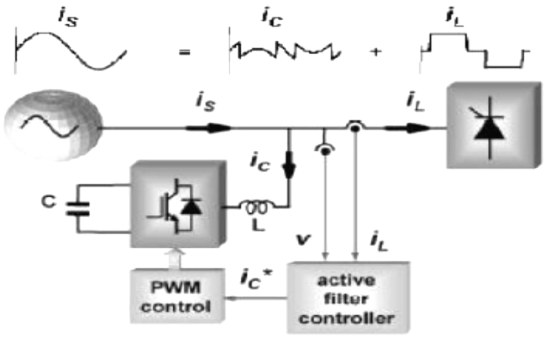


Fig 1: General Block Diagram For shunt a Active filter

From fig 1 it shows that control part plays important role in filtering. Further, these developments have made it possible to use different control algorithm, the controller of active power filter mainly divided into two parts i.e. reference current generation and PWM current controller. The PWM current controller is principally used for providing gating pulse to the active power filter. In reference current generation scheme, reference current is generated by using the distorted wave form. Many control schemes are there for reference current generation, such as p-q theory, Hysteresis Current Control [5] , *Fixed Frequency Control,* Adaptive control[6] ,sliding mode control[6],[7],[8],modulation vector control , SFX control, repetitive control,[12][13],[14] Dead Beat controller [15] Neural Network, Fuzzy logic,[17] wavelet control [18].[19]etc. for improving the steady state and dynamic performance of APFs.

The choice and implementation of the current regulator is one of the more critical issues for the achievement of a satisfactory performance level.This paper presents a comprehensive review of Active Power filter configurations, control strategies and the Total Harmonic Distortion(THD) for different control strategies both in traditional and current environments.

2.1 FIXED FREQUENCY CONTROL

The fixed frequency control [6]has been shown in figure 2 in this scheme the error between the reference and actual current is fed through a conventional PI controller which integrates the error between the feedback and reference current to generate a variable voltage value then, this value is fed into a triangle pulse-width modulator to produce gate signal. The output V control of the amplifier is compared with a fixed frequency (switching frequency fs) triangular waveform. A positive error (i_A^*-i_A) and hence a positive control result in a larger inverter output voltage, thus bringing i_A(phase A current) to its reference value(i_A^*). Similar action takes place in other two phases.

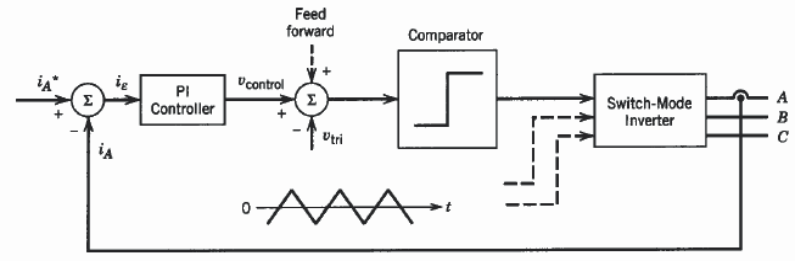


Fig:2 Fixed Frequency Control

2.2 HYSTERESIS CURRENT CONTROL [HCC]

There are various current control methods proposed for active power filter configurations; but the hysteresis current control method is proven to be the best among other current control methods, because of fast current controllability, easy implementation and unconditioned stability. This method controls the switches of the voltage source inverter asynchronously to ramp the current through the inductor up and down, so that it follows the reference current. Hysteresis current control is the easiest control method to implement in the real time. The hysteresis band current control is robust, provides excellent dynamics and fastest control with minimum hardware.

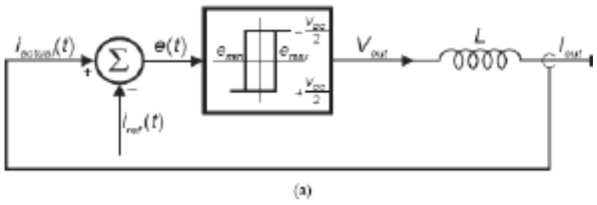


Fig 3. Hysteresis Current Control [HCC]

2.3 SLIDING MODE CONTROL

The sliding mode control has been widely applied to power converters due to its operation characteristics such as fastness, robustness and stability for large load variations. The references for the sliding mode control system are obtained by using the instantaneous reactive power theory. In sliding-mode controllers, either dc-bus voltage (in a VSI) or dc-bus current (in a CSI) is maintained to the desired value and reference values for the magnitudes of the supply currents are obtained. Subtracting load currents from reference supply currents, compensating commands are derived. From the total harmonic distortion in the line currents is less than 2% satisfying limitations required by international standards. For the generation of gating pulses the commonly used techniques are PWM and Hysteresis Current Control (HCC).

2.4 SFX ALGORITHM BASED ADAPTIVE CONTROL

This method discusses a new current control method for active power filters (APF's). It requires only detecting the source current. It requires neither detecting AF output current nor extracting a harmonic component from the source current. Thus, the current control system can be greatly simplified compared to conventional load current detection APЄF's. It introduces an adaptive digital filter (ADF) with a synchronized filtered-x (SFX) algorithm . An SFX-ADF based current controller exhibits a high gain only at fundamental and harmonic frequencies that the load current contains. A proportional regulator is also used to improve the dynamic performance of the current control system. The proposed method **is** suitable for filtering harmonic

currents from one or more specified harmonic-producing loads. This method requires the following conditions. Both harmonics and reactive power compensation is done by active power filters. The Source currents is given by the difference of load and controller current $I_S=I_L-I_C$ .Consider a finite impulse digital filter with a desired response and error signal shown in Fig. 3. The input **x** and output *y* of ADF has the following relation

$$y(t) = K_P \cdot e(t) + K_I \int e(t) \cdot dt \quad (1)$$

The ADF operates so as to. Minimize the mean-square error by renewing the filter weights at every sampling. If the LMS (least-mean-square) algorithm is used, the filter weights are renewed as follows:

$$w(n+1) = wk(n) + 2\epsilon\mu(n)x(n-k) \quad (2)$$

Where k= 0,1----------N-1

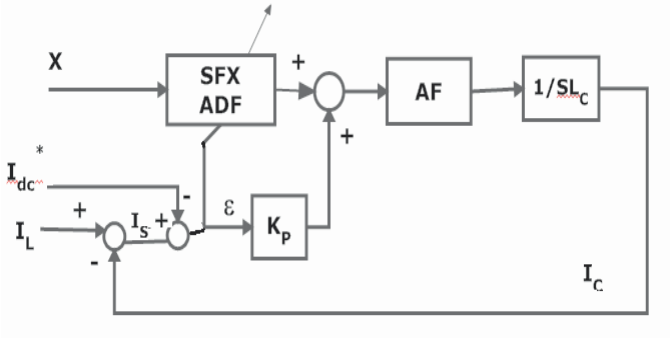


Fig:4 Current Control Scheme For SFX-ADP

The problem with this ADF is that the adaptive algorithm involves a large number of calculations that should be executed within a short sampling time period. Therefore, the order of ADF '*N*' must be limited and as a result the upper frequency of the output is limited .To solve this problem this paper introduces a synchronized filtered-x (SFX) algorithm. The SFX algorithm is suitable for controlling periodic signals, and has been used for controlling noises and Vibrations. Its advantage is that the amount of calculation of the adaptive algorithm can be greatly reduced; the proportional regulator with gain K_P is also used to improve the dynamic performance of the current control system. The SFX-ADF based controller automatically adjusts its transfer function to minimize the mean-square error ϵ^2

2.5 DELTA MODULATION (DM)

The Delta Modulation method is a variation of the traditional hysteresis current regulator. This method consists in applying a constant voltage in all the switching period. The purpose of this control is to obtain the switching signals from the comparison between a fixed tolerance band and current error (normally this band is close to 0).If the mismatch between the actual and reference current is positive, the inverter output voltage must be positive and if there is mismatch then, the inverter voltage output must be negative. During a regular interval T_{SW} synchronized with the switching frequency, the voltage is held constant. If the Delta Modulation is used, the current generated at the $(k+1)^{th}$ sampling time instant.

2.6 PREDICATIVE CURRENT CONTROL

In the *Predicative* control schemes, the regulator measures the phase voltage to make the phase current reach its reference by the end of the following modulation period. In this Control, a modified Method Based on *Predicative* controller is used. The purpose of this method is to compute directly the time period when a switching device is turned on in order to make the phase current reaches its reference by the end of the following modulation period. Figure 4 shows the basic principle of this control strategy for a single-phase equivalent.

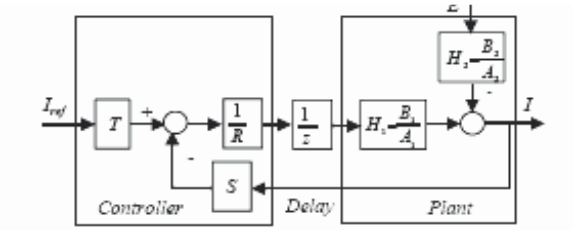


Fig 4: Predicative Controller

3 ARTIFICIAL INTELLIGENCE TECHNIQUES

Artificial Intelligence has experienced an extensive growth in the last decade partially due to uncertainties and vagueness in the process signal and occurrence of random events, and partially due to nonlinearity and complexity of the processes. The system can be complex with nonlinearity and parameter variation problems. An intelligent or self-organizing control system can identify the model, if necessary, and give the predicted performance even with a wide range of parameter variation. *Artificial Intelligence* is an alternative solution to meet the process and user's requirements simultaneously. *Artificial Intelligence* Technique is a technology to extract information from the process signal by using expert knowledge. It either seeks to replace a human to perform a control task or it borrows ideas from how biological systems solve problems and applies it to control processes. The main areas in soft computing notably are fuzzy logic , neural network, Wavelet control, genetic algorithm (GA), rough sets, etc.

3.1 FUZZY CONTROLLER

Fuzzy control system processes the imprecise and vague measurements information using expert knowledge In this theory fuzzy logic and control system features are integrated by using IF-THEN rules. A set of such rules can be used to create a functional controller. The advantages of Fuzzy logic Controller (FLC) over traditional controllers are high robustness, high tracking accuracy, and quick response . Two types of fuzzy controllers are used frequently for the control of APF-Mamdani type and Takagi-Sugeno-Kang (TS) type. Mamdani has developed the application of FL in control system. It was investigated earlier that Mamdani type fuzzy logic controller require large number of fuzzy sets and rules . So, TS method was implemented for the control of APF and it found various advantages over Mamdani type. Using TS type controller the system is found to be robust and it found that it uses less number of fuzzy sets and rules whether it has been used in Harmonic Detection techniques or in Current Control Technique . Many controllers have been developed to improve power quality for single-phase, and three-phase four-wire system using Fuzzy Logic and compared with PI type controller. Results shows that PI controller fails to respond quickly and whether it is harmonics detection technique or current control technique.

To develop the fuzzy-logic control algorithm for APF, two inputs: 1) the voltage error (reference voltage minus actual capacitive voltage, e), 2) the change of capacitive voltage (previous error minus current error; ce) were considered over one sample period. The two inputs were represented by sets of seven membership functions and expressed in linguistic values as negative big (NB), negative medium (NM), negative small (NS), zero (ZE), positive small (PS), positive medium (PM), and positive big (PB). The range for the "error" input was set as[-30,30] and that for "change of error" was set as[-10,10] . A limiting block was introduced before the fuzzy block in order to truncate values beyond these ranges before supplying them to the fuzzy-logic controller. The shape of these membership functions was varied and the effect on the system was studied. The input to the defuzzification process is a fuzzy set (the aggregate output fuzzy set) and the output is a single non fuzzy number, obtained by the center-of-gravity (COG) method of defuzzification. The output (magnitude of reference supply current,) is represented by a set of nine membership functions (MFs) (NVB to PVB) whose shape was taken to be similar to the shape of the input MFs. The range for the output was set as [-30, 30]. The output of the fuzzy-logic controller was multiplied by a unit sine wave in order to bring it in phase with the supply current before comparison. The AND method used during interpretation of the IF-THEN rules was "min" and the OR method used was "max." Also, "min" was used as the implication method whereas the "max" method was used for aggregation. The 49 fuzzy IF-THEN weighted rule base was designed to maintain the capacitor voltage constant by providing the required reference current amplitude. Rule generation and weighting were decided based on the pendulum analogy.

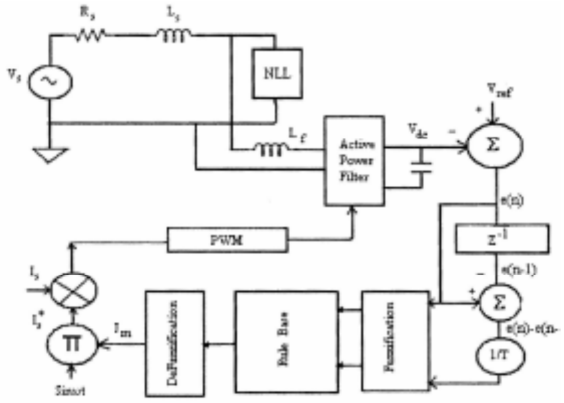


Fig: 5 Structure of Fuzzy Controller for APF

3.2 NEURO CONTROLLER

The described neural networks have been trained and simulated in various ways with the goal of getting the parameter values that produce the optimal performance for each of the topologies . Two different performance indices were chosen to evaluate the effectiveness of each studied network by both of the operation strategies the reached accuracy level (in terms of the error rate) and the required training time [26]. With respect to the accuracy level, at the measuring of the harmonic coefficients an error rate of 1% were estimated as minimum desired accuracy. With respect to the training time, network topologies and parameters were desired, that could be trained in so short times as possible. For this purpose it were compared the needed times to achieve similar accuracy levels. The software tool employed has been the Neural Networks Toolbox of MATLAB. All types of available training algorithms were used and tested, and the most efficient was found to be the Levenberg- Marquardt modified Back *propagation.*

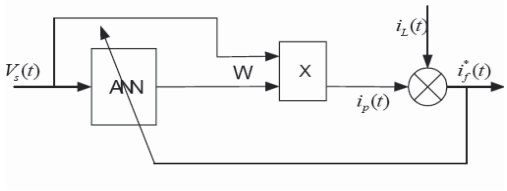


Fig6 Structure of NN Controller for APF

3.3 WAVELET CONTROLLER

A Wavelet Transform (WT) based Technique is used to extract fundamental frequency component from a Non sinusoidal and unbalanced load current in a three phase System. The fundamental frequency component is extracted using Multi resolution analysis (MRA) . The remaining harmonics can be used by the active filter for compensation .The constructed controller based on multi resolution analysis has the advantage of better frequency bandwidth selection. The tuning parameters of the controllers are the gains to be applied to the time-frequency signals at different resolutions. This has the advantage of aiding the process of a proper choice of coefficients of tuning parameters. The extraction by FFT leads to inaccurate results if the signal is contaminated by noise. The main problem of the Fourier transform is the number of points in the observation window, which should be a multiple of the numbers of samples per period. When the fundamental's frequency varies around the 50Hz value, this corresponds to a Modification in the number of samples per period . Thus, the number of points in the observation window is not a multiple of the number of sample per period. As a result, the accuracy of the extraction is reduced.

The Wavelet Transform based technique can eliminate the above mentioned drawbacks up to certain extent. Wavelet analysis is a new development in the area of applied mathematics **.** Fourier analysis is ideal for studying stationary data (data whose statistical properties are invariant over time) but **is** not well suited for studying data with transient events that cannot - be statistically predicted from the data's past. In many filtering applications we need filters with symmetrical coefficients to achieve linear phase. None of the orthogonal wavelet systems except Haar are having symmetrical coefficients. But Haar is too inadequate for many practical applications. Biorthogonal wavelet system can be designed to have this property.

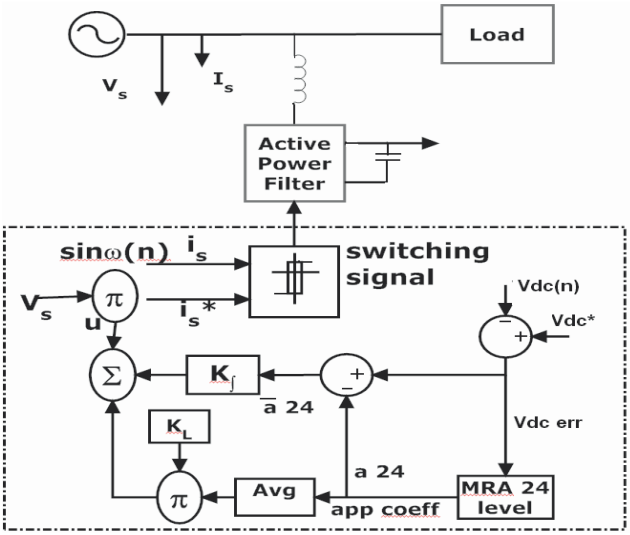


Fig: 7: Structure of wavelet Controller for APF

4 CONCLUSION

Active power filters are the developing devices, which can perform the job of harmonic elimination properly. Most of the proposed control strategies for power quality improvements have been reviewed with regard to performance and implementation. This work reveals that there has been a significant increase in interest of active power filters and its control methods. This could be attributed to the availability of suitable power-switching devices at affordable price as well as new generation of fast computing devices (microcontroller and DSP and FPGA) at low cost. It is hoped that this survey on control techniques for active power filters will be a useful reference to the users and manufacturers.

REFERENCES

[1] Akagi, H., Modern active filters and traditional passive filters; *Bulletin of The Polish Academy of Sciences Technical Sciences,* Vol. 54, No. 3,2006, 255-269.

[2] M. El-Habrouk, M. K. Darwish and P. Mehta, "A Survey of Active Filters and Reactive Power Compensation Techniques," *Proceedings of the IEE International Conference on Power Electronics and Variable Speed Drives*, London, UK, 2000, pp. 7-12.

[3] D.H. Chen and S. J. Xie, "Review of Control Strategies Applied to Active Power Filters," *Proceedings of the IEEE International Conference on Electric Utility Deregulation, Restructuring and Power Technologies (DRPT)*, Hong Kong, 2004, pp. 666-670.

[4] Adrian GLIGOR "Design and Simulation of a Shunt Active Filter in Application for Control of Harmonic Levels" *Acta Universitatis Sapientiae Electrical and Mechanical Engineering*, 1 (2009) 53-63.

[5] Dahono P.A, New hysteresis current controller for single-phase bridge inverters, *IET journal on Power electronics*, vol.2 ,2009,.585-594.

[6] R. Kazemzadeh "Sigma-Delta Modulation Applied to a 3-Phase Shunt Active Power Filter Using Compensation with Instantaneous Power Theory", ©2010 *IEEE* pp. 200-206.

[7] E. Wiebe-Quintana ,"Delta-Sigma Integral Sliding-Mode Control Strategy of a Three-Phase Active Power Filter using d-q Frame Theory", Proceedings *of the Electronics, Robotics and Automotive Mechanics Conference (CERMA'06)IEEE computer society* 2006.

[8] Majid Nayeripour and Taher Niknam, "Nonlinear Sliding Mode Control Design for Shunt Active Power Filter with the Minimization of Load Current", *World Applied Sciences Journal ,IDOSI Publications, 2008* pp. 196-201.

[10] V. S. C. Raviraj and P. C. Sen ,Comparative Study of Proportional–Integral, Sliding Mode, and Fuzzy Logic Controllers for PowerConverters, *IEEE Trans. Industry Applications*, Vol. 33,1997, 518-524.

[11] Hongyu Li., Fang Zhuo, Zhaoan Wang, Lei W. and Wu L., A novel time domain current detection algorithm for shunt active power filters, *IEEE Trans. power systems,* vol.20,2005,. 644–651.

[12] Xie, Zhengxian, Liang, "Energy Shaping Repetitive Control (ESRC) for Three-phase three-wire Shunt Active Power Filter"*2009 IEEE*149(4): P. 265-272.

[13] Shoji Fukuda, Takeshi, "SFX Algorithm Based Adaptive Control Of Active Filters Without Detecting Current Harmonics",*IEE 2004* pp. 199-202.

[14] F. Kamran, and T. G. Habetler, "Combined deadbeat control of a series parallel converter combination used as a universal power filter," in *Proceedings of the 1995 IEEE/PELS Power Electronics Specialist Conference*, 1995, pp. 196-201.

[15] K. Nishida, M. Rukonuzzman and M. Nakaoka, "Advanced Current Control Implementation with Robust Deadbeat Algorithm for Shunt Single-Phase Voltage-Source Type Active Power Filter," *Proc. IEE Electric Power Applications*, vol. 151, no. 3, pp. 283-288, 2004.

[16] Parmod Kumar, and Alka Mahajan ,"Soft Computing Techniques for the Control of an Active Power Filter" ,*IEEE Transactions On Power Delivery*, Vol. 24, No. 1, January 2009

[17] Vazquez, J.R. and P. Salmeron, ,"Active power filter control using neural network technologies. Electric Power Applications", *IEE Proceedings* -,2003. 150(2): p. 139-145.

[18] K. G. Firouzjah, A. Sheikholeslami, M. R. Karami-Mollaei , "A New Harmonic Detection Method for Shunt Active Filter Based on Wavelet Transform," *Journal of Applied Sciences Research*, 4(11): 1561-1568, 2008 © 2008, *insinet Publication*

[19] Malabika Basu, "A wavelet controller for shunt active power filter", *Dublin Institute of Technology, 3rd IET International Conference on Power Electronics, Machines and Drives, Dublin, Ireland*, 2006, pp.76-79

[20] M. Marinelli, L. Salvatore, " wavelet-based algorithms Applied to harmonic detection for active shunt filters,"*11thInternational Conference on Harmonics and Quality of Power* 2004,Sept. 12-15, 2004, pp.721 -727.

[21] Hui Liu, Guohai Liu and Yue Shen, "A Novel Harmonics Detection Method Based on Wavelet Algorithm for Active Power Filter", *Proceedings of the 6th World Congress on Intelligent Control And Automation*, June 21 - 23, 2006, Dalian, Chinapp. 258-267.

International Journal of Innovation and Scientific Research
ISSN 2351-8014 Vol. 10 No. 1 Oct. 2014, pp. 35-39

http://www.ijisr.issr-journals.org/

Terrorism and Democratic Governance in Nigeria

Kolawole Ogunboyede

Department of Political Science and Public Administration,
Adekunle Ajasin University,
Akungba-Akoko, Nigeria

ABSTRACT: The practice of caricature democracy comes with itself consequences of subversion of the will of the people. One of the consequences is the enthronement of the regime of social vices, which is created by tenacious period of military authoritarianism but sustained by bad democratic governance. Good governance creates platform for inclusive governance process but what is abnormal is the increase in the spate of insurgency even in democracy in Nigeria. This paper examined the interface between democratic governance and terrorism in Nigeria. Insurgency and violence in Nigeria manifest in form of boko haram religious set which has vowed to Islamize Nigeria as a condition for peace. The activities of boko haram have assumed terrorist dimension, threatening the corporate existence of the Nigerian State. The paper generated the following research questions in order to raise critical issues of concern and deepen understanding on the relationship between democratic governance and terrorism in Nigeria: is there any relationship between democratic governance and terrorism? Is terrorism in Nigeria a consequence of bad governance and leadership failure? In order to illuminate the factors accounting for terrorist activities in Nigeria, the paper adopted both descriptive and analytical methods and also employed social contract theory to explain the factors precipitating the spread of terrorism in the country. The paper insisted that the genesis of terrorism could be traced to bad governance in Nigeria and put forth necessary recommendations to roll back the boko haram insurgency in Nigeria.

KEYWORDS: Authoritarianism, Corruption, Democracy, Terrorism, Governance.

1 INTRODUCTION

One of the biggest problem of man since existence has been how to ensure his security. Security ranks prominently among problem facing humanity both at individual and national level. In just a decade and half of democratic rule, Nigeria's internal security landscape has deteriorated in fundamental ways. Old security threats have remained or even assumed worrisome dimensions while new threats have emerged. Some of the old threats that assured new dimensions include small arms, and light weapons proliferation, sea piracy, armed robbery, assassination, human trafficking, kidnapping, hostage-taken, and ethno-religious conflict. Threats considered to be relatively new in Nigeria, though not without precedent, is the outbreak of violent extremism evidence in the growing audacity of the Boko Haram religious sect and the spate of bomb blasts across the country, which have now assumed a terrorist dimension. The act of terrorism in Nigeria has threatened the corporate existence of Nigeria and has become a prominent source of concern for the hapless citizens, the government, and indeed the international community.

Notably, willful attacks on innocent citizens and public infrastructure in Nigeria whether undertaken by Fulani herdsmen or radical Islamist groups are fast becoming headline news in local and international media, with damaging consequences on Nigeria's image. One of the major root causes of terrorism in Nigeria, it cannot be dichotomized from poverty, which is an end-product of the evil of the practice of caricature democracy facilitated by the bad leadership which widen the gap between the rich and the poor, sustained poverty by the enthronement of the regime of social vices, which is created by tenacious period of military authoritarianism but sustained by bad democratic governance.

The obnoxious policies of government that only protected the interest of the few elites and excluded the masses set the stage for terrorist violence in Nigeria. The Boko Haram followers, who were frustrated by bad governance, destroyed the institutions of government they believed were the cause of their plight. Where democracy is manipulated, governance is denied. It is the misery of democracy in Nigeria that promotes bad governance that has attracted the attention of this research work. However, all these ask questions: what is the relationship between governance and terrorism in Nigeria? Is terrorism in Nigeria a consequence of bad governance? It is expedient for the concepts to be thoroughly discussed.

2 CONCEPTUALIZING 'TERRORISM'

From the literature, the word "terrorism" was first used in France during the rule of terror days is known as state terrorism. This connotes bloody, repression by government agents directed primarily at the non-arm bearing masses. Essentially, the most pervasive feature of state terrorism is that, people are detained arbitrarily and usually have no right to judicial process and protection. Other attributes of state terrorism include summary trials and extra-judicial killings, beatings, torture, and death squads by shooting at sight. Circumstantially, it had many causes which range from intimidation, injustice of lack of fair hearing, emasculation of the opposition, forced democratization, ethic distrust, economic exploitation and poverty, clash of civilization , cultural and religions variations, bad governance or dictatorship, political oppression, ethic discrimination and marginalization of minority tribes by the major ethnic led governments, religious persecution: cultural dominations, anarchism, war and sadism among others. Essentially, most governments are often to be held accountable for terrorist attacks against their nationals.

Terrorism includes different kinds of activities ranging from assassination, murder, kidnapping, hostage taking, hijacking, shoot-outs with police, sabotage or vandalism, arson, bio—chemical attacks, pollution, threat or hoax, extortion, armed attack, theft, bombing, ambushing or barricade and arms struggles.

Terrorism has been described variously as both a tactic and strategy; a crime and a holy duty; a justified reaction to oppression and an inexcusable abomination. Obviously, a lot depends on whose point of view is being represented. This is the reason why it has been said that one man's terrorist is another man's freedom fighter."

Terrorism has often been an effective tactic for the weaker side in a conflict. As an asymmetric form of conflict, it confers coercive power with many of the advantages of military force a fraction of the cost. It is violence that is consciously carried out by the perpetrators(s) primarily in order to influence the attitudes and behavior of a wider target audience (or multiple target audience).

Wilkinson (2006:328) suggests that terrorism can be distinguished from other forms of violence in the following ways:

- It is premeditated and designs to create a climate of extreme fear.
- It is directed at a wider target than the immediate victims
- It is considered by the society in which it occurs as 'extra-normal', that is, it violates the norms regulating disputes, protest dissent.
- It is used primarily, through not-exclusively to influence the political behavior of governments, communities or specific social groups.

Wilkinson further provides typologies of terrorist movements or groups: ethno-nationalist groups, that is, those identified by ethnicity and political motivation; ideological terrorist groups this includes terrorist groups that want to create a state based on (e.g. A communist state); the other categories are the religions-political groups – such as the Boko Haram sect in the Northern part of Nigeria which aims to create an Islamic republic.

The United States Department of Defense defines terrorism as "the calculated use of unlawful violence or threat of violence to inculcate fear; intended to coerce or to intimidate governments or societies in the pursuit of goals that are generally political, religions, or ideological. The FBI uses this: "Terrorism is the unlawful use of force and violence against persons or property to intimidate or coerce a government, the civilian population or any segment therefore, in furtherance of political or social objectives." The U.S Department of State defines "Terrorism" as "premeditated politically-motivated violence perpetrated against non-combatant targets by sub-national groups or clandestine agents, usually intended to influence an audience.

3 CONCEPTUALIZING "DEMOCRACY"

Democracy varies in different place and historical periods. The current position is that democracy like human right should go beyond voting, it should encompass the right to make economic decisions in government chosen by the citizens. However,

many associate democracy at first thought with one true United states president, Abraham Lincoln (1861-1865) when during the Gettysburg address, which was made to mourn those who have fallen during the great battle of Gettysburg, gave a speech which was been considered as one of the most eloquent statement of the democratic fight ever made. He coined, "Democracy as the government of the people by the people and for the people".

Schumpeter (1967) defines democracy as "institutional arrangement for arriving at political decisions in which individuals acquire the power to decide by means of competitive struggle for people's votes" (Schumpeter 1967) cited in Abdulhamed (2004). The concept here means it is an egalitarian form of government in which all the citizens of a nation together determine public policies, the law and the actions of their state, requiring that all citizens have an equal opportunity to express their opinions.

Also, Edwards, Watterberg and Lineberry (1996) define democracy as "means of selecting policy makers and organizing government so that policy represent and respond to citizen's preferences". Thus democracy can be seen as the system of governance under which people exercise their governing power directly or indirectly through their representative periodically elected by themselves. Indeed, a democratic government is invariably a government that is founded on the principle of the rule of law, accountability and transparency devoid of arbitrariness, highhandedness and dictatorship. From the above, it is obvious that for any government to be called democratic, its origin must be based on the consent of the and the people in this case refers to the people over which a government exercises authority.

4 THEORETICAL FRAMEWORK

In this research work, social contract (Lockean perspective) as an approach would be employed for the analysis of terrorism and democratic governance in Nigeria. Social contract theorists advance the view that the state or, more precisely, civil society is the product of contract, a covenant, an agreement, or a compact. Some philosophers have argued that the sovereign's power should be unlimited, because the state originates in a so-called social contract, whereby individuals accept a common superior power to protect themselves from their own brutish and nasty instincts and to make possible the satisfaction of certain human desires. In contrary, it is also argued that sovereignty resides with the people for whom governments are trustee and that such government can legitimately be overthrown if they fail to discharge their function to the people. Therefore, the philosophical underpinnings behind social control theory are the origin and legitimacy of the government, the law and how, the reason as why to obey the law and how people punish the government in case they fail to keep to the part of their agreement.

The philosophical ideas of the social contact are dated back to Hugo Grotius (1583-1645), Thomas Hobbes (1588-1679), John Locke (1632-1704), Jean Jacques Rousseau (1712-1788) and more recently, John Rawls who wrote in the second half of the 20th century.

John Locke accepted much of Hobbes social contract theory but argued that sovereignty resided with the people for whom governments were trustees and that such government could be legitimately overthrown if they failed to discharge their functions to the people. He attempted to erect effective safeguards against violations of natural law by the government. Locke said that the sovereigns did not take all rights; the principal right remained with the people's will. This will remains with the people. The state was supreme, not only if it was bound by civil and natural law.

Locke believed in the governed as the basis of sovereign and that the state as the guarantor of individual liberty. To Locke, under social contract theory, power was surrendered not to the sovereign but to the community. Locke said "there and there only was a political society when everyone in the society has quitted his natural power resigned it up into the hands of the community". John Locke used the phrase "there and there only" to emphasis the importance of the will of the people informing a political society. Thus, every member of the community surrendered his natural power with free will explicity or implicity and resigned it into the hands of the community in exchange for the discharge of functions to the people, hence a political society becomes with power to preserve property and punish offenders. However, the power cannot be more than that the people had in a state of nature before they entered into a society and gave it to the community for nobody can give more than he has. The term community as used by John Locke signifies the government of the people by the people, for the people, thus community rights should prevail over individual rights and the rights are surrendered into community because the sovereign is the people and only comes from the people

The essence of the social contract is that without organized government, we would live in a state of nature, where we would each have unlimited natural freedoms. The inherent problem with this totally autonomous state is that it include the right to do whatever one wants to do, and thus, grant the freedom to harm all, or any who thereafter one's self preservation. To avoid such an unacceptable state of affairs; we unanimously agree to enter a social contract to acquire civil rights for accepting the obligation to honour the rights of others; giving up some freedoms in the process. The authority or body we

create to represent our joint interest, and to whom we delegate our powers, is the government or the state. Thus, the state is an agent while the people are the principal. The rules and provisions of this scared, profound and noble contract are enshrined in a document known as the constitution.

From the above, the emergence and chief end of the state is to ensure "good life" for a generality of members of the society. Unfortunately, the Nigerian state, in concrete terms, is in most cases an instrument in the hands of a privilege few that perpetually dominates, exploits and subjugates the dominated majority of the citizenry. The state, thus serves the interest of a particular vested class structure rather than the generality of the masses. This few dominant class are the bourgeoisie and political class etc. government inability to provide basic amenities, employment etc has characterizes the Nigerian state as a mark of failure on the part of government to honour her par of agreement in the social contract has brought about terrorism and insecurity in diverse forms, as different groups in bid to overthrown the state engaged in armed conflict at various levels and regions. The state therefore can be said to be in capable and hence incapacitated in ensuring "good life" for its citizens as the chief end of the state.

The Nigerian state experiment is not an exception to the social contract theory. The Nigerian government is an agent of the Nigerian people. The people constitute the principal. The Nigerian government is answerable to the Nigerian masses. Under the social contract theory, the government must be able to protect the citizens, as this is a basis for the formation of a contract. Nigeria is now in a state of war of all. Against all. There is hardly a day that armed robbery, kidnapping and bombing activities does not take place in Nigeria. Evidently, the Nigerian state has breached its obligation under its social contract with the people/ the Nigerian government is obligated under the Nigerian constitution to protect the lives and properties of Nigerians. The inability of the Nigerian government to honuor that obligation is a fundamental and material breach of its responsibility to the people. Extreme political corruption has since become the order of the day in Nigeria. Elections are known to be selections, which are brazenly conducted, in a provocative and rude violation of the governments' social contract with the Nigerian people.

5 TERRORISM IN NIGERIA: A CONSEQUENCE OF ABSENCE OF GOOD GOVERNANCE

The contemporary terrorism in Nigeria is a product of prolonged failure of the Nigerian state to show characteristics or fulfill the purposes accepted a normal or beneficial to the totality of her citizens. There is wide gap between promises and performance by the ruling class. Economic deprivation, marginalization, frustration, and desperation experienced by the greater population of Nigerians (the byproducts of bad governance) are the underlying cause of terrorism in contemporary Nigeria. To describe governance as a good one and to determine whether it is a bad one requires the understanding of the essence of the state which are not embedded in the constitution but also a function of the religious ideas and the nature of current problems confronting the state. Section 14(1) of the 1999 constitution of the Federal Republic of Nigeria states that "the Federal Republic of Nigeria shall be a state based on the principles of democracy and social justice". This is further strengthened in section 16(1) a, b, c and d, that the State shall, within the context of the ideals and objectives for which provisions are made in this constitution harness the resources of the nation and promote national prosperity and an efficient, dynamic and self-reliant economy; control the national economy in such manner as to secure the maximum welfare, freedom and happiness of every citizen on the basis of social justice and equality of status and opportunity without prejudices to its right to operate or participate in areas of the economy, other than the major sectors of the economy.

Section 16(2) states that "The State shall direct its policy towards the promotion of a planned and balanced economic development; that the material resources of the nation are harnessed and distributed as best as possible to serve the common good; that the economic system is not operated in such a manner as to permit the concentration of wealth or the means of production and exchange in the hands of few individuals or of a group; and that suitable and adequate shelter, suitable and adequate food, reasonable national minimum living wage. Old age care and pensions, and unemployment, sick benefits and welfare of the disable are provided for all citizens.

If any section of the population is in fact excluded from participating in the life of the community, even at a minimal level, then that is a contradiction to the concept of the common good (Eboh, 2003). Governance can be defined as the process that is employed to achieve the noble end of the state. Thus, governance simply implies the art of governing a people within a given territory or a state. Governance is the process and mechanisms of allocating the values without jeopardizing the principle of equity, justice and fairness.

However, the above ingredients of good governance as embedded in the 1999 constitution are missing. Therefore, contemporary terrorism in Nigeria is a latent function of prolonged failure of the Nigerian state to deliver purposeful good governance. When leaders steal all the money allocated for building schools, hospitals, industries etc, the greater percentage of the citizenry especially the youths are deprived good education, employment and good health. These youths are therefore

affected socially, psychologically, and economically. Frustrations, dejection and hopelessness remain a day to day occurrence in their lives. They can easily be brainwashed and indoctrinated with false doctrines and co-opted into illegal societies.

6 CONCLUSION AND RECOMMENDATIONS

This article has attempted to established the link between terrorism and bad governance in Nigeria; specifically, how bad governance results in terrorism and how has continue to aid terrorism in Nigeria. In a democracy, political leaders are required to possess the capability to govern well. More importantly, however, they are required to have their conducts, especially in office, guided by moral values. Governance is good provided it is able to achieve the desired end of the state defined in terms of justices, equity, protection of life and property, enhance participation, preservation of the rule of law and improved living standard of the populace. Governances are termed bad when it fails to achieve the purpose(s) of the state. It is also established in this paper that failure of Nigerian government to honour the contract and agreement she entered into with the people is the major cause of terrorism in Nigeria. There is wide gap between promises and performance.

In view of these, the paper recommends that the enthronement of good governance as a panacea for insecurity in Nigeria. The idea of granting amnesty to Niger Delta Militants and the calls from some quarters for amnesty to be extended to Kidnappers and Boko Haram Religious sect is like postponing the evil days because the issue that led to act of terrorism/agitation in the first place remained unaddressed. Therefore, Government should address issues that led to terrorism like unemployment, corruption, poor infrastructures facilities, poverty etc.

REFERENCES

[1] Adamu, M. and Jafar U.L (2004): Globalization and Terrorism: The Nigerian Experience. African Journal of Stability and Development, Vol. 8. No.1 ISSN No: 0976-1195.
[2] Eboh, P.M. (2003): “Philosophy, Women and Responsible Leadership in Africa” in Oguejifor, J.O (Ed). Philosophy, Democracy and Responsible Governance in Africa. New Brunswick and London: Transaction Publishers. Pg 23-26.
[3] Ola Adegboyega Adedolapo (2014): The Role of Civil Society in the Sustenance of Democracy in Nigeria. African Journal of Stability and Development, Vol. 8. No.1 ISSN No: 0976-1195.
[4] Oyeniyi, A.B. (2010): Terrorism in Nigeria: Groups, Activities and Politics. International Journal of Politics and Good Governance, Vol.1 No.1. Quarter ISSN No.:0976-1195.
[5] Schumpeter, A. (1997): The Role of Civil Society in Democratic Governance. Oxford, Oxford University Press.
[6] The Constitution of the Federal Republic of Nigeria (1999).
[7] Thomas, H. (1996): Leviathan, edited by J.C.A. Gaskin (Oxford University Press, 1996). Pg104.
[8] Wilkison, P. (2007): International Relations: A very short introduction. New York; Oxford University Press Inc.

International Journal of Innovation and Scientific Research
ISSN 2351-8014 Vol. 10 No. 1 Oct. 2014, pp. 40-49

http://www.ijisr.issr-journals.org/

The Female Genital Mutilation Act 2011 of Kenya: Challenges Facing its Implementation in Kajiado Central Sub-County, Kenya

Geofrey Towett[1], Peter Gutwa Oino[2], and Audrey Matere[3]

[1]Coordinator, Faculty of Arts and Social Sciences, Kisii University (Eldoret Campus),
P.O. Box, 6434-30100, Eldoret, Kenya

[2]Part-time lecturer, Faculty of Arts and Social Sciences, Kisii University (Eldoret Campus),
Department of Social Sciences,
P.O. Box, 6434-30100, Eldoret, Kenya

[3]Coordinator, Faculty of Education and Human Resource Development, Kisii University (Eldoret Campus),
P.O. Box, 6434-30100, Eldoret, Kenya

ABSTRACT: Female Genital Mutilation/Cut (FGM/C) has been a common practice in both developed and in developing countries like Kenya. Kajiado County in Kenya is one of the areas where the practice is highly practiced with girls of below 13 years undergoing through the 'cut'. This practice is however, a criminal offence as outlined in Female Genital Mutilation Act of 2011, though it continues to thrive in various parts of the country such as in Narok, Migori, Kisii, and to a larger extent Kajiado County. This paper is an outcome of a study that was conducted in Kajiado Central Sub-County in Kenya and examined the challenges facing effective implementation of FGM Act of 2011. The focus on Kajiado Central Sub-County was based on the fact that the county as a whole is largely inhabited by the Maasai community whose FGM/C practice according to the Kenya Demographic and Health Surveys (KDHS) stands at 93 percent. The research on which this paper was drawn adopted a cross sectional research design that employed various methods of data collection. Data was collected by use of research instruments such as semi-structured interview schedule and interview guide for Focus Group Discussions (FGDs) with traditional circumcisers, *manyatta* elders, traditional religious leaders, public health officers, public administrative officers and sampled men and women with at least five children in the study area. The study found that despite the practice of FGM/C being criminalized with hefty penalties in Kenya, the practice is still widespread in Kajiado County. The findings of the study revealed that the implementation of FGM Act 2011 in Kajiado County has been constrained by a number of factors such as deeply ingrained culture and traditional practices, ignorance of the legislation and the consequences of FGM/C, ingrained traditional religious beliefs and superstition, reluctance by law enforcement officers in implementing the Act, as well as high poverty levels in the Sub-County. Based on the findings of the study, this paper recommends that efforts to eliminate FGM/C should not only be backed up by strictly enforcing legislative provisions by the county and national governments, but also incorporating both old women and men who are the custodians of culture. At the same time, the stakeholders should initiate advocacy and education programmes to help change the culture holders' mind sets, for instance, through the local mass media. Additionally, there is need to initiate alternative sources of income for traditional circumcisers who depend on the practice as a source of livelihood. Finally, school curriculum at all levels of education should incorporate themes such as female genital mutilation/cut and its effects on the life of a girl child and women.

KEYWORDS: Female Genital Mutilation/Cut, Circumcision, FGM/C ACT 2011, Kenya.

Corresponding Author: Peter Gutwa Oino

1 INTRODUCTION

Female Genital Mutilation/Cut (FGM/C) is a deeply rooted historical, cultural and religious tradition that has been the subject of considerable debate over the years [1]. Female genital mutilation/cut has been practiced for over 2,500 years in several countries across the world, and most prevalently, in the African Continent, where it is seen as a component part of the African culture [2]. FGM/C is classified as a critical global health issue, which has garnered international attention because of the political ramifications of eradication efforts and its role in the subjugation of girls and women's rights. The World Health Organization (WHO) defines FGM/C as "all procedures that involve partial or total removal of the external female genitalia, or other injury to the female genital organs for non-medical reasons" [3]. In Kenya, The *Children's Act, 2001* defines female circumcision as "the cutting and removal of part or all of the female genitalia and includes the practices of clitoridectomy, excision, infibulations or other practices involving the removal of part, or of the entire clitoris or labia minora of a female person"[4]. Female Genital Mutilation/Cut (FGM/C) is also commonly known as Female Circumcision (FC) [5], and the practice is rooted in gender inequality, ideas about limpidness, modesty and aesthetics and attempts to control women's sexuality. It is habitually instigated and accomplished by women, who see it as a source of nobility and authority [31]. Over 140 million girls and women across the globe have experienced the cut; that is in 27 countries in Sub-Saharan and North-East Africa, and to a lesser extent in Asia, and in the Middle East [6].

In Africa alone, United Nations organizations have estimated that up to three million girls are at risk of being cut annually [7]. In some countries it is practiced as early as a few days after birth, and in others as late as prior to marriage or after pregnancy. One of the notable trends in global FGM/C today is the progressive lowering of the age at which girls undergo the practice. Among communities that practice FGM/C, the procedure is a highly valued ritual, whose purpose is to mark the transition from childhood to womanhood [8]. In these traditional societies, the practice represents part of the rites of passage or initiation ceremonies intended to impart the skills and information a woman will need to fulfill her duties as a wife and a mother [9]. The practice of FGM/C is derived from varied and complex belief systems and rituals surrounding women's fertility and control of their sexuality in traditional male dominated societies. Ref [10] contends that FGM/C is used by men as a tool to exercise power and control over their women. He further asserts that men claim that female sexuality is very dangerous and has to be controlled.

The reasons given by communities that practice FGM/C varies widely but common reasons given for the practice is that it reduces the sexual desire of girls and women, promotes virginity and chastity, maintains fidelity among married women, as well as for hygienic and aesthetic reasons [11]. There are push factors that act as great incentives for families to continue the practice. In communities where it is a tradition, girls and women who do not undergo FGM/C are stigmatized and discriminated against for noncompliance with traditional norms. Stigma and discrimination may take the form of not being marriageable, as FGM/C is considered a pre-requisite for marriage in some societies that practice it. The 'bride price' (paid either in cash or in kind) is part of the marriage transaction in African societies and is generally paid by the groom's family to the family of the bride. This may not be paid if the bride has not undergone FGM/C. Moreover, family 'honour' is considered besmirched in such societies if the bride has not undergone through the 'cut' [12].

In communities that believe in ancestral worship, women are instilled with a fear of the unknown through curses and the evocation of ancestral wrath. Uncircumcised women are considered physically dirty and may be barred from such daily activities as cooking and community decision-making roles. They are considered religiously 'impure' and may not be allowed to undertake certain religious functions such as pouring of libation [13]. In the practicing communities such as Kisii and Kuria in Kenya, uncircumcised women are viewed as 'children' - even though adult - and are banned from key social functions and denied inheritance of property. Another reason FGM/C is sustained is because it provides economic incentives for the practitioners who perform the 'cuts', both in the traditional and modern societies. In some FGM/C-practicing communities, traditional practitioners are given an elevated status, wield considerable power and may resist FGM/C being stopped. Girls who undergo FGM/C are also provided with rewards, including public recognition and celebrations, gifts, the potential for marriage, respect and the ability to participate in social functions as adult women. The rewards may motivate some girls to look forward to undergoing FGM/C [14].

According to the Kenya Demographic and Health Surveys (KDHS) statistics, the overall prevalence of FGM/C has been decreasing over the last decade. In 2008/9, 27% of women had undergone FGM/C, a decline from 32% in 2003 and 38% in 1998. Older women are more likely to have undergone FGM/C than younger women, further indicating the prevalence is decreasing. However, the prevalence has remained highest among the Somali (97%), Kisii (96%), Kuria (96%) and the Maasai (93%), but relatively low among the Kikuyu, Kamba and Turkana, and rarely practiced among the Luo and Luhya (less than 1%) [15]. Female genital mutilation/cut surgeries are defined by four classifications. More precise anatomical descriptions are provided by typologies developed by WHO in 1995 and discussed below [16].

Type I: Partial or total removal of the clitoris and/or the prepuce. In medical literature, this form of FGM/C is also referred to as *'clitoridectomy'*. A number of practicing communities also refer to it as *sunna*, which is Arabic for 'tradition'.

Type II: Partial or total removal of the clitoris and labia minora, with or without excision of the labia majora. The 2007 WHO definition recognizes that although this form of cutting is more extensive than Type I, there is considerable variability in the form or degree of cutting. In English, this type of cutting is often referred to as *'excision'*, although it is important to note that in French the term 'excision' generally refers to all forms of FGM/C.

Type III: Narrowing of the vaginal orifice by cutting and bringing together the labia minora and/or the labia minora to create a type of seal, with or without excision of the clitoris. In most instances, the cut edges of the labia are stitched together, which is referred to as *'infibulation'*. The adhesion of the labia results in near complete covering of the urethra and the vaginal orifice, which must be reopened for sexual intercourse and childbirth, a procedure known as *'defibulation'*. In some instances, this is followed by *re-infibulation*.

Type IV: All other harmful procedures to the female genitalia for non-medical purposes, for example: pricking, piercing, incising, scraping and cauterization. Pricking or nicking involves cutting to draw blood, but no removal of tissue and no permanent alteration of the external genitalia. This is sometimes called 'symbolic circumcision', and some communities have described it as a traditional form of FGM/C. Although symbolic circumcision is still highly controversial, it has been proposed as an alternative to more severe forms of cutting in both African and other countries where FGM/C is performed.

In Kenya, communities that practice FGM/C justifies it as a traditional rite of passage into adulthood. Among such communities include the Somali, Kisii, Kuria and the Maasai [17]. The Maasai are a semi-nomadic community located in several sub-counties in central part of Kenya and Rift Valley. They largely dominate Kajiado county comprising of Kajiado central, Kajiado south and Kajiado north constituencies, where they move around in search of pasture and water for their animals. Traditionally, the Maasai diet consists mainly of cow's milk, maize meal and meat. All of these foods are grown or reared by the Maasai, reducing their need to rely on other communities, which has in turn reduced their exposure to and influence from other cultures [18]. With such an ingrained sense of culture and tradition, it can be very difficult to persuade Maasai people to let go of traditional practices like FGM/C. Even educated Maasai men and women, who are aware of the risks FGM/C poses, practice it for fear of rejection by wider Maasai society. Regardless of how educated she may be or her high social status, an 'uncircumcised' Maasai woman is considered a 'girl child' and risks isolation from the community, as well as zero-to-nil prospects of finding a spouse within the community. The Maasai FGM/C ceremony is a large and annual community celebration for all girls who have reached adolescence during the year. During the course of the celebration, groups of girls mostly between the ages of 12 and 14 undergo FGM/C on the same day by traditional 'circumcisers' (usually experienced elderly women). Until recently, all girls undergo FGM/C procedure with the same sharp instrument (often a sharpened knife known as an "*ormurunya*"), after which a paste made from cow dung and milk fat is applied to stop bleeding [19].

The type of FGM/C commonly practiced amongst the Maasai falls under Type-1 FGM/C (clitoridectomy), which involves the removal of all or part of the clitoris. After undergoing FGM/C, the girls go into seclusion during which they are taught community secrets of marriage and their rights and duties as an accomplished woman in the Maasai community. After the end of seclusion period (determined by cultural holders-elderly women and traditional circumcisers), they then return to the community where they are considered fully grown women, capable of being married. FGM/C is as such tied into the community's sense of honour [20]. Despite the perceived socio-cultural importance of FGM/C among the Maasai, several complications have often been identified. Some of the health complications associated with FGM/C include severe bleeding, tetanus, urinary tract infections, poor urine retention, ulceration, difficult child birth, and pain during sex.

Female Genital Mutilation/Cut is recognized internationally, as a violation of the human rights of girls and women [21]. It is an act of violence that harms women and girls in many ways, limiting their potential for full development, and a major obstacle to the achievement of gender equality in both developed and developing countries. Most governments in countries where FGM/C is practiced have ratified several United Nations Conventions that make provision for the promotion and protection of the human rights of girls and women, including the elimination of FGM/C. These include: The United Nations Convention on the Elimination of All Forms of Discrimination against Women (1979), The United Nations Convention on the Rights of the Child (which protects the rights of girl children) (1989), and The International Covenant on Civil and Political Rights (1966). These Conventions, which form part of binding international law, oblige member states that are signatories to protect their nationals from harmful practices such as FGM/C [22].

In Africa, thirteen countries have responded to the problem of FGM/C by implementing legislation against it. According to 'United Nation Center for Reproductive Rights', there are 16 countries with criminal legislation against FGM/C: Benin (2003-

the date legislation was implemented),Burkina Faso (1996), Central African Republic (1966), Chad (2003), Côte d'Ivoire (1998), Djibouti (1994), Egypt (Ministerial Decree, 1996), Ethiopia (2004), Ghana (1994), Guinea (1965), Kenya (2001 and 2011), Niger (2003), Senegal (1999), Tanzania (1998), Togo (1998), and Nigeria (1999-2002). In Mauritania, for example, the law is restricted to a ban on the practice in government health facilities and by medical practitioners. In Mauritania, the United Republic of Tanzania and some non-African countries, including Canada and the United States, FGM/C is illegal only among minors. Laws banning FGM/C at all ages have been passed in most African countries. For instance, in Burkina Faso, fines can be levied not only against practitioners of FGM/C, but also against anyone who knows that the procedure has been performed and fails to report it [23].

The Kenyan government has progressively put in place several policies to eliminate FGM/C. For instance, in 1983, the president issued a decree against FGM/C and those practicing it were required to stop the practice or face legal action. However, many communities continued the practice in secret by inviting the circumcisers to their homes without the knowledge of the authorities. Thus, although the decree demonstrated the highest level of political will to eliminate FGM/C in the country, it had limited success. Following the 1993 UN Declaration on Elimination of all Forms of Violence Against Women, Kenya developed a National Plan of Action for the Elimination of FGM/C [24]. The UN declaration required governments to commit themselves to condemn violence against women, punish offenders, and address issues surrounding gender-based violence. This sparked even more interest in Kenya in addressing FGM/C, which was further reinforced by the International Conference on Population and Development (ICPD) in Cairo in 1994 and the Fourth World Conference on Women in Beijing in 1995. Following the ICPD, Kenya developed a population policy that was known as *Sessional Paper No. 1 of 2000 on Population Policy for Sustainable Development* which advocated against FGM/C. In 2001, the government put in place the first set of laws that dealt specifically with FGM/C. *The Children's Act* that came into force in 2001 empowered the courts to punish those who facilitate or practice FGM/C [4].

While FGM/C declined somewhat in Kenya after the implementation of *The Children Act 2001*, one in four women was still being 'cut'. This led the government to introduce a more comprehensive law, the *Prohibition of Female Genital Mutilation Act* (2011), which stipulates stiffer punishments for offenders. These include a three- to seven-year prison sentence or a fine of nearly US $6,000 for anyone practicing FGM/C. According to the Act, the offences punishable includes; aiding and abetting female genital mutilation/cut, procuring a person to perform genital female mutilation/cut in another country, use of premises to perform female genital mutilation/cut, possession of tools or equipment usable in FGM/C, failure to report commission of offence, and use of derogatory or abusive language intended to ridicule, embarrass or otherwise harm a woman for having not undergone female genital mutilation/cut, or a man for marrying or otherwise supporting a woman who has not undergone female genital mutilation/cut. A person causing death by performing FGM/C is liable to life imprisonment [25]. The policy calls on stakeholders to take concrete steps to promote the abandonment of FGM/C through legislation, public education, advocacy, media coverage, the empowerment of women, and access to reproductive health and other support services. These laws and policies are supported by the 2010 Constitution of Kenya, which reaffirms the government's commitment to protect and promote human rights and fundamental freedoms [26]. It should however be noted that despite the enactment and implementation of FGM Act of 2011 in the country as well as the 2010 new constitution, prevalence of FGM/C still remains high especially amongst the Maasai, standing at 93% (among female of 13-49 years). It is based on this background therefore, that the researchers sought to find out the challenges facing effective implementation of FGM Act of 2011 in Kajiado Central Sub-County in Kenya.

2 RESEARCH METHODOLOGY

This paper is an output of a study that was conducted in Kajiado Central Sub-County in 2012. The entire Kajiado County has a population of 687,312 inhabitants and an area size of 21,292.7 km^2. Kajiado County as a whole is largely occupied by the Maasai community. Kajiado Central Sub-County consists of fourteen wards and a population size of 48,800 inhabitants. It is one of the three sub-counties of Kajiado County that share common borders with Nairobi County, Machakos County and Kiambu County [27]. The focus on Kajiado Central Sub-County was based on the fact that it is largely dominated by the Maasai community known both locally and internationally because of its conservative lifestyle including their ingrained tradition and culture, and the Sub-County has experienced violent protests by pro-FGM/C campaigners against government officers and the local populace who oppose the 'cut'. The pro-FGM/C advocates have been women drawn from various wards in the Sub-County. The research on which this paper was drawn adopted a cross sectional research design. Four out of fourteen wards were randomly sampled for study and a sample size of 200 respondents was used to solicit data needed in the study. The respondents comprised of traditional circumcisers, *manyatta* elders, traditional religious leaders, public health officers, administrative officers from the sampled wards and sampled men and women with at least five children in the study area. Data was collected by means of semi-structured interviews and Focus Group Discussions with the respondents. The paper significantly revolves around the challenges facing effective implementation of FGM Act of 2011 of Kenya. This is vital

in understanding how best such factors can be addressed in order to mitigate the negative consequences of the 'cut' both to the women as well as the young girls who are often subjected to the 'cut' against their will.

3 FINDINGS AND DISCUSSIONS

The subsequent sections highlight the discussion of major finding of the study.

3.1 CHALLENGES CONSTRAINING EFFECTIVE IMPLEMENTATION OF FGM ACT 2011

The researcher sought to find out the challenges facing effective implementation of FGM Act of 2011 in Kajiado Central Sub-County and the findings were as indicated in Table 1.0.

Table 1.0: Challenges Constraining Effective Implementation of FGM Act 2011

Constraining Factors	Frequency	Percentage (%)
Deeply ingrained culture and tradition	110	55
Ignorance of the legislation and consequence of FGM/C	22	11
Ingrained traditional religious beliefs and superstition	48	24
Reluctance by law enforcement officers	12	6
High poverty level	8	4
TOTAL	**S=200**	**100**

The findings depicted that 110(55%) respondents attributed non-compliance to deeply ingrained culture, while 12 (6%) respondents attributed it to reluctance by law enforcement officers who are implementers of the policy. In addition, 48(24%) respondents cited ingrained traditional religious beliefs and superstition while 8(4%) attributed it to high poverty level in the region. Finally, the findings also indicated that 22(11%) respondents cited ignorance of the legislation and the consequences of FGM/C as a constraining factor to the implementation of the FGM Act 2011.

3.1.1 DEEPLY INGRAINED MAASAI CULTURE AND TRADITION

It was evident from the findings that the leading factor constraining effective implementation of the policy is a deep rooted Maasai culture and tradition regarding FGM/C. It was found out that 55% of the respondents held that the Maasai culture on marriage and ancestral relationship, regard FGM/C as a rite of passage, which demands that girls over 13 years of age must be 'officially' initiated into the society. In relation to marriageability, one of the female respondents retorted that:

> Uncircumcised girls are indecent because they are promiscuous and are ever sex hungry and never have stable families. They are like cars without brakes and are absolutely, sexually uncontrollable. HIV/AIDS is never far from their doorstep. Furthermore, they can neither fetch wealth to the parents nor get a marriage partner in the community. They are just cursed….(Female, age 46 years).

It was apparent from the findings that the Maasai community believes that promiscuity in the society can largely be controlled through FGM/C. Promiscuity among girls is greatly abhorred and promiscuous women are greatly despised and disrespected by the society. In addition, family wealth is guaranteed if the daughters are given over to marriage when they are circumcised. The cultural value of FGM/C is also seen in terms of the number of cows, sheep and goats the parents get as bride price. FGM/C thus remains a strong cultural practice to be upheld at all cost among the Maasai community.

The findings further revealed that the Maasai community has a cultural belief that uncircumcised women are ever 'young girls' who can never 'grow up'. When the researcher probed one of the female respondents, she narrated that:

> The Maasai celebrates FGM/C since community secrets regarding the institution of marriage are passed on to the circumcised girls. Good behavior and responsibility in marriage are passed on and thus reduces failures of responsibilities among women. Which *'moran'* in our community would like to marry an uncircumcised girl who knows nothing regarding such community secrets? (Female, Age 42 years).

It was evident from the responses given by the respondents that FGM/C plays a significant role in relation to marriage and family as a social institution and therefore, the community is greatly ingrained to the practice. Despite the efforts made

by the government to implement the FGM Act of 2011, a lot of resistance from the community has been witnessed due to the perceived significant role played by FGM/C in relation to the Maasai culture and tradition.

In addition, resistance to the implementation of the FGM Act, 2011 was also based on the community principle that Maasai as a tribe identify themselves as belonging to a group whose 'ways' include 'circumcision' in contrast to other different communities. The identity of an individual as a Maasai is largely based on this rite which confirms a sense of belonging to the community. They therefore, maintained that FGM/C must be continued and any effort to stop it must be resisted at all cost because it is their cultural practice and heritage that confirms their identity. FGM/C is a hallmark of social-cultural identity that solidifies one's sense of belonging to the Maasai society [28]. The study conducted by [29] confirmed that in Gambia, respect for what was found from the grandparents was the most strongly and commonly stated reason for performing FGM/C and thus, must be upheld and respected by all people in the society.

Furthermore, one of the administrative officers argued that nomadic life among the Maasai community makes it hard to fully enforce the policy since they constantly migrate across the border to Tanzania. The public administrative officer quipped that:

> It's hard apprehending perpetrators of this practice since the community migrates quite often in search of pasture and water to Tanganyika. Before the officers are mobilized, they are already past the border and they can't come back to the same place when they return. They settle elsewhere and continue with the practice and thus, trans-border migration provides a safe hiding from the law…. (Male, Age 37 years).

It is evident from the findings that nomadic life as a traditional practice among the Maasai community provides a safe hide-out whenever the practice is done. Perpetrators especially traditional circumcisers and families who practice FGM/C cross the border to Tanzania to get safe haven from the law. Seasonal trans-border migration in search of water and pasture by the community in the county makes it difficult for law enforcement officers to make close follow up and apprehend those who either subject their girls to the 'cut', aid and abet female genital mutilation/cut, posses tools or equipment usable in FGM/C, or harm women or girls for having not undergone female genital mutilation/cut.

3.1.2 IGNORANCE OF THE LEGISLATION AND THE CONSEQUENCES OF FGM/C

Research findings indicated that 11 percent of the respondents attributed failure in compliance to the Act, to ignorance of the legislation as well as the consequences of FGM/C. The study established that 72% of the respondents who were largely the *manyatta* elders, traditional religious leaders and men and women sampled for the study, were illiterate and unaware of the existence of FGM/C legislation in Kenya. Although public health officers and administrative officers in charge of various locations and sub-locations in the sampled wards were fully aware of the existence of the legislation, they admitted that illiteracy and lack of awareness campaigns among the community members had largely contributed to the continued existence of FGM/C in the community. When the researchers further probed one of the female respondents regarding her knowledge on the existence and the provisions contained in the FGM Act 2011, she narrated that:

> I can't read or write, leave alone understanding the content of that document. Women in our community learn much through informal means such as teachings after the 'cut'. It is surely news to hear that there is a law that prohibits our most valued rite. Nobody ever asked us our opinion before coming up with such a repressing law and is therefore, unacceptable to us…. (Female, Age 44 years)

It is evident from the above response that majority of community members were absolutely ignorant of the existence of the legislation prohibiting FGM/C. High illiteracy level and lack of awareness campaigns is a hindrance towards popularizing of the law and the efforts to eradicate the practice in the Sub-County. In addition, it is also clear that the community believed that they should have been consulted before the legislation was enacted. They largely believe that the legislation is against their customs and traditions and is not worth abiding by. According to Ref [29], legislations that are largely inconsistent with people's cultures and traditions often face a great non-compliance in both developed and developing countries. The researchers upon probing one of the female public health officers said that:

> The community I come from (Maasai) still hold that FGM/C is important since it reduces complications during child birth, reduces promiscuity, contributes to cleanliness in the genital area and avoidance of diseases…..Efforts to educate them on the negative consequences have never yielded fruits since most of the elites including myself and many learned women around underwent through the cut….(Female, Age 31 years).

The response from the respondent indicated that most people in the community are absolutely ignorant of the negative consequences of FGM/C. They largely believe that FGM/C is paramount in keeping women clean, easy child birth and reduces diseases among women. This is contrary to health risk posed by FGM/C such as death due to excessive bleeding,

hemorrhage, post-operative shock, fractures of the clavicle or dislocation of the hip joint if heavy pressure is applied to restrain the struggling girl during the operation, infection as a result of unhygienic conditions, clitoral neuroma, and calculus formation in the vagina. The fact that even the elite have undergone the 'cut' among the Maasai community as argued by the respondent, makes it difficult for them to stage anti-FGM/C campaigns in areas inhabited by the community. Those who attempt to do so are considered as rebels and traitors who are always ignored in any community gathering regardless of their socio-economic and political achievements. Ignorance of the legislation and the consequences of the 'cut' as well as the elites who have also undergone the 'cut' make it difficult for various administrative officers to implement the policy.

3.1.3 INGRAINED TRADITIONAL RELIGIOUS BELIEFS AND SUPERSTITION

As indicated in Table 1.0, a total of 48(24%) respondents attributed non-compliance to the policy to ingrained traditional religious beliefs and superstition. The Maasai are monotheistic, worshipping a single deity called *Enkai*. The Maasai believe that each person is sent a guardian spirit by *Enkai* to watch them from birth to the day the person dies. The researchers established that they also believe that guardian spirit bring great blessing to all those who abide by the Maasai culture and tradition, but also bring calamities and death to those who rebel and reveals community most guarded secrets such as circumcision. One traditional religious leader (*Loonkidongi)* during the interviews remarked that:

> Blessed be Enkai who brings good fortune to the faithful and destroy his enemies. Enkai value true Maasai who abide by our customs and tradition. He however, curses the rebels and traitors by bringing death to the community. He can send the red cock (lightning), to strike individuals who rebel, or death among the *morans* during cattle raids …. (Male, Age 52 years).

When the researchers further probed the religious leader, it was established that death among the Maasai is attributed to rebellion against culture and tradition and thus, appeasement must be made to calm both the ancestors as well as the guardian spirit. The researcher further established that such appeasement is done through pouring of libation and offering of sacrificial lamb by traditional religious leaders. In addition, he further argued that during both male and female circumcision, the blood that is shed calms the ancestral spirits and the guardian angel and is a sign of absolute spiritual devotion. The initiates (circumcised boys or girls) consequently takes an oath never to reveal community secrets including talking of circumcision practice in public or to the uncircumcised within and outside the Maasai community. One *manyatta* elder quipped that:

> Female circumcision is our culture. Why should we be forced to abandon it when we were born into it? Abandoning our culture would be annoying our ancestors. It would bring a curse to the entire community. (Male, Age 55 years).

The study found out that the Maasai community attributes various occurrences such as disability, deaths at birth, skin diseases, lightning strikes, death during cattle raids and barrenness to abandonment of Maasai culture and traditions. For instance, deaths at birth can occur if a woman is not circumcised since the guardian spirit is angry at the mother. Circumcised women are believed to easily give birth because, through circumcision, they not only appease the ancestors and the guardian spirit through the blood they shed, but also have their birth canal prepared for birth. It was evident during the interview that those who fight against FGM/C are considered to bring bad omen and calamities to the community and must be publicly fought and cursed by elders to die a mysterious death. Such an ingrained religious beliefs and superstition has largely constrained implementation of FGM Act of 2011 in the Sub -County.

3.1.4 RELUCTANCE BY LAW ENFORCEMENT OFFICERS

According to Section 2(d), of FGM Act 2011, law enforcement officer who include police officers, members of the provincial administration, children's officers, probation officers, gender and social development officers and a cultural officers have a role to play in addressing issues related to FGM/C [31]. In relation to this research, the researchers established that six percent (6%) of all respondents believed that law enforcement officers especially the sub-chiefs and chiefs have largely been reluctant in implementing the FGM Act 2011. One respondent who was a chief to a location said that:

> Law enforcement officers especially the chiefs and sub-chiefs have witnessed unprecedented hostility from the community members after trying to implement the Act. A sub-chief from my location had his house razed to the ground by hungry group of women. Other law enforcement officers including health officers have since been threatened should they ever try to rebel against the culture and tradition of their community (Male Age 59 years).

The sub-chiefs and chiefs in their respective areas of jurisdiction have faced enormous aggression and resistance in their attempt to stop the rite. It is evident from the respondent's statement that though there is goodwill to implement the Act by

the law enforcement officers, extreme resistance characterized by burning of officer's houses had prompted them to go slow in implementing the Act in their respective areas of jurisdiction. In addition, various officers such as health officers who attempted to educate the community about the consequences of the 'cut' had been considered as traitors and rebels against the community's most treasured cultural practice. Such rebellion from the community members have resulted in reluctance by the public officers in implementing the Act.

This study is augmented by various evidences from various sources including media outlets. For instance, on 3rd June 2014, the Kenyan Standard Newspaper reported a case where three journalists and a writer were seriously injured and admitted in a nearby health centre by infuriated women in Kajiado County accusing them for being at the fore front in fighting FGM/C. The newspaper reported that:

> …Three journalists including a writer were injured and were treated at a nearby health centre after the demonstrators turned to them accusing them for being at the fore front in fighting FGM/C. NTV Cameraman Mr Abdalah Ngotho and Ms Christine Musa of Media Max were injured during the melee while Mr Ngotho's television Camera was damaged. As whipping went on, Media-Max's Christine opted to save herself using the Maasai dialect declaring she is circumcised and advocating for FGM/C too. Unfortunately the irate women demanded to strip her off for inspection to ascertain her truth....(Standard Newspaper, 4th june,2014 pp2).

Despite the fact that the above reportage captured aggression against journalists in the county, fight against public officials often occurs and goes unreported as such if reported, would be an embarrassment to the public officers affected. Fear of reprisal by the public officials such as the chiefs, sub-chiefs and various public health officers, has prompted them to remain silent and reluctant in making close follow up on reported cases of FGM/C. Such a move consequently, impedes efforts to eradicate FGM/C in the Sub-County.

3.1.5 HIGH POVERTY LEVEL

The study findings revealed that resistance to the implementation of FGM Act 2011 in the area was attributed to the economic gain that various stakeholders get. This was raised by four percent (4%) of the respondents in the study. Focused group discussion revealed that the key actors who mostly benefit economically from FGM/C include traditional circumcisers, traditional religious leaders, parents of the initiates and few law enforcement officers who are often bribed to keep silent on the cultural practice. It was evident from the findings that parents of the female initiates greatly value the practice since it fetches a lot of cows and goats when the initiate is finally given over to marriage. Young men who marry a circumcised woman are required to pay up to seventy cows and twenty sheep and goats as bride price consequently, bringing a lot of wealth to girl's parents. Girl child education as an investment is hardly emphasized by the Maasai community compared to the emphasis put on FGM/C. One of the village elders during a focused group discussion argued that:

> Most members of the community consider their economic status based on the number of livestock they get as bride price, not on the western education that degrades African culture. Having more girls in a family means wealth in waiting since they fetch a lot of cows and goats when they are circumcised and given over to marriage (Female, Age 48 years).

The study further established that traditional circumcisers are highly revered in places where the practice is popular and entrenched in their culture. The traditional circumciser are paid their dues based on the number of initiates they 'cut ' that is, the more the initiates, the more the pay for them. Consequently, traditional circumcisers often emphasizes on the practice claiming that ancestors and guardian spirit watches over the community to punish the homes of those who abet the cultural practice from the great grandparents. Since traditional circumcisers are highly revered for fear of curse among the Maasai community, the community often follows their instructions as absolute truth. These circumcisers derive substantial income from the practice and therefore, they see the practice of FGM/C as their own means of making money and livelihood. They do everything to promote this aspect of their culture, and resist its eradication. Owing to high poverty level in Kajiado County, most members of the community especially the traditional religious leaders, circumcisers, some public officers and parents considers circumcision as both an avenue to economic gain as well as a cultural rite worth protecting. Such community gate-keepers consider that efforts to eradicate FGM/C should be resisted at all cost knowing that it constitutes a major source of economic gain.

4 CONCLUSION AND RECOMMENDATIONS

From the foregoing discussions, FGM/C practice is considered out dated and criminalized in Kenya. However, it is still widely practiced in Kajiado Central Sub-County in Kajiado County. Kenya effected FGM Act of 2011 to help in eradicating the

practice, however, the efforts exerted have achieved little impact and largely hampered by ingrained Maasai culture and tradition, ignorance of the legislation and the consequences of FGM/C, ingrained traditional religious beliefs and superstition, reluctance by law enforcement officers in implementing the Act as well as high poverty levels in the Sub-County, which have influenced the initiators to continue with the practice as a way of generating income for themselves and their families. Based on the findings of the study, this paper recommends that efforts to eliminate FGM/C should not only be backed up by strictly enforcing legislative provisions by the county and national governments, but also incorporating both old women and men who are the custodians of culture in the Maasai community. At the same time, the stakeholders should initiate advocacy and education programmes to help change the culture holders' mind sets, for instance, through the local mass media. Additionally, there is need to initiate alternative sources of income for traditional circumcisers who depend on the practice as a source of livelihood. Finally, school curriculum, at all levels of education should incorporate themes such as female genital mutilation/cut and its effects on the life of a girl child and women.

REFERENCES

[1] Rezaee F, A. (2012). Theories on Female Genital Mutilation/cut; Department of Cultural Anthropology; Uppsala University.

[2] Hernlund, Y. and B. Shell-Duncan (2007) *Trans-cultural Bodies: Female Genital Cutting in Global Context.* Rutgers University Press

[3] World Health Organization, *Eliminating Female Genital Mutilation/cut: An interagency statement, WHO, UNFPA, UNICEF, UNIFEM, OHCHR, UNHCR, UNECA, UNESCO, UNDP, UNAIDS,* WHO, Geneva, 2008, <http://www.who.int/reproductivehealth/publications/FGM/C/9789241596442/en/index. html>, accessed 1 March 2013.

[4] The *Children's Act, 2001 (Government Of Kenya)*

[5] United Nations Children's Fund, *Coordinated Strategy to Abandon Female Genital Mutilation/cutting in One Generation: A human rights-based approach to programming*, Technical Note, UNICEF, New York, 2008.

[6] UNICEF, (2013); Female Genital Mutilation/cutting: A statistical overview and exploration of the dynamics of change: New York.

[7] United Nations. 2012. Advancement of Women: Report of the Third Committee: http://www.un.org/ga/search/view_doc.asp?symbol=A%2F67%2F450

[8] Appropriate Technology in Health (PATH), (1999). *Female Genital Circumcision in Four Districts in Kenya.* Nairobi.

[9] Republic of Kenya, (2001).Report on Female Genital Mutilation/cut [FGM/C] or Female Genital Cutting.

[10] Hosken, Fran.P.1993. The Hosken Report: Genital and Sexual Mutilation/cut of Females, 4th Revised Edition (Women's International Network News: Lexington, MA, 1993. New York: Oxford University Press.

[11] Dorkenoo, E., *Cutting the Rose – Female Genital Mutilation/cut: The practice and its prevention*, Minority Rights Group, London, 1994; Shell-Duncan, B., and Y. Hernlund, 'Female "Circumcision" in Africa: Dimensions of the practice and debates', *Female "Circumcision" in Africa: Culture, controversy, and change*, edited by B. Shell-Duncan and Y. Hernlund, Lynne Rienner Publishers, Boulder, CO, 2000, pp. 1-40.

[12] Ahmadu, F., 'Rites and Wrongs: An insider/outsider reflects on power and excision', *Female "Circumcision" in Africa: Culture, controversy, and change*, edited by B. Shell-Duncan and Y. Hernlund, Lynne Rienner Publishers, Boulder, CO, 2000, pp. 283-312.

[13] Hicks, E. K; (1993). *Infibulations: Female Mutilation/cut in Islamic Society.* London. Heinemann, Educational Books.

[14] Hosken, F. (1993). *The Hosken Report: Genital and Sexual Mutilation/cut of Females.* Lexington. Woman's International Network News.

[15] Government of Kenya (GOK). (1998). *Kenya Demographic and Health Survey (*KDHS). Nairobi. GOK.

[16] World Health Organization,(WHO,1992). Female Circumcision; Statement of WHO, Position and Activities, Geneva, 1992.

[17] Government of Kenya (GOK). (1998). *Kenya Demographic and Health Survey (*KDHS). Nairobi. GOK.

[18] IRIN. 2005. FGM/C amongst the Maasai Community of Kenya Razor's Edge - The Controversy of Female Genital Mutilation/cut: http://www.irinnews.org/InDepthMain.aspx?InDepthId=15&ReportId=62470

[19] K. Arhem, T*he Maasai and the State: The Impact of Rural Development Policies on a Pastoral People in Tanzania,* Discussion Paper No. 52 at IWGIA.

[20] John L. Berntsen, *Maasai and lloikop: Ritual Experts and Their Followers* (1977) University of Wisconsin at Madison).

[21] Rahman, A. and N. Toubia (2000) *Female Genital Mutilation/cut: A Guide to Laws and Policies Worldwide.* Zed Books

[22] Rahman, A. and N. Toubia (2000) *Female Genital Mutilation/cut: A Guide to Laws and Policies Worldwide.* Zed Books

[23] Giuliani, C. (2006) *Female Genital Cutting in Africa: Legal and Non-Legal Strategies to Abandon the Practice.* Institut d'études politiques.
[24] Faiza, M. (2011) Protecting girls from undergoing Female Genital Mutilation/cut: *The experience of working with the Maasai communities in Kenya and Tanzania,* Pafido Enterprises, Nairobi
[25] The Prohibition of Female Genital Mutilation/cut Act, 2011 No. 32 Of 2011
[26] Government of Kenya: *The Constitution of Kenya*; Government Printers; Nairobi, 2010.
[27] Gwako,L (1992) Female Circumcision In Kenya: A Study Of Gusii Women Experience And Current Attitude With mplication for Social Change, Moi University-Eldoret, Kenya.
[28] Hernlund, Y (200) "Cutting Without Ritual And Ritual Without Cutting: Female Circumcision And Reritualization Of Initiation" In Shell-Duncan Bettina And Ylva (Eds) Circumcision In Africa: Culture, Controversy And Change:(235-252), Liner Reiner Publisher Inc, Colorado And London
[29] Anderson, J; Public policy making (2nd) Holt, Rinehart & Winston; New York, 1978.
[30] The Female Genital Mutilation/cut Act 2011 (Government of Kenya)
[31] Martha, N. (1999). *Sex and Social Justice.* Oxford: Oxford University Press

International Journal of Innovation and Scientific Research
ISSN 2351-8014 Vol. 10 No. 1 Oct. 2014, pp. 50-58

http://www.ijisr.issr-journals.org/

Factors Influencing Delivery Practices among Pregnant Women in Kenya: A Case of Wareng' District in Uasin Gishu County, Kenya

Juley-Anne Bochaberi Mokua

MPH, School of Public Health, College of Health Sciences, Moi University, Eldoret, Kenya and Senior Public Health Officer, Uasin Gishu County, Kenya

ABSTRACT: Maternal mortality remains to be a major public health concern globally. In Kenya, pregnancy and childbirth is still an important cause of mortality among women of reproductive age. Due to the various awareness campaigns in Kenya on antenatal clinic attendance in health facilities, high numbers of women are now attending antenatal clinic (ANC). Despite the high rates of ANC attendance, utilization of skilled birth attendants during delivery remains very low. Most women still deliver away from health facilities without the assistance of skilled birth attendants. This study was conducted in Wareng' district and it is based on the premise that, despite awareness campaigns on skilled birth attendance in the country and in particular Wareng' district, there are other factors that determine delivery practices among pregnant women, which include the women's level of education, income levels, marital status and physical access of health facilities. Findings of the study showed that educated women have a better understanding of issues and are able to make their own decisions on matters concerning their health. Those women who make more visits to health facilities are constantly reminded during visits on the importance of delivering in the health facility and being assisted by a skilled birth attendant hence, increasing their chances of utilizing the same. This study recommends that the health practitioners in the reproductive health departments not only in the study area, but also throughout the country, should work with relevant stakeholders and embrace health education programs to provide more information on ANC through the appropriate communication channels so as to ensure that all women are prepared for safe deliveries.

KEYWORDS: Delivery, Maternal Health, Mortality, Wareng' District, Kenya.

1 INTRODUCTION

Maternal mortality remains a major global public health concern more than twenty years after the international Safe Motherhood Initiative was launched (Gwamaka, 2012). Each year, 358,000 women die worldwide from pregnancy-related causes, nearly all in Sub-Saharan Africa and Asia, and many women die from obstetric complications (WHO, 2010). Similarly, the World Health Organization (WHO) has reported that the proportion of deliveries attended by skilled health providers rose from 58% in 1990 to 68% in 2008 worldwide, but remained at only about 50% in Africa (WHO, 2011). The enjoyment of the highest attainable standard of health is one of the fundamental rights of every human being without the distinction of race, religion and political belief, economic or social condition as stated by the WHO constitution (WHO, 2006). In this regard, every woman has a right to the best possible care during pregnancy, delivery and postpartum periods to ensure her survival and that of her newborn.

Despite this knowledge, approximately eight million women suffer pregnancy-related complications and over half a million die every year although these deaths can be prevented. Maternal mortality is defined as the death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management but not from accidental or incidental causes (WHO, 2012). Over 500,000 women globally die every year due to maternal causes, and half of all global maternal deaths occur in

sub-Saharan Africa (CIDA 2011; Kirigia et al. 2011). Each death or long-term complication represents an individual tragedy for the woman, her partner, her children, her family and society at large.

An estimated 2.65 million stillbirths occurred in 2008 worldwide (Lawn et al. 2011), while annually 3 million newborns do not survive the first month of life worldwide (WHO, 2006). The main causes are known, and more than 80% of maternal deaths could be prevented or avoided through actions that are proven to be effective and affordable, even in the poorest countries of the world. Surveys conducted in Egypt and elsewhere have shown that the quality of care provided to the women is a key determinant of maternal outcome (WHO, 2004). The use of skilled birth attendants during childbirth, readily accessible appropriate care in case of complications, and effective postnatal care within the first 24 hours of delivery are some of the strategies that can improve prenatal outcomes for mothers and babies (Fillipi et al. 2006; Adegoke et al. 2009). According to the WHO (2007) report, the high level of maternal and newborn morbidity and mortality has not changed substantially over the last decade as many women in Africa are dying each year from complications of pregnancy and childbirth.

In Kenya, the 2010 maternal mortality rate per 100,000 births for Kenya was 530, however, it has been reported to be as high as 1000 in the North Eastern Province (Red Cross, 2011). This is compared with 413.4 in 2008 and 452.3 in 1990. The under 5 mortality rate, per 1,000 births is 86 and the neonatal mortality as a percentage of under 5 mortality is 33. Additionally, the number of midwives per 1,000 live births in the country is unavailable and the lifetime risk of death for pregnant women is 1 in 38 (UNPF, 2011). With the annual number of maternal deaths being 6222, the total annual economic loss due to maternal mortality in Kenya was estimated at $2240, again one of the highest losses compared to other African regions (Ochako et al. 2011). Maternal health services are provided by facilities at every level of Kenya's health system. The MOH and the National Coordinating Agency for Population and Development (NCAPD) have identified maternal health as a priority health issue and put in place a strategy to reduce maternal morbidity and mortality. Kenya has adopted the WHO goal oriented model of ANC, incorporated it to its national guidelines (ROK, 2004), piloted it in Lugari and Busia districts and eventually rolled it out to all health facilities in the country (ROK, 2004; Birungi and Ouma, 2006).

The KDHS 2008/9 showed that only about 43 percent of births in Kenya took place in a health facility, and that the decision on place of delivery was mainly influenced by factors related to ease of access to services- availability of transport to, and charges for services at the health facility. The same survey also reported that, overall, only 44 percent of births in Kenya were delivered under the supervision of a skilled health provider (nurse, midwife or doctor). This is below the target of 90% of deliveries by 2015. Traditional birth attendants continue to assist with 28% of births, relatives and friends with 21%, and in 7% of births, mothers receive no assistance at all (KNBS, 2008/2009). Although health sector infrastructure has grown over the past decade, many women still live at a considerable distance from health facilities, cannot afford to pay fees for maternal services, and/or face other barriers to accessing quality care. Access to skilled delivery is a particular challenge. Studies have shown that the presence of positive association between utilization of maternal health care and residence; those living in urban and closest to health facilities tend to utilize skilled delivery services more than rural dwellers (KNBS, 2010).

The Constitution of Kenya 2010 further provides that a person has the right to emergency treatment (Article 43(2)), the right to inherent dignity and the right to have that dignity respected and protected (Article 28), and the right to access information (Article 35). The Kenya National Patients' Rights Charter (2013) outlines the right to access health care, the right to receive emergency treatment in any health facility irrespective of ability to pay, the right to the highest attainable quality of health care products and services, the right to be treated with respect and dignity, the right to information, and the right to complain, among others (MoH, 2013).

Besides, Kenya has signed on to several regional mandates regarding health/reproductive health. Kenya participated in and committed to the 2001 Abuja Declaration, pledging to commit at least 15% of the national budget to health care, but this is yet to be implemented. Kenya signed (but did not ratify) the Maputo Protocol on the Rights of Women of 2003, which recognizes reproductive rights and commits state parties to establishing and strengthening existing pre-natal, delivery, and post-natal health and nutritional services for women. As a member of the African Union, Kenya launched the Campaign on Accelerated Reduction of Maternal Mortality in Africa (CARMMA) in November 2010, reiterating the Campaign's slogan that "no women should die while giving life" (UNFPA, 2011).

According to a study conducted in Burkina Faso, distances to health facility, education and asset ownership were major determinants of delivery care utilization (Hounton, 2008). Notably, user fees have almost always been shown to hurt poor people more and prevent them from gaining access to needed care and maternal health is no exception. Use of maternal health services is highly sensitive to the official and non-official fees charged with several reports showing that utilization fell after user fees were introduced. (Borghi, 2006) Consequently, a study by Filippi (2006) supports the argument that women are intensely vulnerable to the effects of costs incurred during childbirth especially costs of emergencies such as caesarean

section. The costs can sometimes reach catastrophic amounts which push families into poverty. For example, near-miss complications in Beninese women accounted for 26% of average yearly household expenditure, and many women often left the hospital before they were well enough for discharge because they could not pay for the care they received. User charges add to the costs of transport and companion time, which can be substantial for those living far from facilities.

Kenyan public health facilities have long suffered from insufficient infrastructure, equipment and staffing. Recent survey data found that only 36% of public health facilities offering delivery services had all the basic delivery room infrastructure and equipment needed, with rural areas and lower level facilities particularly unequipped (NCAPD et al, 2011). The Kenya Health Sector Strategic & Investment Plan (2012-2018) also estimates that current staff levels meet only 17% of minimum requirements needed for effective operation of the health system (KHSSIP, 2012).

One of the constraints to use of maternal health care in the presence of fees is household inability to access cash at the time of need, especially in rural areas where subsistence farming is characterized by temporal or seasonal inability to pay. This issue was reportedly a major constraint for between 40% and 50% of households in West Africa. Unfortunately, resource constraints are not limited to rural areas. In urban Bangladesh, 51% of families did not have enough cash for a normal delivery and 74% did not have enough for a caesarean section and so had to borrow money from a money lender or relative (Borghi, 2006). The time spent looking for money can delay the decision to seek care and reduce timely access with potentially serious implications for maternal health outcomes. Some women will choose other alternatives, including home birth with a skilled attendant, relative or traditional birth attendant, particularly where there are strong beliefs in the normality of childbirth or cultural preferences for certain practices or delivery environments. Given everybody's right to choose what's good for them it is imperative that women are provided with clear and adequate information so as to make informed choices about the most suitable place for them to deliver.

It is worth noting that, the normal delivery and preventive functions of basic care, including some emergency first aid, could be delivered by a skilled attendant in the home. Such strategies have been adopted successfully and have contributed to achievement of low maternal mortality ratios in countries such as Malaysia and the Netherlands (Campbell, 2006). Thus, home births can increase coverage of skilled birth attendants in remote areas and respond to women's demands for home-based care with a good referral system that is responsive. Women's access to and utilization of formal maternity services can be limited by distance to health facilities and the cost of transport, cultural factors including preferences for privacy, modesty and female attendants and women's lack of decision-making power. In addition, the actual or perceived affordability of health services is important as anticipated costs may play a role in deterring care-seeking, with implications for the health outcomes of the mother and child. Even when formal fees are low or non-existent, there may be hidden fees in terms of the cost of transportation, drugs purchased outside of the hospital, and food or lodging for the mother and her accompanying family members (Borghi, 2003).

Fikree *et al.* (2007) noted that women who remain outside of services even when they are accessible may do so for other reasons; costs of using services, difficulties in getting to services (such as finding transport, companions, and funds for associated costs), and absence of decision-making power (male head of household typically makes the final decision concerning type of care and provider especially if funds are required).

In many studies done in the African continent, most mothers express their wish to deliver in a health unit (Kyomuhendo, 2003; JHPIEGO, 2004). However, majority of them end up either not being attended or attended by non trained people during delivery (Maureen & Peter, 2008; Kowalewski et al. 2003). Although most pregnancy and delivery related complications cannot be predicted, high quality antenatal care (ANC) and receiving counseling on birth preparedness during antenatal care appeared to strongly influence women's use of skilled care during delivery (Maureen & Peter, 2008). In Kenya, Maternal health is recognized by the 2010 constitution as a fundamental right hence the goal to have a country where every pregnancy is wanted, every birth is safe, every newborn is healthy and no mother dies while giving life. The six pillars of maternal and newborn health in Kenya include: pre-conceptual care and family planning, focused antenatal care, essential obstetric care, essential newborn care, targeted post-partum care and post-abortion care. These services are underpinned by the foundation of skilled birth attendance and a supportive and functional health system (MOPHS, 2010).

Kenya's vision 2030 recognizes that maternal and child health plays an important role in achieving the MDGs and propelling Kenya to a middle income economy and rapidly industrializing state. It envisions a maternal mortality ratio (MMR) of 147/100,000 live births and 90% of the deliveries attended by skilled medical personnel by 2012 (GoK, 2007). It is estimated that 7,700 Kenyan women die each year because of pregnancy-related causes, which translates to approximately 21 women each day or almost one Kenyan woman every hour. Maternal mortality levels in Kenya have remained unacceptably high at 488 per 100,000 live births, with some regions reporting MMRs of over 1000 /100 000 live births (KDHS, 2009) indicating that MDG 5 (Reduce maternal death to 147 per 100,000 by 2015) is doing poorly.

Fortunately, most of these deaths can be prevented with cost-effective health care interventions including ensuring universal access to skilled attendance at childbirth, emergency obstetric care, and postpartum care, preventing unsafe abortion, and widening contraceptive choices. Since almost all maternal mortality is avoidable, the death of a woman during pregnancy or childbirth is a violation of her rights to life and health. A human rights-based approach to maternal mortality reduction calls on governments to provide universal access to skilled delivery care and emergency obstetric care. It also promotes dignity and equity for women within the health-care system (UNFPA, 2004). Previous studies have identified several factors hindering maternal delivery care service utilization especially in developing countries. In Kenya for instance, there has been free maternal services and physical access to institutional delivery services, however, many women do not use them because of inadequate knowledge, socio-cultural factors and demographic factors at individual, household, and community levels that shape their ability to seek health care. Additionally, very few studies have looked at specific issues influencing the choice of place of delivery among pregnant mothers. The information obtained will be useful for policy implementers in decision making at the sub-district, district, regional level and national level in planning, implementing and evaluating various reproductive health interventions to reduce maternal mortality rate and increase delivery at health facility and with the assistance of skilled birth attendants. It is against this backdrop that this study seeks to examine factors associated with place of delivery among recently delivered women in Kenya.

2 RESEARCH METHODOLOGY

The area of study was health facilities within Wareng District of Uasin Gishu County. Wareng District is one of the three districts in Uasin Gishu County. It borders Eldoret West to the North West, Eldoret East to the east, Koibatek to the south east; Kipkelion to the south, Nandi north to the south west and Nandi south to the west. It has a total area of 997.5 km^2 and is administratively divided into two divisions (Kesses and Kapseret), fourteen locations and 23 sub locations. It had a population of 261,073 persons (2009 census) projected to 280,209 by 2011 using a growth rate of 3.3%. The estimated number of children less than one (1) year is 11,629 (4.15% of the entire population). It has 47 health facilities i.e. 2 level four private hospitals, 7 health centres, 27 dispensaries and 11 private clinics. In 38 of the health facilities FANC has been rolled out and ANC services are offered to clients. Child welfare clinics (CWC) are conducted on all weekdays in all the 38 health facilities.

In this study ,the study population was women who had recently given birth (with recent birth defined as a birth within one (1) year as at the time of the study) and were attending child welfare clinics (CWC) (well baby clinics) in various health facilities within Wareng district during the study period. This was a descriptive cross-sectional study. The sampling frame was the master facility list of all health facilities in Wareng district. Using the district's master facility list 30% of the 38 functional health facilities (12 facilities) were picked from each of the two divisions in proportion to the estimated number of children less than one year in each of the divisions. In Kesses division the number of children less than one year was 5,314 while in Kapseret division it was 6,315. One hundred and sixty two (162) respondents were interviewed from Kesses division and 176 from Kapseret division. The number of respondents interviewed per facility was determined in proportion with the well baby clinic attendance of the selected health facilities. Respondents were then selected systematically by dividing the expected number of well baby clinic attendants by the determined sample size for the selected facilities until the predetermined sample size was reached. This paper is an outcome of a study that was conducted in Wareng' district and partly examined the factors that determine the place of delivery among recently delivered women.

3 FINDINGS AND DISCUSSIONS

3.1 MATERNAL HEALTH IN WARENG' DISTRICT

Wareng' district is one of the catchment areas for the Moi Teaching and Referral Hospital within Eldoret town. The district has 46 health facilities of which 41 are functional. In 38 of the functional health facilities FANC has been rolled out and ANC services are offered to clients. According to the Ministry of Health, by 2011, 84% of the pregnant women in the district had attended at least one ANC visit but only 9% delivered in a health facility as compared to 43% nationally. Some of the reasons given for not delivering in a health facility included; some were not aware of the existence of delivery services at the facility, the health facility was too far away, there was no transport to get to the facility and that it cost too much to deliver in a health facility.

3.2 Place of Delivery among Pregnant Mothers

The study found that more than half of the respondents 205(61%) reported to have delivered at the health facility, 28(8%) and 99(29%) at the TBA's home and the respondent's home respectively. Six (2%) delivered on the way to hospital as indicated in figure 1.

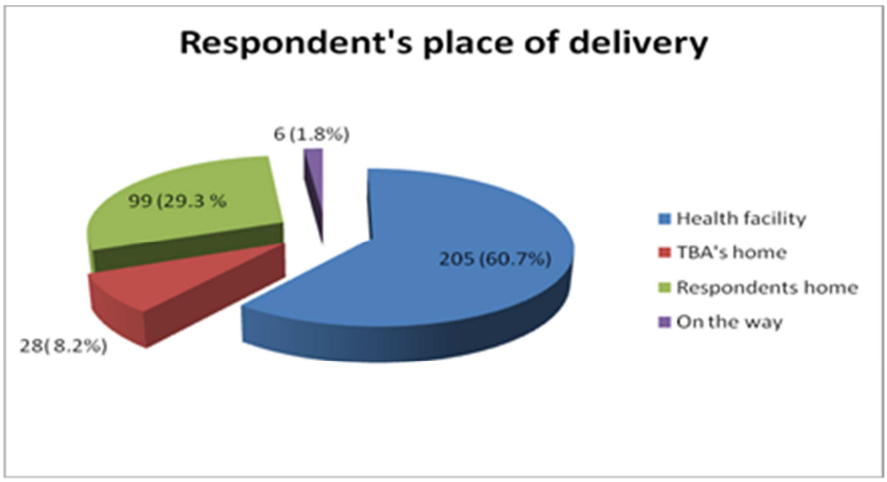


Figure 1: Respondents' place of delivery

One hundred and seventy six (53%) mothers reported that they had planned to deliver at the place where they delivered while one sixty (48%) delivered where they had not planned to deliver.

3.3 Birth Attendant by Place of Delivery

Most of the mothers who reported to have delivered in the health facility were assisted by a nurse/midwife 146 (71.2%) while those who delivered away from the health facility were mainly assisted by a traditional birth attendant (TBA) 71 (53.4%) as shown in figure 1. Overall 204 (60.4%) of the respondents reported that they were assisted by a skilled birth attendant during the delivery of their last child.

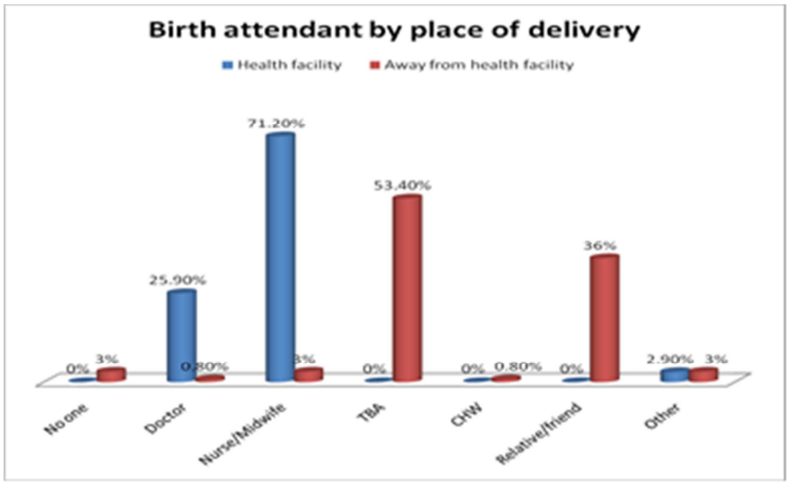


Figure 2: Birth attendant by place of delivery

3.4 Birth Preparedness, Complication Readiness and Utilization of Skilled Attendance

More than half of the respondents 210(62%) were prepared for birth and its complications while 128 (38%) were not prepared for birth and its complications. Amongst those who were prepared for birth and its complications 146 (70%) reported to have used a skilled attendant during their last delivery. The results showed that being prepared for birth and its

complications increases utilization of skilled birth attendants during delivery (p<0.001). Those who were prepared for birth and its complications were almost three times more likely to use a skilled attendant during birth as compared to those who were not prepared (OR; 95% CI: 2.753: 1.746– 4.342).

3.5 CHOICE OF PLACE OF DELIVERY

The study was interested to know the factors that influenced the choice of delivery among pregnant mother in the study. Table 1 below highlights the major factors that influence the choice of place of delivery among pregnant mothers.

Table 1: Factors associated with choice of place of delivery 1

Factor	Place of delivery		χ2 value	P-value
	Facility	Away		
Religion				
Christian	207(62.5)	124(37.5)	0.02	1.000*
Muslim	2(66.7)	1(33.3)		
Others	2(50)	2(50)		
Marital status				
Single	31(50)	31(50)		
Married	170(64.6)	93(35.4)	5.465	0.118*
Widowed	2(66.7)	1(33.3)		
Div/Separated	7(77.8)	2(22.2)		
Level of education				
None	0(0)	3(100)		
Primary	68(43.3)	89(86.7)	64.432	<0.001*
Secondary	91(74)	32(26)		
Tertiary	51(94.4)	3(5.6)		
Source of income				
Business	64 (78)	18 (22)	31.771	<0.001*
Salaried employment	28 (84.8)	5 (15.2)		
Casual employment	22 (51.2)	21 (48.8)		
Farming	42 (43.8)	54 (56.2)		

** Fishers exact chi-square*

Level of education was significantly associated with choice of place of delivery (p<0.001). The proportion of mothers utilizing health facility for delivery increased with increase in level of education. Source of income was also associated with the utilization of health facility for delivery (p<0.001) as indicated in table 1 above.

Table 2: Factors associated with choice of place of delivery 2

Factor	Place of delivery		t-value	p-value
	Facility	Away		
Mean age(yrs)	27.6 (sd 5.8)	26.5(sd 6.1)	1.499	0.135
Average monthly income(Kshs)	7886 (sd8943)	3249(sd 4093)	5.560	<0.001
Parity	3(sd 2)	3(sd 3)	1.686	0.093
No. of times attended ANC	4.76 (sd 2.8)	4.23 (sd 0.7)	2.579	0.010
Age at first ANC attendance	4.12 (sd 1.3)	4.36 (sd 1.4)	1.568	0.118

Average monthly income significantly influenced the choice of place of delivery (p<0.001) as shown in table 2. Those choosing to deliver at the health facility had on average higher income than those choosing to deliver away from the facility. The number of ANC visits made during the last pregnancy also influenced choice of place of delivery (p=0.010) with those making more visits more likely to deliver in the health facility.

Table 3: Predictors of choice of place of delivery

	B	S.E.	p-value	OR	95.0% C.I. for OR	
					Lower	Upper
Education(ref=tertiary)			.000			
Primary	3.440	.801	.000	31.185	6.495	149.743
Secondary	2.108	.808	.009	8.231	1.688	40.125
No. of ANC attended	-.531	.241	.028	.588	.366	.944
Source of income(ref=farming)			.001			
Business	-1.479	.377	.000	.228	.109	.477
Salaried employment	-.459	.651	.480	.632	.176	2.262
Casual employment	-.181	.433	.676	.834	.357	1.951

The multiple logistic regression indicated that, source of income, education level and number of times attended ANC were significant predictors of choice of place of delivery ($p<0.001$ and $p=0.001$ and $p=0.028$) respectively. Those with primary and secondary levels of education were more likely to deliver away from the health facility compared to those with tertiary level of education (OR; 95% CI: 31.185: 6.495–149.743 and 8.231: 1.688–40.125) respectively. Businesswomen, salaried employees and casual workers were less likely to deliver away from the facility compared to farmers as indicated in table1.

3.6 CHOICE OF A SKILLED BIRTH ATTENDANT

Marital status, level of education and source of income contributed to the utilization of a skilled birth attendant ($p=0.025$, $p<0.001$ and $p<0.001$) respectfully. Those who were married reported to have used a skilled birth attendant more than those who were single or separated. Increase in the level of education led to an increase in the use of skilled birth attendant. Having a steady source of income (salaried employment) increased the likelihood of using a skilled birth attendant.

In this study 60.7% of the mothers delivered in a health facility compared to 43% in the KDHS 08/09 and 65% in a study undertaken in Ethiopia and 67% in a study in Uganda. (Hiluf, 2007; Kabakyenga, 2012). This can be explained by the fact that mothers interviewed had all attended at least four ANC visits thus increasing their likelihood of delivering in a health facility (Mpembeni, 2007).All pregnant women should be encouraged to deliver in health facilities as this is an important factor in reducing the health risks to both the mother and the baby.

The results from this study indicate that more pregnant women in the study area deliver in health facilities as compared to the 9% that is recorded by the district health records office. This could be because the district has no district hospital and is part of the catchment of the Moi Teaching and Referral Hospital thus more mothers may prefer to deliver in MTRH. This can be because they feel that in case of any complications they will be attended better at MTRH thus will not require further referral to another facility hence saving on costs. It could also be due to inadequacy in the reporting tools thus making it difficult for the health records officer to capture information on mother's place of delivery.

3.7 ASSISTANCE DURING DELIVERY

In this study 60.4% of the births were assisted by a skilled birth attendant as compared to 44% of births in Kenya (KDHS 08/09) and 33% in Rift Valley Province (NCAPD et al. 2011).This can be explained by the fact that mothers interviewed had made at least four ANC visits and studies have shown that mothers who attend ANC 4 times or more are more likely to be assisted during delivery by a SBA as compared to those who make less visits (Mpembeni, 2007). Also the study was done in a hospital setting which could mean that mothers seeking further services for children are those who received advice during ANC and at delivery on the importance of attending child welfare clinic.

The proportion of women attended by a skilled birth attendant during delivery is one of the targets for measuring MDG 5. Skilled birth attendance is one of the known interventions to reduce maternal mortality hence the need to ensure that every delivery is conducted by a skilled birth attendant. In this study BP/CR was associated with the utilization of SBA at the time of delivery ($p<0.001$). The association was seen in other studies which showed that women who were well prepared for birth

were more likely to choose assistance by SBAs during birth than those who were not well prepared (Agarwal, 2010; Kabakyenga, 2012). BP/CR ensures that pregnant women, their families and the community at large prepares for the birth of the baby and are aware of danger signs in pregnancy hence can promptly identify them and ensure that the woman receives the required care promptly.

3.8 CHOICE OF PLACE OF DELIVERY AND SKILLED BIRTH ATTENDANT

In this study, the level of education was associated with increased likelihood of delivery in a health facility and under the care of a skilled birth attendant. The relationship has also been shown in other studies. (Hounton 2006; Kabakyenga, 2012) This could be because educated women have a better understanding of issues and are able to make their own decisions on matters concerning their health. In this study women who made more ANC visits also tended to deliver in health facilities under the care of a skilled birth attendant as compared to those who made less visits. Studies have shown that mothers who make more visits also deliver in health facilities (Mpembeni, 2007). This could be because of the constant reminder during visits on the importance of delivering in the health facility and being assisted by a skilled birth attendant.

This study also showed that women with a personal source of income were more likely to deliver in a health facility and be assisted during delivery by a skilled birth attendant as compared to those with no income. This might be related to the fact that women with a personal source of income have better power to make their own decision in matters related to their health and the expected expenses (Kunst, 2001; Mpembeni, 2007). Therefore women should be encouraged to make the required number of ANC visits as this increases their chances of delivering under the care of a skilled birth attendant. Also women need to be empowered in terms of education and financially as this will enable them make wise decisions concerning their health and that of their unborn baby. This way all births will be conducted by skilled birth attendants in an enabling environment leading to better maternal and neonatal outcomes.

4 CONCLUSION

From the foregoing discussion, it is evident that most pregnant mothers who attended ANC at least 4 times during their last pregnancy are likely to deliver in hospitals. It is also evident that education, levels of income and physical access to health facilities through walking or using other means of transport are major factors and/or determinants for pregnant women to deliver in a health facility in Wareng' district. This study concludes that for pregnant women to delivery in a health facility, there should be awareness raising on their levels of education on safe deliveries, socio-economic status, and more importantly change their socio-cultural perceptions towards delivering in a health facility as well as use of skilled birth attendants. This study recommends that the health practitioners in the reproductive health departments not only in the study area, but also throughout the country, should work with relevant stakeholders and embrace health education programs to provide more information on ANC through the appropriate communication channels so as to ensure that all women are prepared for safe deliveries.

REFERENCES

[1] Adegoke A, van den Broek N (2009), *Skilled birth attendance-lessons learnt,* BJOG 2009;116 (Suppl. 1):33–40.

[2] Agarwal S *et al*(2010), *Birth Preparedness and Complication Readiness among Slum Women in Indore City, India,* J Health Popul Nutr 2010 Aug; 28 (4): 383-391

[3] Birungi H, Ouma W O (2006), Acceptability *and Sustainability of the WHO Focused Antenatal Care package in Kenya***,** Frontiers in Reproductive Health Program, Population Council, Institute of African Studies, University of Nairobi

[4] Borghi *et al.* (2006), *Mobilising financial resources for maternal health*, Lancet 2006; 368: 1457–65, DOI: 10.1016/S0140-6736(06)69383-5

[5] Campbell O M R and Graham W J (2006), *Strategies for reducing maternal mortality: getting on with what works,* Lancet 2006; 368: 1284–99, DOI: 10.1016/S0140- 6736(06)69381-1

[6] CIDA 2011 cida.gc.ca/acdicida/ACDI-CIDA.nsf/eng/JUD-41183252-2NL

[7] Filippi V, Ronsmans C, Campbell OMR, Graham WJ, Mills A, Borghi J, Koblinsky M, Osrin, D. (2006). Maternal survival-Maternal health in poor countries: the broader context and a call for action.

[8] GoK, (2007), *Kenya vision 2030; A globally competitive and prosperous Kenya.* Ministry of planning, Government printer,

[9] Gwamaka S. M. D. (2012). Utilization and Factors Affecting Delivery in Health Facility among Recent Delivered Women in Nkasi District Master of Public Health Dissertation. Muhimbili University of Health and Allied Sciences.

[10] Hailu M, Gebremariam A, Alemseged F, Deribe K (2011),*Birth Preparedness and Complication Readiness among Pregnant Women in Southern Ethiopia.* PLoS ONE 6(6): e21432. doi:10.1371/journal.pone.0021432

[11] Hiluf, M., Fantahun M., (2007), *Birth Preparedness and Complication Readiness Among Women in Adigrat Town, North Ethiopia.* Ethiop. J. Health Dev. 2007;22(1): 14-20.
[12] JHPIEGO (2004), *Maternal and neonatal health, Monitoring birth preparedness and complication readiness, tools and indicators for maternal and newborn health*, Johns Hopkins, Bloomberg school of Public Health, Center for communication programs, Family Care International; Available at: http://pdf.dec.org/pdf_docs/ PNADA619.pdf
[13] Kabakyenga J K, Ostergren P O, Turyakira E, Pettersson K O, (2012), *Influence of Birth Preparedness, Decision-Making on Location of Birth and Assistance by Skilled Birth Attendants Among Women in South-Western Uganda*. PLoS ONE 7(4): e35747. doi:10.1371/journal.pone.0035747
[14] Kenya National Bureau of Statistics (KNBS) and ICF Macro, Kenya Demographic and Health Survey, 2008/2009.
[15] Kirigia et al. (2011) Effects of maternal mortality on gross domestic product (GDP) in the WHO African region.
[16] KNBS and ICF Macro (2010), *Kenya Demographic and Health Survey 2008–09*. Calverton, Maryland: Kenya National Bureau of Statistics and ICF Macro; National Bureau of Statistics and ICF Macro;
[17] Kowalewski M, Mujinja P, Jahn A: Can mothers afford maternal health care costs? User costs of maternity services in rural Tanzania. Afr J Reprod Health 2002, 6:65–73.
[18] Kunst A, Houweling T (2001), A global picture of poor–rich differences in the utilisation of delivery care; In: De Brouwere V, Van Lerberghe W (Eds) *Safe Motherhood Strategies: A Review of the Evidence.* Stud Health Serv Organ Policy 2001; 17: 297–315
[19] Kyomuhendo GB: Low use of rural Maternity service in Uganda: Impact of women's Status, traditional *Lancet* , 368(9546):1535-1541.
[20] Maureen M, Peter M: Determinants of skilled birth attendant utilization in Afghanistan. Am J Public Health 2008, 98(10):1849–1856.
[21] MOH (2011), *Consolidated district health sector plan; Wareng district 2011/2012 (AOP 7)*, DHMT Wareng.
[22] Mpembeni, *et al.* (2007), *Use pattern of maternal health services and determinants of skilled care during delivery in Southern Tanzania: implications for achievement of MDG-5 targets.* BMC Pregnancy and Childbirth 2007, 7:29. Available at: http://www.biomedcentral.com/1471-2393/7/29
[23] National Coordinating Agency for Population and Development (NCAPD) Kenya, Ministry of Medical Services (MOMS) Kenya, Ministry of Public Health and Sanitation (MOPHS) Kenya, Kenya National Bureau of Statistics (KNBS) Kenya, ICF Macro. 2011. Coordinating Agency for Population and Development, Ministry of Medical Services, Ministry of Public Health and Sanitation, Kenya National Bureau of Statistics (KNBS) Kenya and ICF Macro.
[24] Ochako et al. (2011). Utilization of maternal health services among young women in Kenya: Insights from the Kenya Demographic and Health Survey 2003.
[25] Red Cross Kenya (2011). Maternal Health
[26] United Nations (2007), Millennium Development Goals Report, United Nations, New York, NY, USA
[27] UNPF, (2011). "The State of the World's Midwifery". Retrieved August 2011.
[28] Urassa, D.P, Pembe A.B, Mganga F, (2012), *Birth Preparedness and Complication Readiness Among women in Mpwapwa District, Tanzania.* Tanzania Journal of Health Research 2012; (14) 1 DOI: http://dx.doi.org/10.4314/thrb.v14i1.8
[29] WHO (2009), *Address by Sarah Brown Patron, White Ribbon Alliance for Safe Motherhood*, Geneva, World Health Organization.
[30] WHO: *Trends in Maternal Mortality: 1990 to 2008*. Geneva: WHO, UNICEF, UNFPA & The World Bank; 2008.
[31] World Health Organization (2007), Maternal Mortality: Estimates of WHO, UNICEF, UNFPA, and World Bank, WHO, Geneva, Switzerland.

International Journal of Innovation and Scientific Research
ISSN 2351-8014 Vol. 10 No. 1 Oct. 2014, pp. 59-63

http://www.ijisr.issr-journals.org/

The Influence of Information Technology on the Nigerian Banking Industry

Victor EBIEFIE[1], Kayode AKINYEMI[2], Tinuola Adenike ADEKOJO[3], and Ibrahim Adeniyi IBIYEMI[4]

[1]Department of Economics (Research Student),
University of Lagos- Akoka Lagos, Nigeria

[2]Centre for Continuing Education,
Federal University of Technology, Akure,
PMB 704, Akure Ondo State, Nigeria

[3]Department of Economics (Research Student),
University of Ibadan, Oyo State, Nigeria

[4]Department of Politics and International Relation,
Lead City University Ibadan, Nigeria

ABSTRACT: The main purpose of this research work was to examine the influence of information technology on the Nigerian banking industries. Two research hypotheses were postulated as a guide to this study and a ten (10) items questionnaire was designed, validated and used to get the required information. Simple frequency tabulation and percentages was used to test and answer the research hypothesis. It was found out that introduction of information technology increases service delivery, improve innovation and provide new products /packages, it also help management and managers to influence their corporate planning processes, anticipate problems and take corrective measures. Based on these findings, it was recommended that managers and indeed management should tap from the knowledge available on information technology to improve on their services provision and introduction of new packages to supersede the existing ones. Also, government should improve on infrastructural provision to help enhance the proper take off of information technology development and that orientation awareness programmes should be created by managers, management, government of all level and non governmental organizations to eradicate computer illiteracy.

KEYWORDS: information technology, corporate planning, packages, services rendered and management.

1 BACKGROUND TO THE STUDY

The impact of information technology in our society cannot be overemphasized. Information technology is conceptualized by to be concerned with the various means of generating, processing and transferring information using basically computers and telecommunication gadgets. The increasing needs for information search and subsequent storage would not have been possible without the introduction of information technology through the use of internet. Technological development particularly in the area of telecommunications and information are revolutionizing the way business is done.

In the banking industry, information technology has increased the speed in which financial dealings can be easily assessed and has also created the link between the various banking institutions in the country. The first giant step in electronic revolution was the computerization of financial institutions. Once, we often hear of e-banking, e-commerce and even the used of Automated Teller Machine (ATM), this and many more are the after effect of the introduction of information technology in the economy.

In Nigeria, the introduction of these services comes as a result of the financial liberalization policy of the Federal Government which comes as a tool for actualizing the goals and the policy thrust of the National Economic Empowerment and Development Strategy (NEEDS) as well as the Millennium Development Goals(MDGs) of International Monetary Fund (IMF) and world bank. Information technology consist of the convergence or merging of various aspects of electronic technology such as the use of microcomputers for the processing and storage of information, the application of electronic spreadsheet and business modeling programmes, word processing for preparing standard reports and other correspondents at high speed, and electronic mails (e-mail) for transmitting message from one location to other without the use of papers.

In line with global trends, businesses in Nigeria too have been undergoing tremendous changes since achieving independent in 1960. The first step in the evolutionary process was the gradual deregulation of the financial sector, which commenced in the 1970's. Since Nigeria banking industry is model towards the British banking industry, the various services practiced by the British is adopted into the Nigerian banking system. The introduction of Automated Teller Machine (ATM) can be considered as the first and the most visible piece of evidence of the emerging electronic banking in Nigeria. Today, the use of computers has revolutionized the way information is generated, collected, processed, stored, retrieved and disseminated. One way of doing this is through the effective utilization of computerized database or electronic resources like CD- ROM and internet.

For the purpose of this study therefore, the researcher will focus mainly on the influence of information technology on banking services control or improvement and effect of information technology on corporate planning.

2 LITERATURE REVIEW

This segment is aimed at reviewing related literature and views espoused by some authors on the impact of information technology in the Nigerian Banking Industry and will be done under the following subsections; the influence of information technology on banks service provision and impact of information technology on banks corporate planning.

2.1 THE INFLUENCE OF INFORMATION TECHNOLOGY ON BANKS SERVICE PROVISIONS

The banking industry is today the fastest growing industry in the country. According to [8], the introduction of information technology which came as a positive fallout from liberalization programmes of the Federal Government have brought about growth in the number of banks thereby creating competition in the industry forcing many banks to adopt various strategies that will enable them consolidate their existence. Again, he [8] further buttresses his point by opining that the trend of competition, the banking industry witnesses a rapid transformation due mainly to improvement in service delivery.

Furthermore, in line with [8]'s assertion, [2], opined that the introduction of new products and services in the market was another positive spill over of the increased competition in the banking industry. Some of these new products are technology-based. A lot of them are existing products repackaged, branded and aggressively marketed and promoted. But in the process, value is added, the consumers now has greater choice and now feel more satisfied. Some of the innovation and services rendered as a result of information technology are Automated Teller Machine (ATM), magnetic link character recognition; electronic funds transfer (EFT), SQL Image machine, home and office banking, electronic card products, electronic money transfer services. Other packages rendered after the advent of liberalization includes provision for the payment of fee based product such as VAT, school fees, National Examination Council fee, West African Examination Council fee, Unified Tertiary Matriculation Examination fee, Electricity bill, water rate, Telephone bill, custom duties, importers fee, Property development tax, are now paid in the banks; provision of business advisory services, introduction of business development unit, subsidiaries services etc [16].

It is noteworthy that apart from the fact that these services continue to provide succor to the generality of people, it also serves as avenues to generate the much added foreign exchange to the economy. Therefore, the tremendous patronage which these services continued to enjoy in the country's financial sector makes other banks to plan to put in place money transfer services in future, so we can conclude that information technology has made banking easier and service rendered effective and efficient.

2.2 IMPACT OF INFORMATION TECHNOLOGY ON BANKS CORPORATE PLANNING

Information technology has impacted positively on organizational planning such as banks corporate planning, this is evidence in the work of [5], who posit that information technology helps managers to determine and interpret what each segment of the organization must do so that every function will be integrated with all related activities and all duplications

and gaps avoided as far as possible through appropriate planning. It also helps to provide clear cut policies for guidance and coordination of personnel who are accountable for day to day executive decision. This implies that information technology through its logical operations and interpretation helps managers to decide before time, what each part of an organization is to do at a particular time and how best to perform such tasks efficiently in order to avoid wastage of time and resources.

Also, in consonant with Brady ideas, [13] observed that the application of information technology on organizational corporate planning helps managers to anticipate problems and take corrective action before they become menace to the organizations operations and to coordinate all significant activities so that personnel, facilities and materials can be schedule. This implies that with information technology, banks and business organizations can adopt the best procedures to prevail in the future, which will affect the company's products, processes and market.

2.3 METHODOLOGY

The research adopted design method for its findings. To access the influence of information technology on banks, the following research questions was drawn to serve as a guide to the research work: (i) Does information technology influences service delivery in the Nigerian banking industry? (ii) To what extend does information technology influences corporate planning process in the Nigerian banking industry? The population of study was twenty (20) staff randomly selected from five (5) banks and a ten(10) item closed –ended questionnaire was drawn to reflect the research question propose for this work. To this end, purposive sampling was adopted to select the actual sample of the study because the researcher concentrated on one segment of the population for ease of data collection. The instrument used for the collection of data was a ten items close ended questionnaire that reflects on the research questions. The response ranges from a "yes" or "no" items to determine the respondents disposition. The questionnaire was distributed directly to the respondents and supervises then collected. The data from the respondents was collated, collected, scored, tabulated and analyzed according to the set research questions. A simple percentage analysis was used to analyzed and interpret the data.

3 RESULTS

The result from the analysis of the data shown on the table below shows that 90% of workers in the bank agree that banking industry is today the fastest growing industry while10% disagree. Also, 75% of the respondents agree that the introduction of information technology has improved service delivery while 25% disagree. Consequently, 75% of the respondents agree that the introduction of information technology has provided various packages in the bank while 25% disagree. The tabular representation of the questionnaire items and the respondent's disposition is on the table below:

S/N	Items in the questionnaire	views	Frequency	Percentages
1	The banking industry is today the fastest growing industry	Yes no	18 2	90% 10%
2	The introduction of Information technology has improve services delivery in banks	Yes no	15 5	75% 25%
3	The introduction of information technology has provided various packages in the banking industries	Yes no	15 5	75% 25%
4	The advent of information has led to the introduction of new product	Yes no	13 7	65% 35%
5	As a worker in a bank, introduction of Information technology has increases competition and speed up jobs completion among various department	Yes no	19 1	95% 5%
6	Information technology helps managers determine what every segment of the bank must do	Yes no	13 7	65% 35%
7	Information technology introduction helps managers coordinate activities of workers	Yes no	12 8	60% 40%
8	Information technology help managers anticipate problems and take corrective measures	Yes no	14 6	70% 30%
9	Information technology helps management predict conditions or events that are expected to prevail in the future	Yes no	16 4	80% 20%
10	Information technology does not influence banks corporate planning	Yes no	5 15	25% 75%

4 DISCUSSION

The analysis from the tables above shows that 65% of the respondents agrees that the advent of information technology has led to the introduction of new products while 35% of them disagreed. Conversely, 95% of the respondents agree that information technology has increases competition and speed up jobs completion among various departments in the banks while 5% says no or disagree. Also, the responses shows that 60% of the respondent agrees that introduction of information technology helps manager coordinate activities of workers while 40% disagree. Furthermore, 70% of the respondents agree that information technology help managers anticipate problems and take corrective measures while 30%of them disagreed. Similarly, 80% of the respondents agree that information technology help management predicts conditions or events that are expected to prevail in the future while 20% opined that information technology does not let the management established such an agreement. Also, 25% of the respondents agree that information technology does not influence bank's corporate planning while 75% says no and assert that banks corporate planning is greatly influence by information technology introduction. Fromm the foregoing analysis, it can be inferred that introduction of information technology increases service delivery, provide new packages, increases competition and speed up jobs completion among various department in the bank and promote growth in the banking industry, this corroborated [8], [5], [13]and [2]propositions.

5 CONCLUSION

The findings of the study showed that Nigeria's banking industry is one of the fastest growing industry and the introduction of information technology increases service delivery and bank's corporate planning processes. In Nigeria, there are factors impeding the development and utilization of information technology, such as illiteracy, low infrastructural facilities, low standard of living, poor power supply, corruption, lack of awareness and low patronage etc. Improvement on this factors, will lead to increase development and utilization of information technology and communication gadgets because a country that claimed to be globalizing must be able to provide basic infrastructure and must eradicate illiteracy.

From the above conclusion, it was recommended firstly that the government Federal, State and Local should endeavour as a matter of fact improve on infrastructural provision to help enhance proper take off of information technology. Secondly, managers and indeed management should tap from the knowledge available on information technology to improve on their services provision and introduction of new packages. Thirdly, the government, individuals and NGO'S should in as much as possible reduces the rate of illiteracy on the usage of computer by providing palliative and conducive measures environment for the masses to make computer studies compulsory to eradicate illiteracy. Also our examination bodies and curriculum expert should introduce computer in primary, secondary and tertiary institutions to reduce the illiteracy rate and to inculcate the habit of using computer. Finally, computer awareness and orientation programmes should be created by both tiers of government and even management staff to enforce information technology usage in our society.

REFERENCES

[1] Anderson, R.G (1989). Data Processing. Vol.1 & 2 Britain: Pitman Publishing.

[2] Anyanwu, J.(2005) An Introduction to Microeconomics: Benin: University Press.

[3] Berger, A. N (2003). The Economic Effects of Technological Progress from the banking industry, Journal of Money, Credit, Banking. 35(2) 141-176.

[4] Brynjolfeson, E; and Hitt, L. M (2000), Beyond computation: Information Technology, Organizational Transformation and Business Performance, "Journal of Economic Perspectives" 14(4), 23-48

[5] Brady, R (1992). Information Technology in Business. Leckhampton: Stanley Thornes Publishers Ltd.

[6] Economides, N; and Salop, S.(1992). Competition and Integration among complements, and Network Market Structure, The Journal of Industrial Economics, xi (1), 105-123

[7] Hagg, S; Cummings, M; and Mccubery, D. J (2002). Managing Information System for the Information Age. (3rd Ed). Boston: McGraw – Hill Irwin.

[8] Iganiga, B. O (2000). The Structure of the Nigerian Financial System. Lagos: Amfitop Publishers.

[9] Inyang, B. J (2004). Corporate Planning and Policy: Concepts and Application. Calabar: Merb Publisher.

[10] Farell, J; and Saloner, G. (1985). Standardization, Compatibility and Innovation, RAND Journal of Economies, 16(1), 70-83.

[11] Isangedighi, A. J; Joshua, M.T; Asim, A. E AND Ekuri, E.E (2004). Fundamentals of Research And Statistics in Education and social Science. Calabar: University of Calabar press.

[12] Jaja, S.A; and Zeb-Obipi, S. (2005). Management Elements and Theories. Port Harcourt: Pearl Publishers.

[13] Keen, P.G.W (1991). Shaping the Future: Design through Information Technology. Harvard Business School Press.

[14] Obi, E.C (2001). Management: Basic Theories and Processes. Aba: Matik Education Books.
[15] O' Brien, J.A (2003). Introduction to Information Systems: Essential for the e-business Enterprises Boston: McGraw Hill Irvin
[16] Union Bank of Nigeria Annual General Report booklet (2000)

International Journal of Innovation and Scientific Research
ISSN 2351-8014 Vol. 10 No. 1 Oct. 2014, pp. 64-70

http://www.ijisr.issr-journals.org/

Review On Fingerprint Recognition: Minutiae Extraction and Matching Technique

Gurpreet Singh[1] and Vinod Kumar[2]

[1]CSE Department,
Guru Kashi University,
Talwandi Sabo, Punjab, India

[2]AP, CSE Department,
Guru Kashi University,
Talwandi Sabo, Punjab, India

ABSTRACT: The recent advancement in fingerprint identification and authentication have encouraged many people to conduct researches in Fingerprint Identification and Authentication (AFIA) as fingerprint identification is becoming a new domain for user authentication. Fingerprint classification plays an important role in large organizations where fingerprint identification systems are deployed. Fingerprint identification is very helpful in authentication when two fingerprints do not match and also it reduces the time used for identification. This paper presents a thorough review on the existing classification approaches that have applied to fingerprint recognition problems. The explanation in this paper covers the various evaluation parameters used by AFIS classification approaches.

KEYWORDS: Fingerprint Recognition, Biometrics, Classification Approaches, Evaluation.

1 INTRODUCTION

Biometrics is method of identifying a human being based on a physiological or behavioral characteristic. Biometric system includes face, fingerprints, hand geometry, handwriting, iris, gait, palm print, vein pattern, and voice. These technologies have become the foundation of highly secure identification and verification systems. The increase in factors like vulnerability to security and transaction process, then the need for secure identification and individual verification also increases. Biometric-based systems provide secure financial transactions and data confidentiality. Biometrics can be implemented in local, governmental, military and commercial applications also. Network security, ID proof, E-banking, Money transactions, retail sales and social services are already in benefit due to biometric technology. In biometric systems, iris and fingerprint technologies are widely accepted as they have reliability and possess uniqueness. Identification of fingerprint is most popular due to its unique characteristics formed out of ridges and furrows. Fingerprint classification is categorizing fingerprint database in which the input fingerprint is first processed and then classified into set of same class. A database usually contains a number of fingerprints with different features. The identification of input fingerprint inside a database becomes a cumbersome process. Therefore classification of fingerprint helps to increase the throughput of identification and authentication process. The fingerprints are classified among the set of classes of predefined categories in database.

2 FINGERPRINT CLASSIFICATION TECHNIQUES

Fingerprint classification identifies and categorizes various fingerprints. Various unique identification points such as e.g. island, ridge end, core and delta exists in a fingerprint.

Corresponding Author: Gurpreet Singh

A typical fingerprint classification is categories into the following six classes: whorl, right loop, left loop, arch, twin loop, and tented arch [3] . It also contains one or more regions where the ridge lines make different shapes (curvature, termination, etc.). These regions are called singularities or singular regions may be classified into three typologies: loop, delta, and whorl.

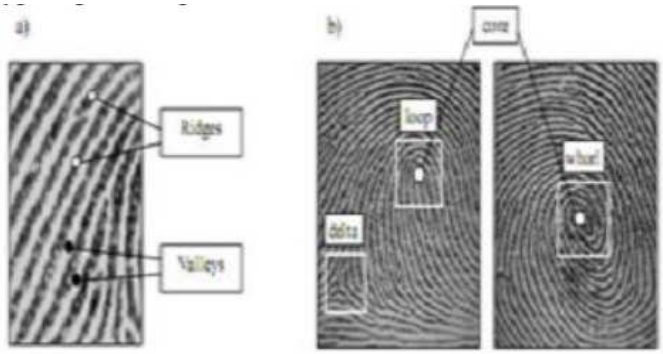


Fig. 1: Structure of fingerprint.
a) Ridges and valleys on a fingerprint image
b) Singular regions (white boxes) and core points (small circles) in fingerprint images.

3 STRUCTURE OF FINGERPRINT RECOGNITION

Fingerprint based recognition system can operate in either identification or verification mode. Fingerprint identification refers to one-to-many match, where input Fingerprint image of an individual is matched with other templates present in database. It is used to confirm the identity of a person. Fingerprint recognition system basically follows four steps that are image Acquisition/Enrollment, Image Enhancement/Preprocessing, Feature extraction and Matching/Authentication.

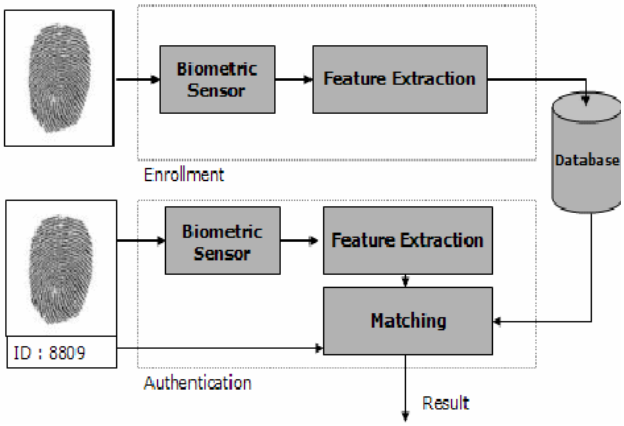


Fig. 2. Block diagram of Fingerprint recognition system

The various steps of fingerprint recognition are:
a) Fingerprint Acquisition/ Enrollment
b) Fingerprint Image Enhancement
c) Minutiae Extraction
d) Minutiae Matching
e) Fingerprint Classification/Authentication

3.1 IMAGE ACQUISITION

In this part, image of Fingerprint is first acquired with the help of sensors. Captured images may be blurred or may contain noises, which Detroit the quality of an image and affect the performance of Fingerprint recognition system. The fingerprint image acquired may vary by location of finger placed, direction and stretching degree.

3.2 PRE-PROCESSING

After acquiring the image through sensors, preprocessing or image enhancement is done on the image. Sometimes image may contain noise while enrollment process, noise can be remove with help of filters utilized in processing/enhancement part of the processing. Sometimes there is a need of images normalization.

3.3 FEATURE EXTRACTION

The third process is the pre-processing feature extraction process. In feature extraction phase, features of image are extracted such as Ridges, valleys, minutiae and singular points (loops, core, whorls and delta). These features are helpful for unique identification or verification of an individual. The features obtained from captured images are stored in database for further process of matching.

3.4 MATCHING

Next phase is matching process after feature extraction. Feature matching phase identifies similarities between current fingerprint templates and previously stored template. Input images provided to the system are matched with previously stored templates present in database. Matching is entirely dependent on whether the system Performs identification or verification. If it performs identification i.e. one-to-many matching approach is used, where fingerprint of an individual matches with all available templates in database otherwise one-to-one match is done for verification, where input image of a person is matched with only one template.

4 RELATED WORK

This section gives overview of various fingerprint classification methods. The following parameters are used for differentiating between various methods: Orientation map, singular points, Ridgeline flow and multiple parameters based methods etc. [5]

4.1 RIDGELINE FLOW

The direction of flow of the ridges is an important identification characteristic. It is not always easy to extract ridges from noisy images. It is usually represented as a set of curves parallel to the ridge lines as in figure 3; these curves do not necessarily coincide with the fingerprint ridges and valleys.

Fig. 3. Tracing of Ridges [6]

Andrew has described a classification technique based on the characteristics of the ridges. Two new classifiers have been presented by Andrew. The first classification described is by using Hidden Markov Model (HMM). In fingerprint image

the direction changes slowly hence HMM is suitable here for classification. The second classification method describes named Decision Trees.

Features are extracted from input images and then classified using a decision tree approach. Neeta and Dinesh have presented an approach for classification based on ridge flow. To reduce computation HRC is calculated based on the values of the slope within the block. After locating HRC, Ridge tracing is performed. Hye-Wuk and Lee [9] have published classification approach using HMM. Features are extracted from orientation field by locating the direction of the extracted ridge which is then taken as input for HMM for designing fingerprint models.

4.2 ORIENTATION MAP

Orientation map is also an important phase in image mapping. It describes the orientation of the ridge-valley structure in an image.

Fig. 4. Smoothed Orientation Field [6]

Jiao Jiao Hu, Mei Xie has introduced a classification technique using genetic algorithm and neural network. Orientation field is given as input to genetic programming process. Extracted features are given as input to neural network algorithm like back propagation and Support Vector Machine (SVM) for classification.

4.3 CORE AND DELTA POINTS

In fingerprint image mainly loops and whorls points are classified. These points are also called as core and delta. The delta is that point on a ridge front of and near to the center of the divergence of the type lines. The core is present when there is at least one ridge that enters from one side and then curves back, leaving the fingerprint on the same side as shown in figure 5.

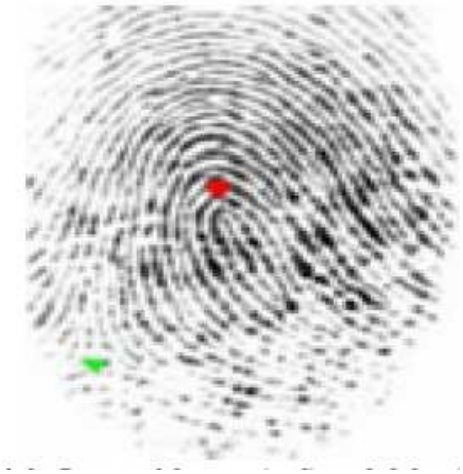


Fig. 5. Right Loop with core (red) and delta (green) [6]

M.Usman, Assia Khanam has suggested way of locating core point form the region of interest. Msizia and Ntsika have preprocessed image and a novel way of locating core and delta points.

4.4 REMOVAL OF SPURIOUS SINGULAR POINTS

Accuracy of a system increases if singular points are reduced, if the image is of poor quality as shown in figure 6.

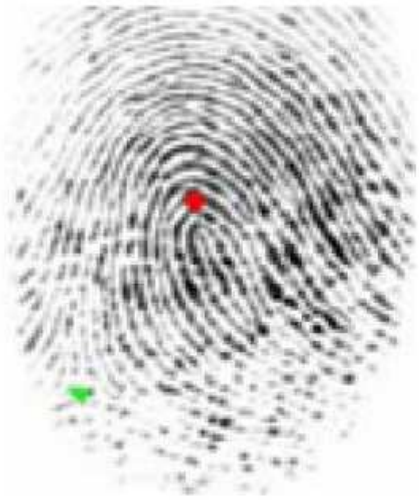


Fig. 6. Spurious Singular Points (yellow) [6]

N.Johal et al. presents an algorithm to tune orientation map by finding the direction of gravity. Blocks are found whose slope is in the range of 0 to pi/2 to obtain singular points.

4.5 TRANSFORMS

In Fourier Transform the basis function is sine wave whereas wavelet transform is based on small waves called wavelets of different frequency. Fourier Transform gives only frequency information, where time information is lost in transformation process. M.Mokji et.al has used Haar Wavelet transform (HWT) is used for directional image. H.Neto et.al has proposed Discrete Wavelet Transform (DWT), which is used to feature extraction and neural network does the classification process. Different classification techniques have been proposed by several authors in the field of Artificial Neural Networks. ANN is used to give higher accuracy and learning rate. It is basically used for classification purpose in image processing. The fingerprints have been traditionally classified into categories based on information in the global patterns of ridges. Classifying fingerprints into groups reduces the need to matching an input fingerprint with an entire fingerprint database during identification and recognition process and thus reduce computing requirements.

Two classifiers, namely, K Means and 3-nearest neighbor, were used to classifier the extracted features into four different fingerprint types, namely, Arch, Left Loop, Right Loop, or Whorl. The method achieved high classification accuracy and was quick in producing the results. Tan, X., Bhanu, B., Lin, Y, used a feature-learning algorithm using Genetic Programming (GP) to learn and features that are evolved in image processing operations for fingerprint classification. The primitive operators used were simple and easy to compute. These operators were separated into computation operators and feature generation operators. This classification method can be found to be effective over quality fingerprint images.

Maheswari and Chandra, presents fingerprint classification system using Fuzzy Artificial Neural Network. The fingerprint features like singular points, their positions and directions of core and delta points are obtained from a binarized fingerprint image captured from sensors. The method used for producing good classification results using fuzzy neural networks. An algorithm that used two machine learning algorithms was presented by. They used Support Vector Machine (SVM) and Recursive Neural Networks (RNNs) during classification. The RNNs are trained on a structured representation of the fingerprint image and were also used to extract a set of distributed features integrated in the SVMs. SVMs are

combined with a error correcting coding scheme, which exploits information contained in ambiguous fingerprint images. Kant and Nath presented an approach that improves the speed, efficiency of fingerprint matching algorithm during the time of enrollment itself. For this reason, the hard points of fingerprints like delta and core were used and the classifiers are grouped into any of the six other classes.

According to Wei L, singularities detection can be used to increase the accuracy of classification algorithms and proposed a method for searching singularities using delta field Poincare index. Used these singularities, a rapid rule-based classification algorithm was proposed to classify the fingerprint into 5 classes, arch, tented arch, left loop, right loop, whorl and double loop. The detection algorithm searches the direction field which has the larger direction changes to get the singularities. Wei , Yong hui and Fang has proposed a structure based approach which is based on curve features of ridgelines, used to classify the fingerprints with other fingerprint images available in database. The algorithm mainly uses the direction to classify the ridgelines in fingerprint. In this method, the classifier firstly calculates the total directional change of ridgelines; here they are grouped according to their shape. The grouped ridgelines along with the extracted singular points are used to classify the fingerprints into arch, tented arch, left loop, right loop, whorl and double loop classes.

Combining singular points and orientation image information for fingerprint classification was proposed by. Algorithm says that singular points and constrained nonlinear orientation features and the final feature vector comprised of the coefficients of the orientation model and the singularity information. This resulted in compact feature vector which is used as an input to a Support Vector Machine (SVM) classifier to perform the image classification. Maheswari and Chandra has used low dimensional features obtained from feedback based line detector to classify fingerprints into five classes (arch, left loop, right loop, whorl, and tented arch). The line detector was a cooperative dynamic system that gives oriented lines and preserves multiple orientations at points where differently oriented lines meet. The feature extraction was based on characterizing the distribution of orientations around the fingerprint.

Three types of classifiers are used namely, support vector machines, nearest neighbor classifier, and neural network. An algorithm that used two machine learning algorithms was presented by. They used Support Vector Machine (SVM) and Recursive Neural Networks (RNNs) during classification. The RNNs are trained on a structured representation of the fingerprint image and were also used to extract a set of distributed features integrated in the SVMs. SVMs are combined with an error correcting coding scheme, which exploits information contained in ambiguous fingerprint images.

5 CONCLUSIONS

We can say that fingerprint recognition is very reliable recognition system. It classified the fingerprints into five classes (arch, tented arch, left loop, right loop and whorl). Fingerprint recognition has various phases as image enrollment, preprocessing or enhancement, feature extraction and matching. The singular points are quite frequently features for classification. In a similar fashion, the rule based and neural network classifiers have been frequently used. Recently the use of SVM and machine learning classifiers has been proposed. Based on the overall survey we can say that Classification is normally based on the ridges, local feature (i.e. Minutiae) and global features (i.e. Singular points). The various methods and issues in fingerprint recognition are discussed in this paper. There is need of efficient method for fingerprint recognition system which will reduce computational time and increase efficiency.

REFERENCES

[1] www.biometrics.org.

[2] X. Z. Honglong Chang and B. Li, "Application of bp neural network in the fingerprint identification," in *International Conference on Computer Technology and Science*, 2012.

[3] Z. Wang and Wang, "Fingerprint classification by directional fields," in *Fourth IEEE International Conference on Multimodal Interfaces*.

[4] A. R. A. K. Jain, P. J. Flynn, "Handbook of biometrics," in *Springer Science and Business Media*, 2008, pp. 978–387.

[5] M. Yao and Pontil, "A new machine learning approach to fingerprint classification," in *7th Congress of the Italian Association for Artificial Intelligence*, vol. 12, 2005, pp. 57–63.

[6] D. A. P. Rekha Vig, "Review of fingerprint classification methods based on algorithmic flow," in *Journal of Biometrics, Bio info*, 2011.

[7] A. Senior, "A combination fingerprint classifier," in *IEEE International Conference on Pattern Analysis and Machine Intelligence*, vol. 4, 2001, pp. 1165– 1174.

[8] B. G. Neeta Nain, Bhavitavya Bhadviya and D. Kumar, "A fast fingerprint classification algorithm by tracing ridge-flow patterns," in *IEEE International Conference on Signal Image Technology and Internet based Systems*, 2008, pp. 235–238.

[9] J.-H. L. Hye-Wuk Jung, "Fingerprint classification using stochastic approach of ridge direction information," in *IEEE, International Conference on Fuzzy Systems*, 2009, pp. 169 –174.

[10] M. X. Jiao Jiao Hu, "Fingerprint classification based on genetic programming," in *IEEE International Conference on Computer Engineering and Technology*, vol. 6, August 2010, pp. 193–196.

[11] S. N. M.Usman Akram, Anam Tariq and A. Khanam, "Core point detection using improved segmentation and orientation," in *IEEE International Conference on Computer systems and Applications*, December 2004, pp. 637–644.

[12] F. V. N. Ishamel S. Msizia, Brain Leke-Betechuoh and N. Msimang, "A fingerprint pattern classification approach based on the coordinate geometry of singularities," in *IEEE International Conference on Systems, Man, and Cybernetics*, USA, 2009, pp. 510 – 517.

[13] B. B. Tan X. and Lin, "Learning features for fingerprint classification," in *AVBPA 2003*, vol. 62, April 2005, pp. 318–326.

International Journal of Innovation and Scientific Research
ISSN 2351-8014 Vol. 10 No. 1 Oct. 2014, pp. 71-76

http://www.ijisr.issr-journals.org/

Anasarque fœtale et anémie provoquées par le Parvovirus B19: A propos d'un cas avec revue de la littérature

[Hydrops Fetalis and anemia caused by Parvovirus B19 in Pregnancy: A case report with review of the literature]

Khalid Guelzim[1], Youssef Benabdejlil[1], Alain Talbot[2], Jaouad Kouach[1], Driss Moussaoui[1], and Mohammed Dehayni[1]

[1]Service de Gynécologie-Obstétrique, Hôpital Militaire d'Instruction Mohammed V- Rabat, Maroc

[2]Pôle Mère-enfant, Hôpital Jacques Monod, Le Havre, France

ABSTRACT: The authors report a case of hydrops fetalis discovered incidentally during a morphological ultrasound performed at 23 weeks of gestation in a 31 years old primigravida woman. The etiology was an infection by parvovirus B19. What is special about our observation is firstly that fetal infection by parvovirus B19 in pregnancy is rare and responsible of fetal anemia. Besides, thanks to a multidisciplinary care including obstetricians, neonatologists, anesthetists and after two transfusions, our patient was conducted pregnancy up to 34 weeks of gestation and give birth by caesarean section of a newborn female.

KEYWORDS: Parvovirus B19, Intrauterine infection, fetal anemia, Intrauterine transfusion.

RESUME: Les auteurs rapportent un cas d'anasarque fœtal de découverte fortuite lors d'une échographie morphologique réalisée à 23 semaines d'aménorrhée chez une primipare de 31 ans dont l'étiologie était une infection par le Parvovirus B19. Ce qui fait la particularité de notre observation, c'est tout d'abord que l'infection fœtale par le parvovirus B19 reste une infection rare responsable d'une anémie fœtale. De plus grâce à une prise en charge multidisciplinaire adéquate entre obstétriciens, néonatologues, réanimateurs et après deux transfusions, notre patiente a pu mener sa grossesse jusqu'à 34 semaines d'aménorrhée et donner naissance par césarienne d'un nouveau né de sexe féminin.

MOTS-CLEFS: Parvovirus B19, Infection intra-utérine, anémie fœtale, Transfusion intra-utérine.

INTRODUCTION

Les infections à Parvovirus B19, bien que souvent asymptomatiques chez la femme enceinte, peuvent provoquer chez le fœtus dans 1 à 10% des cas une anémie et une anasarque, voir entraîner la mort in utéro. Le diagnostic virologique de cette infection est important à effectuer, car il s'agit d'une cause éventuellement curable d'anasarque foeto-placentaire. Nous rapportant un cas d'anasarque fœtal de découverte fortuite lors d'une échographie morphologique réalisée à 23 semaines d'aménorrhée dont l'étiologie était une infection par le Parvovirus B19. Après avoir exposé notre observation, nous effectuerons une revue de la littérature concernant l'infection par le parvovirus B19 au cours de la grossesse.

Corresponding Author: Youssef Benabdejlil

OBSERVATION

Il s'agissait d'une primigeste âgée de 31 ans, sans antécédents pathologiques, sans moyen contraceptif, mariée depuis six mois adressée à notre formation de la part de son médecin généraliste pour une échographie obstétricale morphologique du deuxième trimestre à 23 SA. Cette dernière montrait une grossesse monofoetale évolutive, une biométrie correspondant à l'âge gestationnel théorique avec un tableau anasarque fœtale (épanchement abdominal et pleural de faible abondance), une hyperéchogénicité intestinale et une hépatomégalie. L'exploration du cœur retrouvait une cardiomégalie avec une bonne contractilité surtout au niveau du ventricule gauche. Le ventricule droit était un peu moins dynamique avec une fuite tricuspide peu importante. Les vélocités artérielles doppler étaient normales, voir légèrement augmentées au niveau aortique et pulmonaire. Le reste de la morphologie fœtale semblait normale. Le placenta était épaissi. Le liquide amniotique était en quantité normale. La mesure Doppler de la vitesse systolique dans les artères cérébrales moyennes fœtales objectivait une accélération du flux systolique (70cm/s). Tous ces éléments orientaient indirectement vers une anémie fœtale. Jusque là, le suivi de la grossesse de la patiente était sans particularité et le bilan prénatal normal. La patiente était de groupe sanguin B+, la sérologie toxoplasmose était négative contrôlée mensuellement et la sérologie rubéole négative. Devant ce résultat échographique, un bilan étiologique d'anémie foetale a été demandé comportant la recherche d'agglutinines irrégulières revenue négative, un test de Kleihauer négatif et des sérologies virales (Parvovirus B19, Cytomégalovirus, Epsteinbarr virus). La sérologie Parvovirus B19 est revenue positive : IgM :1,54 et IgG : 6,79. Le diagnostique d'infection fœtale avec par Parvovitus B19 avec anasarque et anémie était posé. Après une tocolyse par Tractocile* pendant 24 heures, une transfusion in utéro à été réalisée au terme de 24 SA. La transfusion a confirmé l'anémie avec un taux d'hémoglobine particulièrement bas à 3 grammes pour 100 ml. La transfusion in utéro a permit de remonter le taux d'hémoglobine à 10 grammes. La surveillance du fœtus a montré dans un premier temps une quasi normalisation des signes d'anémie en étudiant la vitesse circulatoire au niveau de l'artère cérébrale (diminution des vitesses cérébrales). Par la suite une réaggravation des vitesses circulatoires était observée avec réapparition d'une anémie sévère. Une progression des signes de foetopathie était constaté, à savoir apparition d'une hépatomégalie de très grande taille, d'une placentomégalie énorme ainsi que d'un oligoamnios. Après 10 jours, une nouvelle transfusion in utéro a été réalisée confirmant une anémie profonde à 5g d'hémoglobine. L'échographie foetale faite à 32 SA après les deux transfusions montrait la persistance de l'ascite et de l'hépatomégalie, le fœtus était en présentation du siège, dos antérieur. Il n'y avait pas d'épanchement péricardique ni pleural. La cardiomégalie restait stable avec une bonne contractilité ventriculaire et sans signe évident de défaillance cardiaque. Une corticothérapie par Béthamétasone pendant 48 heures était administrée. Une surveillance échographique ainsi que du rythme cardiaque fœtal par cardiotocographe était faite deux fois par semaines. A 34 semaines, une césarienne était réalisée permettant l'extraction podale d'un nouveau de sexe féminin Apgar 10/10, poids de naissance 2300 g réceptionné par le pédiatre et transferé en néonatologie. Le bilan biologique chez le nouveau avait objectivé une hémoglobine à 9g/dl . Il a été transfusé avec une hémoglobine de contrôle à 13 g/dl. Après un séjour d'une semaine en néonatologie, le nouveau né était bien portant et a été remis à la mère.

DISCUSSION

Le parvovirus B19 appartient à la famille des Parvoviridae, sous-famille des Parvovirinae, genre Erythro-virus. Il s'agit d'un virus nu, comportant une capside icosaédrique, et dont le génome est de type ADN monocaténaire linéaire. Son génome code pour 2 protéines structurales VP1 et VP2 et une protéine non structurelle NS1. VP1 et 2 participent à la formation de la capside et NS1 joue un rôle dans la réplication de l'ADN viral. La transmission virale s'effectue par voie aérienne. Elle a également été décrite en cas de transplantation d'organes ou de transfusion de produits sanguins labiles. Après pénétration par voie respiratoire, le virus atteint ses cellules cibles ; les précurseurs érythroïdes. Durant la grossesse, le virus peut infecter le fœtus par voie hématogène transplacentaire. Lors d'une primo-infection, la virémie est très élevée et les particules virales sont au contact des cellules du syncitiotrophoblaste dans les espaces intervilleux. Le virus va être internalisé dans ces cellules comme en témoigne l'expression à leur surface de l'antigène P. Après ce passage à travers la première couche cellulaire de la barrière placentaire, les particules virales vont gagner les capillaires veineux fœtaux. À ce niveau, elles vont pouvoir infecter leurs cellules cibles : les érythroblastes circulants. Ceux-ci vont par la suite être disséminés dans l'organisme fœtal et pourront être mis en évidence dans le foie et la moelle osseuse principalement mais aussi dans tous les tissus fœtaux. La déplétion des cellules érythroïdes entraîne une anémie fœtale parfois sévère. Cependant, les autres lignées peuvent être atteintes avec pour conséquence une pancytopénie. Cette anémie est en cause dans la survenue d'une insuffisance cardiaque fonctionnelle par le biais d'une augmentation de la perméabilité vasculaire avec fuite liquidienne dans le secteur extracellulaire, par insuffisance hépatique fonctionnelle et par gêne au retour veineux liée à une hépatomégalie. L'insuffisance cardiaque peut également être de nature organique consécutive à la constitution d'une myocardite virale. Il peut en résulter une mort fœtale in utero (MFIU). L'infection à Parvovirus B19 est ubiquitaire. La séroprévalence augmente

avec l'âge : moins de 5 % chez les enfants de moins de 5 ans, 40 % à l'âge de 20 ans, 75 %à 50 ans. Globalement 50 à 60 % des femmes en âge de procréer sont immunisées [1].

Le mégalérythème épidémique survient plus volontiers en hiver et printemps même si l'infection peut être contractée durant toute l'année. Il existe des variations cycliques de la prévalence des primo-infections avec des épidémies survenant tous les 4 ans [2]. Il s'agit principalement d'une maladie de l'enfant scolarisé. Les personnes travaillant au contact d'enfants sont particulièrement exposées. Le risque de primo-infection en cours de grossesse est estimé à 1,5 % les années d'endémie et à 13 % les années d'épidémies. Ce risque augmente avec le nombre d'enfants présents au domicile et particulièrement lorsque ceux-ci sont scolarisés. L'infection de la femme enceinte est asymptomatique dans environ 1/3 des cas. Elle ne présente pas de caractéristiques particulières par rapport à la forme habituelle de l'adulte. La présence de signe clinique ne semble pas corrélée à une augmentation du taux de transmission verticale du virus [4]. Après une incubation de 4 à 14 jours, la primo-infection clinique se manifeste par un état pseudo grippal subfébrile, puis apparaît une éruption caractérisée par un rash maculopapuleux légèrement œdémateux débutant par les joues puis s'étendant au tronc et aux extrémités en macules roses pâles, confluentes. Chez l'adulte, cette éruption peut être atypique, morbilliforme, purpurique ou d'allure rubéoliforme. Chez 30 % des adultes (surtout la femme jeune) s'y associe une polyarthrite bilatérale et symétrique, intense, débutant aux extrémités puis atteignant les grosses articulations. Arthralgies et éruption cutanée sont liées à la formation de complexes immuns. Un facteur rhumatoïde peut alors être détecté dans le sang. L'évolution est bénigne. D'autres manifestations peuvent exister et concerner différents tissus : hématologique (thrombopénies, neutropénies, pancytopénies), neurologique (méningites, encéphalites, neuropathies), cardiaque (myocardites). Le diagnostic biologique de l'infection maternelle à Parvovirus B19 repose sur la détection des anticorps spécifiques. La séroconversion (apparition d'anticorps de type IgG) signe la primo-infection. Si l'on ne dispose pas d'un sérum antérieur, la présence d'IgG associés à des IgM est évocatrice. Cependant dans 25 % des cas, les IgM maternels peuvent avoir disparu au moment ou l'infection fœtale est diagnostiquée. Les IgM apparaissent 3 à 4 jours après le début de la symptomatologie soit 40 jours après le contage et persistent en général 3 à 4 mois. Leur recherche s'effectue par immunocapture avec des anticorps monoclonaux. Il existe des faux positifs de la détection des IgM en cas d'infections croisées avec le cytomégalovirus. Les IgG apparaissent dans les 7 jours suivant les premiers signes cliniques et persistent des années. Leur présence témoigne d'une infection ancienne, alors que la présence d'IgM correspond à une primo-infection. La recherche du génome viral par PCR peut être une aide précieuse en cas de difficultés dia gnostiques car l'ADN viral est détectable durant le premier mois de l'infection puis décroît progressivement. Le diagnostic postnatal de l'infection congénitale à Parvovirus B19 peut être effectuée par mise en évidence du génome viral par PCR dans les urines ou le sang des nouveau-nés. Chez la femme enceinte, l'infection à Parvovirus B19 va entraîner une virémie maternelle qui débute à J8 et dure en moyenne 5 jours, pouvant entraîner une transmission virale materno-fœtale transplacentaire par voie hématogène [5]. Le risque de transmission materno-fœtale varie selon le terme : 0 % en période périconceptionnelle, 14 % en fin de 1er trimestre, 50 % à la fin du 2e trimestre, et plus de 60 % en fin de grossesse [6]. Il a été montré que la transmission verticale du Parvovirus B19 existait tout au long de la grossesse à partir de 7-8 semaines d'aménorrhée [7]. Cependant, les conséquences chez le fœtus sont différentes selon le terme de la grossesse. Lorsque l'infection à virus B19 survient au premier trimestre, elle peut être responsable d'avortements spontanés. Nyman et al ont étudié de façon prospective sur une période de 30 mois hors période d'épidémie la fréquence de l'infection à B19 dans les produits de fausses couches du premier trimestre par PCR. Ils ont observé la présence d'une infection à virus B19 dans 3 % des cas [8]. Dans la série deTolvenstam et al., ce taux était de 5 % sur 37 cas [9].

Au troisième trimestre, Skjöldebrand-Sparre et al. Ont montré que 7,5 % des mort fœtales était liées à une infection à Parvovirus B19, justifiant ainsi la nécessité de rechercher une telle infection dans le bilan de MFIU [10]. Dans cette série de 7 cas de MFIU liées au Parvovirus parmi 93 MFIU sur une période de 6 ans (soit 0,3 %des grossesses), aucune anasarque n'a été observée. C'est avant tout au 2e trimestre que l'infection par le Parvovirus est la mieux documentée. Cependant, le taux de transmission verticale et la proportion de MFIU Parvovirus B19 et grossesse et anasarque attribuables à l'infection par le Parvovirus B19 sont mal connus. Dans une étude prospective concernant 618 femmes enceintes, la séroprévalence était de 49,7 % (307 femmes). Parmi les femmes non immunisées en début de grossesse, 16,7 % (52) ont fait une primo-infection en cours de grossesse. Chez les 52 fœtus issus de ces grossesses, les auteurs n'ont observé aucun cas de MFIU ni d'anasarque [4]. Dans la série de Nyman et al, le taux de détection du génome viral dans 64 produits de fausses couches du deuxième , trimestre était de 12 % [8]. Tolvenstam et al. ont étudié les tissus placentaires et fœtaux de 47 cas de MFIU survenues après 22 SA. Dans 15 % des cas, une infection par le Parvovirus a été observée [9]. Aucun de ces fœtus ne présentait un tableau d'anasarque. Au 2^{e} trimestre, l'infection fœtale peut se présenter sous forme d'une anasarque. Sa fréquence est de l'ordre de 30 à 40 % en cas de passage transplacentaire dans les infections de la première moitié de la grossesse. Les cas décrits dans la littérature concernent majoritairement des infections maternelles survenues entre 11 et 18 SA [11]. Il existe une période de latence d'environ 6 semaines entre la séroconversion maternelle et l'apparition des premiers signes d'anasarque à l'échographie. Le terme moyen de découverte d'une anasarque liée au Parvovirus est 22SA (exceptionnellement au 3^{e} trimestre). Le diagnostic d'anasarque est échographique. Elle est définie par la présence d'au

moins 2 signes fœtaux (ascite, épanchement péricardique, épanchement pleural, œdème sous-cutané > 5 mm mesuré perpendiculairement au niveau du front) ou d'un signe fœtal et d'un signe annexiel (œdème placentaire, hydramnios). L'anasarque est le reflet d'une anémie fœtale non régénérative (c'est ce qui la distingue d'une anémie par allo-immunisation érythrocytaire) et parfois d'une défaillance myocardique associée. Elle peut être en rapport avec de nombreuses pathologies materno-fœtales (hématologiques, rénales, pulmonaires, gastro-intestinales, hépatiques, métaboliques, infectieuses, placentaires et funiculaires). On distingue classiquement les anasarques de cause immune (dus à des anticorps maternels) et les anasarques non immuns. Cependant cette classification a peu d'intérêt pratique et devant la découverte d'une anasarque il convient de classer ceux-ci dans le groupe des anasarques à traitement urgent ou des autres causes. L'urgence consiste donc à classer l'anasarque dans le cadre nosologique adéquat des anémies fœtales qui sont accessibles à un traitement intra-utérin. Les autres causes d'anasarques doivent être éliminées par une échographie fœtale (à la recherche de malformations), par une recherche d'agglutinines irrégulières, par la réalisation d'un caryotype fœtal et par une recherche virale dans le liquide amniotique. Cependant, la prise en charge d'une anasarque fœto-placentaire étant une situation d'urgence, les résultats des analyses pratiquées sur le liquide amniotique n'auront qu'un intérêt rétrospectif. Une recherche de signes indirects d'anémie fœtale doit être réalisée par mesure Doppler de la vitesse systolique dans les artères cérébrales moyennes fœtales (accélération du flux sys- tolique) [12-15]. Cette évaluation indirecte du taux d'hémoglobine fœtale permet d'orienter vers une ponction de sang fœtale dite « armée » (c'est-à-dire dans des conditions permettant la réalisation d'une exsanguino-transfusion). L'atteinte cardiaque fœtale peut être la conséquence de l'anasarque fœtale (dilatation fonctionnelle des cavités cardiaques) ou être le témoin d'une réelle myocardite liée à l'infection virale. Elle se manifeste par une cardiomégalie, une hypocontractilité myocardique et une hypertrophie des parois cardiaques. En l'absence de dépistage systématique des séroconversions maternelles en cours de grossesse, le diagnostic d'infection à Parvovirus B19 est fait le plus souvent suite à la découverte d'une anasarque à l'échographie de façon fortuite ou en cours de surveillance échographique après notion de contage. En cas d'anasarque liée à une anémie fœtale, l'urgence est à la correction de l'anémie mais les prélèvements à visée étiologique doivent être pratiqués dans le même temps. Le diagnostic prénatal de l'infection fœtale à Parvovirus B19 s'effectue par recherche du virus ou du génome viral dans le liquide amniotique (PCR) ou le sang fœtal. La cordocentèse permet aussi de rechercher des signes non spécifiques d'infection (thrombopénie fœtale, augmentation des γ GT). Cependant l'examen de référence actuel est la PCR sur liquide amniotique. Cette PCR peut également être effectuée sur produits d'avortements ou des tissus fœtaux prélevés lors d'une autopsie. La sérologie fœtale avec recherche d'IgM dans le sang du fœtus prélevé par cordocentèse n'est pas suffisamment fiable car sa sensibilité n'est que de 50 % [16]. D'après une série rétrospective de 539 cas d'anasarque liés à une infection par le Parvovirus B19, l'évolution était la mort fœtale in utero (30 %), la résolution spontanée (34 %), la résolution après transfusion sanguine (29 %), le décès post-transfusion (6 %) et l'interruption médicale de grossesse dans 1 % de cas [17]. Plusieurs publications font état d'une résolution spontanée d'une anasarque liée au Parvovirus B19 [18-20]. Cependant il est difficile de prédire quel fœtus doit bénéficier d'une transfusion fœtale in utero . Il n'existe pas actuellement d'étude randomisée comparant les deux attitudes, ni même de critères pronostiques suffisamment pertinent pour surseoir à la transfusion fœtale in utero chez un fœtus en anémie sévère liée à une infection par le Parvovirus B19. Fairley et al.ont étudié le rôle de la transfusion intra-utérine pour anasarque consécutive à une infection par le Parvovirus B19 chez 66 fœtus en Angleterre et au Pays-de-Galles, entre juin 1992 et septembre 1994.Dans 29 cas, le fœtus était mort au moment de la première échographie. Douze des 38 fœtus en vie lors de la première échographie ont reçu une transfusion in utero et 3 de ces 12 fœtus sont décédés. Vingt-six n'ont pas reçu de transfusion in utero et 13 sont décédés. Après ajustement sur la sévérité de l'anasarque évalué par l'échographie et sur l'âge gestationnel, le risque de décès chez les fœtus ayant reçu une transfusion in utero a été beaucoup moins important que chez les fœtus ayant été traités par l'expectative (Odds ratio0,14, IC 95 % 0,02-0,96). Ces résultats suggèrent que la transfusion in utero serait bénéfique en terme de mortalité chez les fœtus infectés par le Parvovirus B19 en état d'anasarque [21].Le pronostic des fœtus en anasarque ayant été transfusés in utero est donc considéré comme favorable à la lumière de plusieurs études. Dembinski et al.ont évalué le devenir chez 20 fœtus infectés par le Parvovirus B19 en cours de grossesse et ayant été transfusés in utero, avec un recul de 13 mois à 9 ans. Chez ces 20 enfants, aucun retard de développement n'a été observé. Cependant dans cette cohorte seulement 65 %des enfants (20 sur 31) ont pu être évalués, les autres ayant été perdus de vue [22]. Miller et al.ont également décrit le devenir à long terme de 2 enfants ayant présenté un tableau d'anasarque ayant justifié une transfusion in utero. Dans les deux cas, le pronostic était favorable [11]. Rodis et al.ont comparé le devenir de 108 enfants avec infection congénitale à Parvovirus B19 et 97 cas contrôles, avec un recul moyen de 4 ans. Un retard de développement dans les registres moteur, de la parole, du langage, ou de l'attention, était observé chez respectivement 7,4 et 7,2 % de ces enfants [23]. Ces données de la littérature ont jusqu'à présent permis de conclure à un pronostic globalement favorable en cas de transfusion fœtale in utero. Cependant en janvier 2007, Nagel et al.ont décrit le devenir neuro-développemental de 25 enfants infectés in utero par le Parvovirus B19 et ayant été transfusés in utero en raison d'une anasarque (pour 24 d'entre eux).Le taux moyen d'hémoglobine était de 4,5 g/dl avant transfusion. Seize de ces enfants âgés de 6 mois à 8 ans sont été évalués sur le plan psychomoteur. Soixante-huit pour cent de ces enfants ne présentaient aucune anomalie, et 32 % avaient un retard psychomoteur avecun examen neurologique subnormal. Chez

ces enfants, le pronostic à long terme ne semblait pas être en rap-port avec le degré d'anémie avant transfusion [24]. Ces dernières données sont en contradiction avec les publications antérieures.

Chez la femme enceinte, un dépistage sérologique doit être rapidement réalisé pour évaluer le statut vis-à-vis du parvovirus. Cette sérologie doit être refaite après 3 semaines afin de mettre en évidence une séroconversion en cas de premier prélèvement négatif. En cas de séroconversion, une information doit être prodiguée à la patiente par l'obstétricien concernant les risques de transmission verticale, de l'histoire naturelle de l'infection et des différentes évolutions possibles. On peut proposer un suivi échographique toutes les deux semaines pendant 8 semaines à la recherche de signes évocateurs d'infections ou d'anémie. Les signes les plus précoces d'anémie sont l'élévation des vitesses maximales systoliques dans l'artère cérébrale moyenne. La recherche simple d'anasarque ne suffit pas compte tenu de la faible proportion de fœtus présentant un tableau d'anasarque. En cas d'anasarque fœto-placentaire, le traitement repose sur la réalisation de transfusions fœtales in utero . Il s'agit d'un geste invasif, dont l'indication doit être pesée en fonction du degré estimé d'anémie fœtale (par la mesure du pic systolique dans l'artère cérébrale moyenne) et confirmé par l'Hemocu® pratiqué en début de procédure, de la gravité du tableau clinique et du degré de l'atteinte cardiaque fœtale. Plusieurs transfusions peuvent être nécessaires. La présence de réticulocytes dans le sang fœtal est le témoin de la régénération de l'anémie et semble être de valeur pronostique favorable. En matière de prévention, et en cas d'épidémie à Parvovirus B19, l'exclusion professionnelle des femmes enceintes séronégatives travaillant au contact d'enfants est discutée. En effet l'efficacité d'une telle mesure est théorique car le facteur de contamination principal est le contage intra- familial avec un enfant d'âge scolaire présent dans le foyer. En l'état actuel des connaissances, il n'est pas justifié d'effectuer de sérodépistage systématique des femmes enceintes et aucun vaccin n'est actuellement disponible

CONCLUSION

L'infection à Parvovirus B19 pendant la grossesse est à risque de conséquences fœtales graves. Le risque est le plus élevé en cas d'infection aux 1er et 2ème trimestres de la grossesse, mais existe également au 3ème trimestre. Les conséquences fœtales aux 1er et 3ème trimestre sont aujourd'hui mieux appréhendés grâce à la recherche d'ADN viral par *polymérase chain reaction* (PCR). Le Parvovirus ne semble p.as être tératogène. L'infection pendant la grossesse peut-être à l'origine d'une anémie fœtale sévère et d'une anasarque non-immune. Le tropisme cardiaque du virus peut-être à l'origine d'une myocardite qui pourra aggraver la dysfonction cardiaque fœtale. Le suivi de l'anémie fœtale in utéro est fondé sur l'évaluation vélocimétrique doppler du pic systolique de l'artère cérébrale moyenne. Le traitement repose sur l'exsanguino-transfusion par codocentèse

RÉFÉRENCES

[1] Cohen BJ, Buckley MM. The prevalence of antibody to human parvovirus B19 in England and Wales. J Med Microbiol 1988;25:151-3.

[2] Anderson MJ, Jones SE, Fisher-Hoch SP, Lewis E, Hall SM, Bartlett CL, et al. Human parvovirus, the cause of erythema infectiosum (fifth disease)? Lancet 1983;1:1378.

[3] Pattison JR, Jones SE, Hodgson J, Davis LR, White JM, Stroud CE,et al. Parvovirus infections and hypoplastic crisis in sickle-cell anaemia. Lancet 1981;1:664-5.

[4] Harger JH, Adler SP, Koch WC, Harger GF. Prospective evaluation of 618 pregnant women exposed to parvovirus B19: risks and symptoms. Obstet Gynecol 1998;91:413-20.

[5] Mortimer PP, Cohen BJ, Buckley MM, Cradock-Watson JE, Ridehalgh MK, Burkhardt F, et al. Human parvovirus and the fetus. Lancet 1985;2:1012.

[6] Morinet F. Erythropoïese foetale et parvovirus B19. Pathol Biol. 1992;40:711-3.

[7] Koch WC, Harger JH, Barnstein B, Adler SP. Serologic and virologic evidence for frequent intrauterine transmission of human parvovirus B19 with a primary maternal infection during pregnancy. Pediatr Infect Dis J 1998;17:489-94.

[8] Nyman M, Tolfvenstam T, Petersson K, Krassny C, Skjolde brand-Sparre L, Broliden K. Detection of human parvovirus B19 infection in first-trimester fetal loss. Obstet Gynecol 2002;99:795-8.

[9] Tolfvenstam T, Papadogiannakis N, Norbeck O, Petersson K, Broliden K. Frequency of human parvovirus B19 infection in intrauterine fetal death. Lancet 2001;357:1494-7.

[10] Skjoldebrand-Sparre L, Tolfvenstam T, Papadogiannakis N, Wahren B, Broliden K, Nyman M. Parvovirus B19 infection: association with third-trimester intrauterine fetal death. Bjog 2000;107:476-80.

[11] Miller E, Fairley CK, Cohen BJ, Seng C. Immediate and long term outcome of human parvovirus B19 infection in pregnancy. Br J Obstet Gynaecol 1998;105:174-8.

[12] Mari G, Deter RL, Carpenter RL, Rahman F, Zimmerman R, Moise KJ, et al. Noninvasive diagnosis by Doppler ultrasonography of fetal anemia due to maternal red-cell alloimmunization. Collaborative Group for Doppler Assessment of the Blood Velocity in Anemic Fetuses. N Engl J Med 2000;342:9-14.
[13] Mari G, Detti L, Oz U, Zimmerman R, Duerig P, Stefos T. Accurate prediction of fetal hemoglobin by Doppler ultrasonography. Obstet Gynecol 2002;99:589-93.
[14] Mari G, Abuhamad AZ, Cosmi E, Segata M, Altaye M, Akiyama M.Middle cerebral artery peak systolic velocity: technique and variability. J Ultrasound Med 2005;24:425-30.
[15] Cosmi E, Mari G, Delle Chiaie L, Detti L, Akiyama M, Murphy J, et al. Noninvasive diagnosis by Doppler ultrasonography of fetal anemia resulting from parvovirus infection. Am J Obstet Gynecol 2002;187:1290-3.
[16] Zerbini M, Musiani M, Gentilomi G, Venturoli S, Gallinella G, Morandi R. Comparative evaluation of virological and serological methods in prenatal diagnosis of parvovirus B19 fetal hydrops. J Clin Microbiol 1996;34:603-8.
[17] Rodis JF, Borgida AF, Wilson M, Egan JF, Leo MV, Odibo AO, et al. Management of parvovirus infection in pregnancy and outcomes of hydrops: a survey of members of the Society of Perinatal Obstetricians. Am J Obstet Gynecol 1998;179:985-8.
[18] Bhal PS, Davies NJ, Westmoreland D, Jones A. Spontaneous resolution of non-immune hydrops fetalis secondary to transplacental parvovirus B19 infection. Ultrasound Obstet Gynecol 1996;7:55-7.
[19] Boley TJ, Popek EJ. Parvovirus infection in pregnancy. Semin Perinatol 1993;17:410-9.
[20] Smoleniec JS, Pillai M, Caul EO, Usher J. Subclinical transplacental parvovirus B19 infection: an increased fetal risk? Lancet 1994;343:1100-1.
[21] Fairley CK, Smoleniec JS, Caul OE, Miller E. Observational study of effect of intrauterine transfusions on outcome of fetal hydrops after parvovirus B19 infection. Lancet 1995;346:1335-7.
[22] Dembinski J, Haverkamp F, Maara H, Hansmann M, Eis-Hubinger AM, Bartmann P. Neurodevelopmental outcome after intrauterine red cell transfusion for parvovirus B19-induced fetal hydrops. Bjog 2002;109:1232-4.
[23] Rodis JF, Rodner C, Hansen AA, Borgida AF, Deoliveira I, Shulman Rosengren S. Long-term outcome of children followingmaternal human parvovirus B19 infection. Obstet Gynecol 1998;91:125-8.
[24] Nagel HT, de Haan TR, Vandenbussche FP, Oepkes D, Walther FJ. Long-term outcome after fetal transfusion for hydrops associated with parvovirus B19 infection. Obstet Gynecol 2007;109:42-7

International Journal of Innovation and Scientific Research
ISSN 2351-8014 Vol. 10 No. 1 Oct. 2014, pp. 77-82

http://www.ijisr.issr-journals.org/

Development and Shelf-Life Prediction of Pineapple (*Ananas comosus*) Preserve and Candy

Jakia Sultana Jothi[1], Monirul Islam[2], Md. Serajul Islam[3], Md. Ramim Tanver Rahman[4], and Shireen Akther[1]

[1]Department of Food Processing and Engineering,
Chittagong Veterinary and Animal Science University (CVASU),
Chittagong-4225, Bangladesh

[2]Rural Development Academy (RDA),
Bogra-5842, Bangladesh

[3]Society for Social Service (SSS),
SSS Bhaban, Tangail, Bangladesh

[4]State key Laboratory of Food science and Technology,
School of Food Science and Technology, Jiangnan University,
Wuxi-214122, P.R. China

ABSTRACT: The present study was conducted to develop and investigate pineapple (*Ananas comosus)* preserve and candy to assess its prospect in marketability and study their storage life. Pineapple slices were treated with 2% solution of common salt to prevent browning, then cut into cube shape and treated with 1% calcium chloride and 0.25% potassium metabisulphide solution and finally processed. The preserves were processed with 60° Brix, 65° Brix and 70° Brix sugar syrup. The candies were processed with 65° Brix, 70° Brix and 75° Brix sugar syrup. Initially the composition of pineapple preserves processed with different level of sugar ware found in the range as moisture content 33.09-35.65%, ash 1.36-1.42%, protein 1.01-1.07%, fat 0.61-0.66%, total sugar 61.37-63.73% and reducing sugar 30.52-31.46% and pineapple candies were found in the range as moisture content 19.05-20.88%, ash 1.52-1.58%, protein 1.15-1.21%, fat 0.72-0.77%, total sugar 75.70-77.35% and reducing sugar 45.16-46.39%. The sensory results showed that color, flavor, texture, taste and overall acceptability scores differed significantly ($p<0.05$). The preserve (P_2) processed from 65° Brix sugar syrup and the candy (C_2) processed from 70° Brix sugar syrup was the favorite sample of the sensory evaluation with the highest overall acceptability among others of the similar product. The shelf-life of candy (6 month) packed in high-density polyethylene bag is higher than preserve (4 month) packed in glass bottle when stored at ambient temperature (27° C to 30°C).

KEYWORDS: Pineapple, preserve, candy, nutritional evaluation, organoleptic properties and storage life.

1 INTRODUCTION

The pineapple (*Ananas comosus*) is a compound fruit and matures within 18-22 months after plantation. It has exceptional juiciness and a vibrant tropical flavor that balances the tastes of sweet and tart. It is the leading edible member of the family Bromeliaceae which embraces about 2,000 species, mostly epiphytic and many strikingly ornamental [1].

Pineapple is a major fruit of Bangladesh. According to cultivated area and yield of production, it occupies 5th position (4.6 M. tons/ acre). The major growing area of our country are: Sylhet, Tangail, Chittagong Hill Tracts, Dhaka (mainly Joydebpur) and Chittagong [2].

Corresponding Author: Jakia Sultana Jothi

The pineapple fruit must be a good source of vitamin A and B and rich in vitamin C. It contained enzymes, bromelin and pineapple leaf was a good source of chlorophyll [3]. The quality of pineapple largely depends on the amount of sugar and acid present, while the amount of sugar depends on the ripeness of the fruit, also on the variety, soil condition and climatic condition [4]. Pineapple does not increase in sweetness after it is harvested because of absence of starch stored in the fruit that will change to sugar. The sugars are formed in leaves of the pineapple plant and transferred to the fruit. It is usually sweeter in summer months when days are longer with abundant sunshine [5].

Candy is a sweet food prepared from fruits or vegetables by impregnating them with sugar syrup followed by draining of excessive syrup and then drying the product to a shelf stable state. Fruits and vegetables like apples, ginger, mangoes, guava, carrots and citrus peels have been used to prepare candies [6, 7 and 8]. A mature fruit with heavy sugar syrup till it becomes tender and transparent is known as preserves. Fruits, impregnetated with sugar on glucose syrup and subsequently drained free of syrup and dried, is known as candy. The most suitable fruits and vegetables for preserves and candy are pineapple, cherry, papaya, amla etc. [3].

Further, attributable to least commercial involvement, the pineapple is still to be used in processed industries. And also there are huge requirement for this type product from the stand point of health and nutrition. Considering the above facts the present investigation was undertaken with the following objectives: (i) to develop preserve and candy from pineapple, (ii) to predict the shelf-life of pineapple preserve and candy.

2 MATERIALS AND METHODS

The experiment was conducted in the laboratory of the Department of Food Processing and Engineering, Chittagong Veterinary and Animal Sciences University, Bangladesh. The fresh and fully mature pineapple (Honey Queen Variety), sugar and salt collected from the local market were used in the study. Other ingredients were used from laboratory stocks. All of them were at analytical grade (purity ≥ 98%).

2.1 PREPARATION OF PINEAPPLE

Fully mature pineapples (Honey Queen Variety) were collected from local market and washed thoroughly under running water. The pineapples were peeled with a stainless steel knife and kept them in a 2% solution of common salt to prevent browning. The fruits were cut into cube shape with knife and after that the cubes were treated with 1% calcium chloride and 0.25% potassium metabisulphide solution. Then the pineapples were washed with water. Finally these pieces of pineapple were ready to make preserve and candy.

2.2 PROCESSING OF PINEAPPLE PRESERVE

The cubes were dipped in sugar syrup of 50° Brix containing 0.2 per cent citric acid for a day. Then the cubes were removed from the syrup and increased consistency of syrup to 60° Brix by boiling. The cubes were dipped in sugar syrup of 60° Brix containing 0.2 per cent citric acid for a day. Then the process was repeated to raise the strength of syrup from 60° Brix to 65° Brix and finally to 70° Brix. The cubes were steeped in 70° Brix TSS for a week. At each level of TSS (60° Brix, 65° Brix and 70° Brix coded as P_1, P_2 and P_3 respectively) the syrup was drained and filled the container with fresh sugar syrup corresponding with the level of TSS from whom that was collected. The sugar was used as similarly described by Ponting *et al.* (1966) [9]. The preserves thus prepared were packed in glass bottle and stored in room temperature (27±3^{o}C).

2.3 PROCESSING OF PINEAPPLE CANDY

The cubes were dipped in sugar syrup of 50° Brix containing 0.2 per cent citric acid for a day. Then the cubes were removed from the syrup and increased consistency of syrup to 65° Brix by boiling. The cubes were steeped in 65° Brix syrup for a day. Then the process was repeated to raise the strength of syrup from 65° Brix to 70° Brix and finally to 75° Brix. The cubes were steeped in 75° Brix for a week. At each level of TSS (65° Brix, 70° Brix and 75° Brix coded as C_1, C_2 and C_3 respectively) the syrup was drained before bottling. The preserves were spread on tray and then dried in a Cabinet dryer at 70°C for 2 hr. The products were finally brought to room temperature (27°C ± 3^{0}C) [9].The candies thus prepared were packed in high-density polyethylene bag and stored in room temperature (27±3^{o}C).

2.4 CHEMICAL ANALYSIS

The fresh pineapple, processed preserves and candies were analyzed for moisture, ash, vitamin-C, protein, fat, total sugar, reducing sugar and dietary fiberas per the methods of AOAC [10]. Ranganna (2011) states the methods of reducing sugar and non-reducing sugar determination [11].

2.5 ORGANOLEPTIC PROPERTIES

Sensory characteristics of all types of candies and preserves were evaluated for different sensory attributes by a panel of trained and semi trained 20 panelists each. All the panelists were briefed before evaluation. Sensory attributes like appearance and color, flavor, taste, texture and overall acceptability for all samples were assessed using nine point hedonic scales. Hedonic scale was in the following sequence: 9 = Like extremely, 8 = Like very much, 7 = Like moderately, 6 = Like slightly, 5 = Neither like nor dislike, 4 = Dislike slightly, 3 = Dislike moderately, 2= Dislike very much and 1= Dislike extremely [12]. The samples were coded with letters and served to the panelists at random to guard against any bias.

2.6 SHELF-LIFE OF PRESERVE AND CANDY

The prepared preserve was packed in glass bottle and the candy was packed in high-density polyethylene bag (HDP). Both the preserve and candy was stored in room temperature (27±3^{o}C). The packed preserve and candy was unwrapped at a regular interval to asses through organoleptic test for color, flavor and overall acceptability. The spoilage was determined by organoleptic rejection and visual microbial growth.

2.7 STATISTICAL ANALYSIS

The data obtained from the experiments were statistically analyzed for analysis of variance (ANOVA) and consequently Duncan's Multiple Range Test (DMRT) was used to determine significant difference among the various samples in triplicate. Data were analyzed using the software, IBM SPSS Statistics, version 20 at the 0.05 level [13].

3 RESULT AND DISCUSSION

3.1 COMPOSITIONS OF FRESH PINEAPPLE

Initially the moisture content 88.25%, ash 0.87%, protein 0.58%, fat 0.46%, total sugar 5.04%, reducing sugar 3.96%, dietary fiber 1.44% and vitamin-C 48.66 mg/100 g was obtained in fresh pineapple (Honey Queen). These findings are more or less similar to those reported by Kader *et al*. (2010) [2].

3.2 CHEMICAL CHARACTERISTICS OF PINEAPPLE PRESERVES

In the present study three types of pineapple preserves, containing syrup with 60˚ Brix, 65˚ Brix and 70˚ Brix respectively, were prepared and analyzed for their composition. The results are presented in Table 1.

The analysis showed the higher moisture content of pineapple preserves was obtained from sample P_1 (35.65%) and the lower moisture content was obtained from sample P_3 (3.09%). There was significant variation of moisture content among the sample P_1, P_2 and P_3. This variation might be due to various levels of syrup concentration used in preserve and processing time of preserve. The higher sugar concentration and processing time increases the osmotic dehydration, that's why decrease moisture contents. On the other hand, ash, protein, fat, total sugar and reducing sugar significantly increased. The P_3 pineapple preserve had higher ash (1.42%), protein (1.07%), fat (0.66%), total sugar (63.63%) and reducing sugar (31.46%) followed by P_2 and P_1.

The composition of pineapple preserve processed with different level of sugar was found in the range as moisture content 33.09-35.65%, ash 1.36-1.42%, protein 1.01-1.07%, fat 0.61-0.66%, total sugar 61.37-63.73% and reducing sugar 30.52-31.46%.

3.3 CHEMICAL CHARACTERISTICS OF PINEAPPLE CANDIES

In the present study three types of pineapple candy, processed with 65˚ Brix, 70˚ Brix and 75˚ Brix syrup respectively, were prepared and analyzed for their composition. The compositions of pineapple cadies have been shown in Table 1.

Table 1. Composition of Pineapple Preserves and Candies[1,2]

Component (%)	Preserve			Candy		
	P_1	P_2	P_3	C_1	C_2	C_3
Moisture	35.65±0.02[a]	34.38±0.03[b]	33.09±0.03[c]	20.88±0.03[a]	20.01±0.02[b]	19.05±0.03[c]
Total ash	1.36±0.006[c]	1.39±0.003[b]	1.42±0.006[a]	1.52±0.006[c]	1.55±0.003[b]	1.58±0.006[a]
Protein	1.01±0.006[c]	1.03± 0.003[b]	1.07±0.003[a]	1.15±0.003[c]	1.17±0.003 [b]	1.21±0.006 [a]
Fat	0.61±0.003[c]	0.63±0.003[b]	0.66±0.003[a]	0.72±0.003[c]	0.75±0.003[b]	0.77±0.003[a]
Total sugar	61.37±0.03[c]	62.54±0.05[b]	63.73±0.10[a]	75.70±0.04[c]	76.50±0.07[b]	77.35±0.14[a]
Reducing sugar	30.52±0.03[c]	30.97±0.01[b]	31.46±0.06[a]	45.16±0.02[c]	45.64±0.06[b]	46.39±0.11[a]

[1]*Values are mean ± standard error of triplet determinations.*
[2]*Means with different superscript within the same row differ significantly ($p < 0.05$) using Duncan multiple range test.*

The analysis showed the higher moisture content (20.88%) was obtained in C_1 followed by C_2 (20.01%) and C_3 (19.05%).There was significant variation of moisture content among the sample C_1, C_2 and C_3.The C_3 had higher ash (1.58%), protein (1.21%), fat (0.77%),total sugar (77.35%) and reducing sugar (46.39%) and C_1 had lower ash (1.52%), protein (1.15%), fat (0.72%), total sugar (75.70%) and reducing sugar (45.16%).This variation might be due to various levels of syrup concentration used in pineapple candy and processing time of candy. The higher sugar concentration and processing time decrease moisture contents. On the other hand, ash, protein, fat, total sugar and reducing sugar significantly increased.

The composition of pineapple candies processed with different level of sugar was found in the range as moisture content 19.05-20.88%, ash 1.52-1.58%, protein 1.15-1.21%, fat 0.72-0.77%, total sugar 75.70-77.35% and reducing sugar 45.16-46.39%.

3.4 ORGANOLEPTIC PROPERTIES OF PINEAPPLE PRESERVE

The pineapple preserves, containing syrup with 60˚ Brix, 65˚ Brix and 70˚ Brix respectively, were subjected to sensory evaluation by a panel of 40 tasters. The mean score for color, flavor, texture, taste and overall acceptability of the pineapple preserves are presented in Table 2. The two-way analysis of variance (ANOVA) indicated that all these sensory attributes of different preserves were significantly ($p<0.05$) different and thus the preserves showed varied degree of acceptability in terms of color, flavor ,texture, taste and overall acceptability .

Table 2. Mean Scores for Color, Flavor, Texture, Taste and Overall Acceptability of Pineapple Preserves

Sample code	*Mean scores on sensory attributes				
	Color	Flavor	Texture	Taste	Overall acceptability
P_1	6.463±0.411[c]	6.271±0.532[c]	6.332±0.601[c]	6.577±0.329[c]	6.371±0.432[c]
P_2	8.134±0.244[a]	8.125±0.311[a]	8.079±0.049[a]	8.307±0.069[a]	8.189±0.093[a]
P_3	7.425±0.391[b]	7.374±0.201[b]	7.401±0.431[b]	7.527±0.211[b]	7.394±0.321[b]
LSD ($p<0.05$)	0.465	0.465	0.465	0.465	0.465

Means ± Standard Error with different superscripts within a column are significantly different and the same superscripts do not significantly different (NSD) at **p<0.05.*

As shown in Table 2, the color, flavor, texture, taste and overall acceptability of the preserves were not equally acceptable. The Duncan's Multiple Test (DMRT) revealed that the mean sensory score for color (8.134), flavor (8.125), texture (8.079), taste (8.307) and overall acceptability (8.189) of $P_2$was higher followed by P_3 and P_1. P_1 was inferior due to low concentration of sugar and P_3contained very high concentration of sugar. Among the experimental preserves, the P_2 was the favorite sample of the sensory evaluation with the highest overall acceptability.

3.5 ORGANOLEPTIC PROPERTIES OF PINEAPPLE CANDY

The pineapple candies were subjected to sensory evaluation by a panel of 40 tasters. The mean score for color, flavor, texture, taste and overall acceptability of the pineapple candies are presented in Table 3. The two-way analysis of variance (ANOVA) indicated that all these sensory attributes of different pineapple candies were significantly ($p<0.05$) different and

the extent of difference among the samples for their quality attributes were calculated by DMRT methods. Thus degree of acceptability in terms of color, flavor, texture, taste and overall acceptability of the pineapple candies were observed.

Table 3. Mean Scores for Color, Flavor, Texture, Taste and Overall Acceptability of Pineapple Candies

Sample code	*Mean scores on sensory attributes				
	Color	Flavor	Texture	Taste	Overall acceptability
C_1	6.941 ± 0.264^{c}	6.887 ± 0.211^{c}	6.924 ± 0.129^{c}	6.945 ± 0.152^{c}	6.938 ± 0.153^{c}
C_2	8.534 ± 0.322^{a}	8.481 ± 0.401^{a}	8.187 ± 0.321^{a}	8.431 ± 0.318^{a}	8.389 ± 0.217^{a}
C_3	7.772 ± 0.341^{b}	7.604 ± 0.337^{b}	7.318 ± 0.107^{b}	7.432 ± 0.283^{b}	7.509 ± 0.284^{b}
LSD ($p<0.05$)	0.465	0.465	0.465	0.465	0.465

**Means with different superscripts within a column are significantly different at p<0.05*

The colors, flavors, textures, tastes and overall acceptability of the pineapple candies were not equally acceptable. In the case of color, the DMRT test revealed that C_2 was most preferred and securing higher mean score (8.534) and C_1 was securing lower mean score (6.941). The flavor of C_2 was more preferred and significantly different than other samples. The texture of C_2 (8.187) was significant better than C_1 (6.924) and C_3 (7.318). In the case of taste, the DMRT test revealed that C_2 was most preferred and securing higher mean score (8.431) and $C_1$was securing lower mean score (6.945). The DMRT test of the overall acceptability revealed that $C_2$was more preferred due to its highest secured mean score (8.389) and significantly better than other samples.

3.6 Shelf-Life Of Pineapple Preserves And Candies

The shelf-life of pineapple preserves(packed in glass bottle) and candies(packed in high-density polyethylene bag) was studies for the period of 135 days and 195 days respectively at ambient temperature (27 ± 3^{o}C).Observation of color, flavor, overall acceptability and fungal growth of pineapple preserve and candy has been shown in Table-4. No remarkable change of preserve was observed up to 4 months (120 days) of storage. The remarkable change in color, flavor, overall acceptability and fungal growth were observed at 135 days of storage and the pineapple preserve (containing 65˚ Brix syrup) remarked as unacceptable to consume. The changes occurred possibly due to fermentation in presence of fungus (mold and yeast). Fraziar and Westheff (1978) described that main spoilage organism for fruit products are mold and yeast [14]. From table 3, the pineapple preserves containing 65˚ Brix syrup were shelf stable up to 4 months of storage at ambient temperature.

The color, flavor and fungal growth of pineapple candies processed with 70˚ Brix syrup were acceptable as there were no changes up to 6 month of storage time. The remarkable change was detected and the candy processed with 70˚ Brix syrup remarked as unacceptable to consumer at 195 days of storage. The changes occurred possibly due to fermentation in presence of fungus (Table 4). From table 4, the pineapple candy processed with 70˚ Brix syrup were shelf stable up to 6 months of storage at ambient temperature.

Table 4. Effect of Storage Time on the Quality of Pineapple Preserves and Candies

Storage period (day)	Preserve (P_2)				Candy(C_2)			
	Color	Flavor	Overall acceptability	Fungal Growth	Color	Flavor	Overall acceptability	Fungal Growth
0	Good	Pleasant	Acceptable	Not Visible	Good	Pleasant	Acceptable	Not Visible
30	Good	Pleasant	Acceptable	Not Visible	Good	Pleasant	Acceptable	Not Visible
60	Good	Pleasant	Acceptable	Not Visible	Good	Pleasant	Acceptable	Not Visible
90	Good	Pleasant	Acceptable	Not Visible	Good	Pleasant	Acceptable	Not Visible
120	Good	Pleasant	Acceptable	Not Visible	Good	Pleasant	Acceptable	Not Visible
135	Not Good	Off Flavor	Not Accepted	Visible	Good	Pleasant	Acceptable	Not Visible
150	-	-	-	-	Good	Pleasant	Acceptable	Not Visible
180	-	-	-	-	Good	Pleasant	Acceptable	Not Visible
195	-	-	-	-	Not Good	Off Flavor	Not Accepted	Visible

Comparing pineapple preserve and candy, it was clear that the storage stability of candy (6 month) is higher than preserve (4 month) as the moisture content was lower in candy (20.01%) than preserve (34.38%). Both the preserve and candy provide necessary plastic mouth feel to enable the food to be ready to eat (RTE) and product can kept for long time without refrigeration or thermal processing in any hermetically sealed container.

4 CONCLUSION

The study indicated a good prospect of pineapple processing for commercial products. From the investigation it may be concluded, the best pineapple preserves containing 65˚ Brix syrup and candies processed with 70˚ Brix syrup were identified based on sensory attributes. Both the pineapple preserve and candy contains reduced amount of moisture than the fresh fruit. The shelf-life of candy (6 month) is higher than preserve (4 month) where moisture content was the most important factor. So the pineapple can be used for preparing preserve and candy both at home scale and could be made available throughout the year. By processing pineapples value may be increased and production can be maximized which will have effect on the national economy. Further investigation is necessary to study economic and safety aspects of the pineapple products before commercial exploitation.

REFERENCES

[1] R. Wood, *The Whole Foods Encyclopedia*, , NY: Prentice-Hall Press, New York, 1988.

[2] A. Kader, F. Mah, J. Hossain, M. M. Islam, G. Kabir, S. K. Sarkar And N. Absar, "A Comparative Analysis on The Nutritional Contents of Two varieties of Pineapple of Chittagong Region", *Chittagong Univ. J. B. Sci.,*Vol. 5, no. 1 and 2, pp. 105-112, 2010.

[3] Sen, S. K., *Pineapple Production and Utilization*. In: T. K. Bose, and S. K. Mitra (Eds.), Fruits: Tropical and Subtropical, Naya Prokash, Calcutta, pp. 13-23, 1990.

[4] E.Cho, J. M. Seddon, B. Rosner, W. C. Willett and S. E. Hankinson, "Prospective Study of Intake of Fruits, Vegetables, Vitamins, and Carotenoids and Risk of Age-Related Maculopathy", *Arch Ophthalmol*, Vol. 122, No. 6, pp. 883-892, 2004.

[5] E. Karmas, "Techniques for Measurement of Moisture Content of Foods", *Food Technology*, Vol. 34, No.4, pp. 52-59, 1980.

[6] U. Mehta, and S. Bajaj, "Changes in the Chemical Composition and Organoleptic Quality of Citrus Peel Candy during Preparation and Storage". *J Food Science and Technology*, Vol. 21, pp. 422–424, 1984.

[7] S. Sharma, Y. S. Dhaliwal and M. Kalia, "Canied Apple: A New Perspective", *J Food Science and Technology*, Vol. 35, pp. 79–82, 1998.

[8] N. Chandu, and M. Prasad, "Development of guava candies", *J Food Science and Technology*, Vol. 43, pp. 210–212, 2006.

[9] J. D. Ponting, , G. G. Watters, R. R. Forrey, R. Jackson and W. L. Stanley, "Osmotic Dehydration of Fruits", *Food Technology,* vol. 20, no.10, pp. 125-128, 1966.

[10] AOAC Methods, *Official Method of Analysis*, 15th edition, Association of Official Agricultural Chemists, Washington DC, USA, 2005.

[11] S. Ranganna, Handbook of Analysis of Quality Control for Fruits and Vegetable Products, 2nd Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2011.

[12] E. Larmond, Laboratory Methods for Sensory Evaluation of Foods, Department of Agriculture, Publication Ottawa, Canada, 1977.

[13] IBM SPSS Statistics, IBM SPSS Statistics for Windows, Version 20.0, IBM Corp., Armonk, New York, 2011.

[14] W. C. Fraziar, and D. C. Westheff, Food Microbiology, 3rd Edn, McGrow-Hill Book Co., USA, 1978.

International Journal of Innovation and Scientific Research
ISSN 2351-8014 Vol. 10 No. 1 Oct. 2014, pp. 83-89

http://www.ijisr.issr-journals.org/

A Study of Face Databases used as Benchmarks in Face Recognition

Sheela Shankar[1] and V.R Udupi[2]

[1]Department of Electronics & Communication Engg,
KLE Dr. M. S. Sheshgiri CET, Udyambag, Belgaum, India

[2]Department of Electronics and Communication Engg,
Gogte Institute of Technology, Belgaum, India

ABSTRACT: Face recognition has become one of the robust means of authentication and hence lots of research has been carried on in this regard. For any face recognition system, the availability of a standard database consisting of appropriate face image samples is very important, since it serves as a benchmark for testing and comparing the results directly for the face recognition algorithms. From the last few decades, the creation of face database by proper acquisition of face images, has been an interesting research topic among research community. While there are many face databases available, the appropriate choice should be based on the task given (age, lighting, poses, expression, etc.). This paper makes a scrutinizing study of the existing face databases. The aim here is to give a clear picture to the researchers regarding the selection of the face databases to build effective face recognition systems.

KEYWORDS: Face recognition, face database, benchmark, face recognition algorithms, authentication.

1 INTRODUCTION

Face recognition has gained wide acceptance in the research community [1]. Face recognition algorithms are being developed on a large basis and testing their effectiveness is a major concern to researchers in the field. To make the algorithms efficient, it is mandatory to report their progress using standard benchmarks. This is facilitated by face databases and there are many well-established face databases to assess the performance characteristics of face recognition algorithms [2-6].

However, the efficiency of these databases is highly dependent on the a few factors. Collecting a large amount of sample patterns is as important as developing recognition methods for pattern recognition applications. The database should be a rich collection of images with many variations with respect to lighting, poses, expressions, accessories, background, etc. A detailed study of the face databases focusing mainly on facial expressions has been studied in [7]. This paper deals with a study of few of the challenging databases that have been served as a benchmark for face recognition systems.

1.1 AR FACE DATABASE

The database was created by Aleix Martinez and Robert Benavente in the Computer Vision Center (CVC) at the U.A.B. in the year 1988. It was the first database to include occlusions. The total number of subjects used here is 126 with 4000 total images. It provides provision for variation in illumination, frontal poses, expression, scarves, eye glasses, etc. [8]. The size of the RGB colour images is 768 × 576 pixels. In a 2-week interval, the subjects face images were captured twice by subjecting them to 13 different conditions. Fig. 1. shows samples taken from the AR Face Database.

Corresponding Author: Sheela Shankar

Fig. 1. Images from AR Face Database.

1.2 INDIAN MOVIE FACE DATABASE (IMFDB)

The database was designed as a benchmark for face recognition algorithms in unconstrained settings. This database consists of 34512 faces of 100 known Indian actors. The images were collected from around 103 Indian movies. Totally 67 male and 33 female actors with at least 200 images per actor was taken. It involved selection of images manually with variations in pose, scale, expression, age, illumination, etc. It provides details in terms of pose, age, gender, amount of occlusion, expressions [9]. Fig. 2. shows the face images of Amitabh Bachchan taken from IMFDB.

Fig. 2. Sample images from IMFDB

1.3 YALE DATABASE

The database contains 165 grayscale images of 15 individuals in GIF format [10]. Per subject there are 11 images. The variations considered here with respect to configuration and facial expressions are w/glasses, w/no glasses, center-light, left-light, right-light, happy, sad, sleepy, wink, normal and surprised. In a period of 10 years, the performance has been increased from 58.14% [11]-99.3% [12].

1.4 LABELED FACES IN THE WILD (LFW)

This database was developed by Tamara Berg, David Forsyth, and the computer vision group at UC Berkeley [13], [14]. It was shown here that the database of face images could be built by harvesting large sets of imperfect data from the web. It was basically built by analyzing the associated captions and pictures, and then the images were clustered by identity. It had achieved a labelling accuracy of 77%. The database contains more than 13000 images taken from around 1680 subjects covering major ethnicities of the world [15]. Fig. 3. shows the images of Bill Gates taken from LFW database.

Fig. 3. Images from LFW database

1.5 KOREAN FACE DATABASE

This database contains the facial images of subjects from Korea by subjecting the data acquisition phase to variances in expressions, illumination and pose [16]. Eight lights and seven cameras were used and the subjects were imaged in the centre of an octagonal frame. The background selected was a blue screen. Totally 52 images were taken for each subject. Expressions that were taken into consideration were happy, anger, neutral, blink and surprise. It used two types of illumination-incandescent lights and fluorescent. Fig. 4. shows samples from Korean face database with two types of illumination.

Fig. 4. Images from Korean Face Database

1.6 THE JAPANESE FEMALE FACIAL EXPRESSION (JAFFE) DATABASE

The database comprises of 219 images taken from ten female subjects [17]. The database was developed by Michael Lyons, Miyuki Kamachi, and Jiro Gyoba. The six basic expressions- surprise, sadness, disgust, anger, happiness, and fear were considered. Even neutral face was used. For the sake of less intricacy, only Japanese female models were taken as subjects. To expose all the regions dealing with expression, the hair was tied at the back. To create illumination on the face, tungsten lights were used. Fig. 5. shows the face images of taken from JAFFE database.

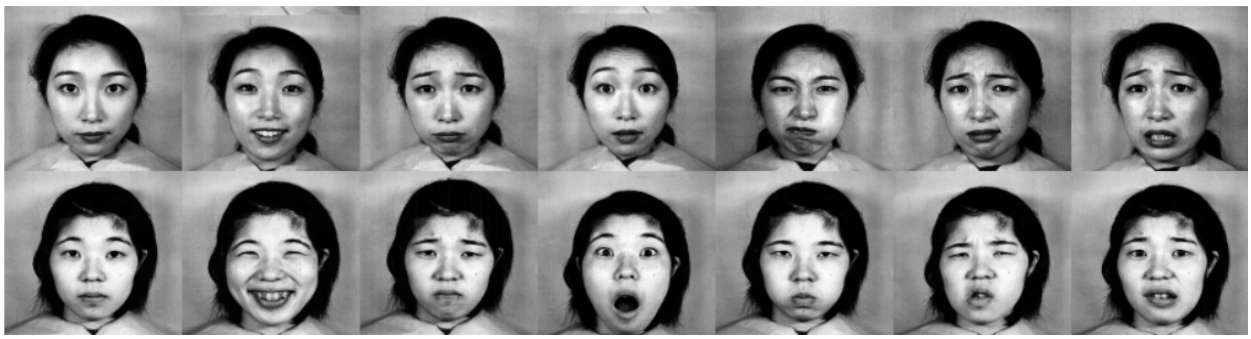


Fig. 5. Images from JAFFE database.

1.7 BIOID FACE DATABASE

The database consists of 1521 gray level images of 23 different persons, with a resolution of 384 X 286 pixels [18]. The important characteristic of this database is that it includes realistic images as background, for example home or office settings. These backgrounds change for each image with difference in lighting, expression and pose. It has manual marking on each eye in the image. Fig. 6. shows face images taken from BioID face database.

Fig. 6. Images from BioID Face Database

1.8 MIT CBCL FACE DATABASE

The database comprises of 4,548 non-faces and 2,429 faces images in the training set and 23,573 non-faces and 472 faces in the test set [19]. The resolution used is 19 X 19 in grayscale PGM format. The database was developed on October 15, 1989 at the MIT Media Laboratory. 16 males (mostly graduation students) were selected as subjects for the data acquisition. The subject was asked to sit on a couch and was digitized 27 times, by subjecting him to variances in camera zooming, lighting and head orientation.

1.9 FERET DATABASE

This database was designed to foster face recognition with the collected images directly supporting both the algorithm development and the FERET evaluation test [20, 21]. FERET program was sponsored by the Department of Defence (DoD) Counterdrug Technology Development Program Office. From August 1993 and July 1996, the database was collected in 15 sessions. It included 1199 subjects and 365 duplicate set of images. By July 1996, the database contained a total of 14216 images. Here the term 'duplicate' refers to the subject whose image was already contained in the database. 13 conditions with variations in illumination, occlusion and expressions were taken into consideration. The images were captured in sets of 5 to 11. Two frontal views were taken. During the second iteration, the subject was requested for a different expression. Fig. 7. shows images taken from FERET database.

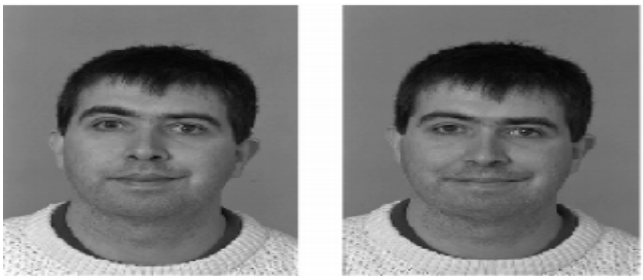


Fig. 7. FERET Database

1.10 NIST MUGSHOT IDENTIFICATION DATABASE

This database consists of 1573 subjects with 78 females and 1495 males. It contains views from both the front and side profile [22]. This database is being distributed for testing and development of the mugshot identification systems. The database has 131 cases with two or more front views and 1418 with only one front view, separating front views and profiles.

Profiles have 1268 cases with only one profile and 89 cases with two or more profiles. Cases with both profiles and fronts have 89 cases with two or more of both profiles and fronts, 27 with one profile and two or more fronts, and 1217 with one profile and only one front. Algorithm run using this set of images can be found in [23].

1.11 AT & T FACE DATABASE

This database contains images of 40 subjects, with 10 images per subject, totaling to 400 images. Each face image is of 112 X 92 pixel size [24]. Variations in the faces are with respect to open/closed eyes, presence and absence of glasses, smiling/ no smiling. The images were taken against a dark homogenous background. There were few variations in scale. There was also some tolerance for some side movements for subjects which is the unique feature for this database. Fig. 8. shows images taken from AT & T face database.

Fig. 8. AT & T face database

1.12 PLASTIC SURGERY FACE DATABASE

This database consists of real world faces of 900 subjects [25]. The images are taken before and the after the surgery totaling to 1800 images. For every subject, there are two frontal face images with variation in illumination and neutral expressions. The database comprises of 519 image pairs with respect to local surgeries and 381 cases of global surgery. Various types of facial surgeries have varying effects on the facial features. The database contains images that cover a variety of cases such as brow lift, Rhytidectomy (face lift), Blepharoplasty (eyelid surgery), Rhinoplasty (nose surgery), skin peeling and Blepharoplasty (surgery of the eyelid).

1.13 INDIAN FACE DATABASE

This database was created by Vidit Jain and Amitabha Mukherjee [26]. The data samples were acquired in February 2002, from IIT Kanpur. Totally 61 subjects (242 females, 422 males) were selected, totaling to 664 images. The subjects are in frontal, upright position. The background selected is bright and homogeneous. The variations include: emotions-smile, neutral, sad and laughter; poses-looking left, looking front, looking up and looking right. Gender classification using PCA method has been done on the samples taken from this database [27]. Fig. 9. Shows samples taken from the Indian Face Database.

Figure 9. Images from Indian Face Database

1.14 CAS-PEAL FACE DATABASE

This database has been built under the sponsors of National Hi-Tech Program and ISVISION by the Face Recognition Group of ICT, CAS and ICT. It's a Chinese face database [28]. The acronym PEAL stands for Pose, Expression, Accessory and Lighting.

The variations in image acquisition are with respect to the following criterion: expression, pose, lighting and accessories. Totally 1040 subjects (445 females, 595 males) were selected and the database has 99,594 images. To acquire varying images with poses in one shot, 9 cameras were spaced equally in a horizontal semicircular manner with height and radius being 1.1 meters and 0.8 meters respectively (Fig. 10). 18 images were captured in two shots by asking the subjects to look up and down. 15 lighting directions, 6 accessories (3 caps and 3 glasses) and 5 expressions were taken into consideration. Age and time were considered during data acquisition. Also open mouth and surprise were included in the database. Fig.11. shows the images taken with respect to pose from this database.

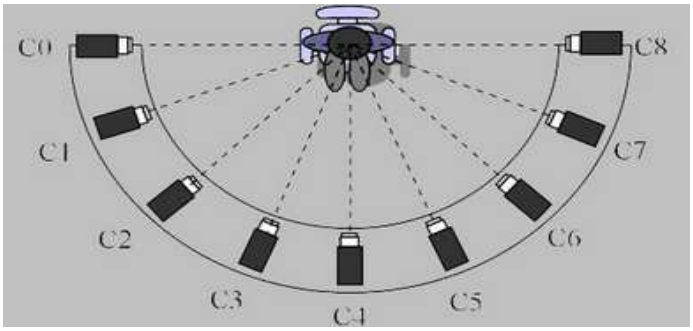


Fig. 10. The positioning of 9 cameras in image capturing in CAS-PEAL database.

Fig. 11. Images from CAS-PEAL database taken with 9 cameras at one shot.

2 CONCLUSION

Face databases which have been served as benchmarks for face recognition algorithms have been studied. Most of the databases discussed here are freely available. The reader is expected to get an insight of the existing face databases which are vital for the working of all the face recognition algorithms. Proper selection of available face databases is thus a critical issue in the testing phase of face recognition program.

ACKNOWLEDGEMENTS

The authors are immensely grateful to the valuable suggestions and help provided by the Department of Electronics and Communication Engineering, KLE Dr. M.S. Sheshagiri College of Engineering and Technology, Udyambag, Belgaum, Karnataka.

REFERENCES

[1] Zhao, Wenyi, Rama Chellappa, P. Jonathon Phillips, and Azriel Rosenfeld. "Face recognition: A literature survey." *Acm Computing Surveys (CSUR)* 35, no. 4 (2003): 399-458.
[2] W. Zhao Sarnoff, R. Chellappa, J. Phillips, and A. Rosenfeld, “Face recognition: A literature survey,” in ACM Comput. Surv., 2003.
[3] A. S. Georghiades, P. N. Belhumeur, and D. J. Kriegman, “From few to many: Illumination cone models for face recognition under variable lighting and pose,” in PAMI, 2001.
[4] A. Mart´ ınez and R. Benavente, “The AR face database,” in CVC Technical Report, 1998.
[5] D. Jelsovka, R. Hudec, and M. Breznan, “Face recognition on FERET face database using LDA and CCA methods,” in IEEE TSP, 2011.
[6] T. Sim, S. Baker, and M. Bsat, “The CMU Pose, Illumination, and Expression Database,” in PAMI, 2003.
[7] Anitha, C., M. K. Venkatesha, and B. Suryanarayana Adiga. "A survey on facial expression databases." *International Journal of Engineering Science and Technology* 2, no. 10 (2010): 5158-5174.
[8] Available at: http://www2.ece.ohio-state.edu/~aleix/ARdatabase.html

[9] Setty, Shankar, Moula Husain, Parisa Beham, Jyothi Gudavalli, Menaka Kandasamy, Radhesyam Vaddi, Vidyagouri Hemadri et al. "Indian Movie Face Database: A benchmark for face recognition under wide variations." In *Computer Vision, Pattern Recognition, Image Processing and Graphics (NCVPRIPG), 2013 Fourth National Conference on*, pp. 1-5. IEEE, 2013.
DOI: 10.1109/NCVPRIPG.2013.6776225

[10] Available at: http://vision.ucsd.edu/content/yale-face-database

[11] P. N. Belhumeur, J. P. Hespanha, and D. J. Kriegman, "Eigenfaces vs. Fisherfaces: Recognition Using Class Specific Linear Projection," in *PAMI*, 1997.

[12] J. Wright, A. Y. Yang, A. Ganesh, S. S. Sastry, and Y. Ma, "Robust Face Recognition via Sparse Representation," in *PAMI*, 2009.

[13] Tamara L. Berg, Alexander C. Berg, Michael Maire, Ryan White, Yee Whye Teh, Erik Learned-Miller, and David A. Forsyth. Names and faces in the news. CVPR, 2004.

[14] Tamara L. Berg, Alexander C. Berg, Jaety Edwards, and David A. Forsyth. Who's in the picture. NIPS, 2004.

[15] Available at: http://vis-www.cs.umass.edu/lfw

[16] Hwang, Bon-Woo, Myung-Cheol Roh, and Seong-Whan Lee. "Performance evaluation of face recognition algorithms on asian face database." *Automatic Face and Gesture Recognition, 2004. Proceedings. Sixth IEEE International Conference on*. IEEE, 2004.
DOI: 10.1109/AFGR.2004.1301544

[17] Available at: http://kasrl.org/jaffe.html

[18] Available at: https://www.bioid.com/About/BioID-Face-Database

[19] Available at: http://cbcl.mit.edu/software-datasets/FaceData2.html

[20] Phillips, P. Jonathon, Harry Wechsler, Jeffery Huang, and Patrick J. Rauss. "The FERET database and evaluation procedure for face-recognition algorithms." *Image and vision computing* 16, no. 5 (1998): 295-306.
DOI: 10.1016/S0262-8856(97)00070-X

[21] Phillips, P. Jonathon, Hyeonjoon Moon, Syed A. Rizvi, and Patrick J. Rauss. "The FERET evaluation methodology for face-recognition algorithms." *Pattern Analysis and Machine Intelligence, IEEE Transactions on* 22, no. 10 (2000): 1090-1104.

[22] Available at: http://www.nist.gov/srd/nistsd18.cfm

[23] Lim, Joo-Hwee, Jian Kang, Sumeet Singh, and Desai Narasimhalu. "Learning similarity matching in multimedia content-based retrieval." *Knowledge and Data Engineering, IEEE Transactions on* 13, no. 5 (2001): 846-850.
DOI: 10.1109/69.956107

[24] Available at: http://www.cl.cam.ac.uk/research/dtg/attarchive/facedatabase.html

[25] Available at: https://research.iiitd.edu.in/groups/iab/facedatabases.html

[26] Vidit Jain, Amitabha Mukherjee, The Indian Face Database. http://vis-www.cs.umass.edu/~vidit/IndianFaceDatabase/, 2002.

[27] Kekre, H. B., Tanuja K. Sarode, and Jagruti K. Save. "Gender Classification of Human Faces Using Class Based PCA." International Journal of Scientific and Research Publications, Volume 4, Issue 2, February 2014.

[28] Available at: http://www.jdl.ac.cn/peal/

International Journal of Innovation and Scientific Research
ISSN 2351-8014 Vol. 10 No. 1 Oct. 2014, pp. 90-98

http://www.ijisr.issr-journals.org/

Analysis of Soil Nutrient and Heavy Metal Concentration in Agricultural Land of Zirani Industrial Area, Savar, Dhaka

Fakhrun Nessa[1] and Md. Arif Hossain Jewel[2]

[1]Department of Environmental Science and Resource Management,
Mawlana Bhasani Science & Technology University (MBSTU),
Tangail-1902, Bangladesh

[2]Rural Development Academy (RDA),
Bogra-5842, Bangladesh

ABSTRACT: Now a days the contamination of soil by heavy metal from industrial sources has become a serious issue. This research was conducted to observe the nutrient status and concentration of heavy metal in soil. In this work, nine soil samples were collected from three different points of the Zirani industrial area, Savar during October/ 2013. The result of pH revealed that all the soil samples were acidic in nature. The maximum value of OC % was recorded 2.13% at point 3. However, it was observed that except N the concentration of available K, P, and S in soil samples were higher than their critical level of soil chemical properties. The highest value of Pb was 0.762ppm which found at point 1 and the lowest value was 0.575ppm in point 2.0.089ppm was the highest value of Cu which was found at point 3 and the lowest value 0.065ppm was found at point 3. The maximum concentration of Zn 3.05ppm was found at point 3 whereas the lowest value was recorded 1.90ppm in point 1.The highest value for the Cd was recorded 0.235ppm which was founded at point 2 and 0.104ppm was lowest value that was founded at point 3. The result also showed that Cu and Pb concentration were relatively higher than their recommended value in soil. The abundance order of heavy metal content in soil samples were Pb>Cu>Zn>Cd which indicated that the concentration of these heavy metals were harmful for the environment and human life.

KEYWORDS: Heavy metals, Environmental Pollution, Soil, Soil nutrient, Contamination.

1 INTRODUCTION

Environmental and health related problems have become a major global concern in the recent years [12]. Environment pollution is a worldwide problem and its potential to influence the health of human populations is great [6]. Pollution reaches its most serious proportions in the densely settled urban-industrial centers of the more developed countries [9]. Soil plays a very important role for environment as it produces food for human beings and animals. But, due to human activities, soil is the receptor of many pollutants including pesticides, fertilizers; particulate matters etc. and getting polluted [3].Main Causes of soil pollution include municipal solid waste, hospital waste, excessive use of pesticides/fertilizers/herbicides, ponding of industrial effluents, disposal of industrial solid waste on open land etc.

Heavy metal contamination in soil is a major concern because of their toxicity and threat to human life and the environment [2]. Heavy metals refer to those metallic elements which have density of above 5 g cm-3. These metals include arsenic, cadmium, chromium, copper, lead, nickel, zinc, molybdenum and vanadium. In Bangladesh, industrial wastes and effluents are being discharged randomly on soils, into canals, rivers, along the road sides or in the vicinity of the industrial areas without any treatment. Lead, cadmium, arsenic, mercury, chromium and nickel are the significant contaminants [7].Lead can be heavily absorbed by particles from sediments and, thus, it is very difficult to be Trans located, while cadmium

Corresponding Author: Md. Arif Hossain Jewel

ions can be directly absorbed [13]. Cd, Cr and Pb are of concern because they are toxic to plants and animals even in small concentrations; however Zn is an essential trace metal for plants and animal but can be dangerous at high concentrations [14]. At high concentrations these metals exhibit chronic toxicity or carcinogenicity as well as fatality [10].

Global contamination of the environment has resulted in increasing amounts of heavy metals in both the air and soil. Acid atmospheric pollutants damage assimilatory organs of plants, which results in partial loss of their assimilatory surface, disturbance of their physiological conditions, and decrease of their vitality [8]. Also, their development and growth may be affected at high levels of metal concentration implying reduced cultures and economic loss.

Savar, one of the largest industrial areas near Dhaka in Bangladesh, has more than 100 local and foreign industries. These generate a large amount of effluents everyday which are being directly discharged into the surrounding land, agricultural fields, irrigation channels and surface water that finally enter into the river [11]. So a large number of areas in Saver district are now being threatened by the environmental pollution. The objectives of this research were: i) To observe the nutrient status of sampling soil. Ii) To know heavy metals concentration in the soil of study area.

2 MATERIALS AND METHODS

2.1 STUDY AREA

Nine soil samples were collected from industrial area located at Zirani in savar which location was given in the table and identify the location point on map.

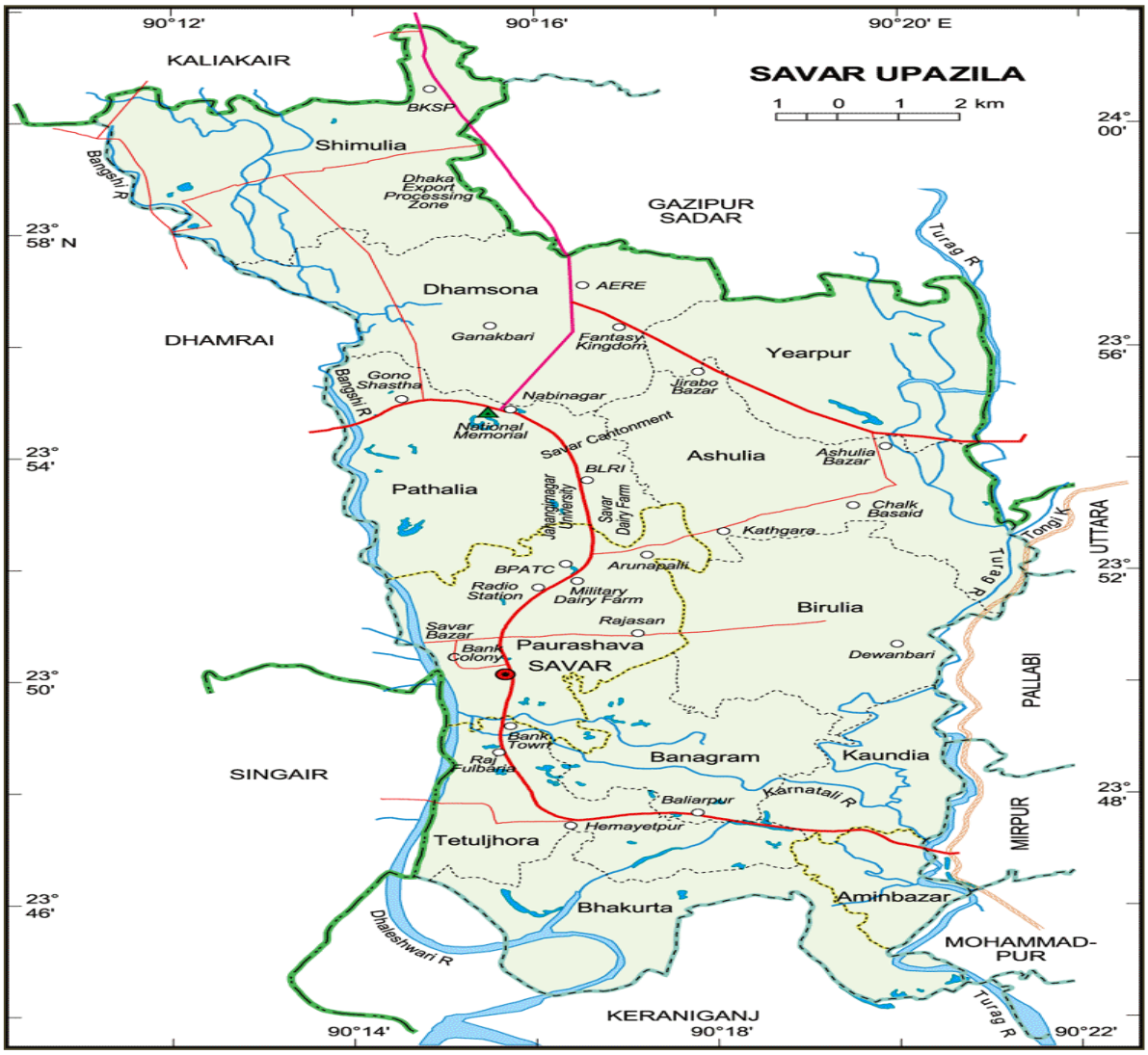


Fig.2.1. Map of Bangladesh showing the study area (Source: Google map, 2013-2014).

2.2 SAMPLES COLLECTION

The soil samples representing 0-15 cm from the surface was collected at a approximate distance of 30, 40 and50 meters from the waste dumping site. The samples were scraped from the top to bottom with the help of an auger. Each samples were kept separately on a brown paper and contents of each brown paper were mixed thoroughly. Then about 1kg of soils was collected from each paper to give a representative sample. Samples were placed in sealed polythene bags and lebeled including date of collection, location and code number of soil sample.

2.3 PREPARATION AND ANALYSIS OF SAMPLES

From the collected samples, the gravels, pebbles, plant roots, leaves, etc. were picked up and removed. The collected soil samples were dried in air for 7 days by spreading on a clean piece of paper, and then the samples were mixed well and ground to pass through a 2 mm mesh stainless steel sieve. The soil samples were kept in a clean polythene bag and then transported to the Central laboratory of Bangladesh Agricultural University (BAU), Mymensingh for the analysis of soil pH, organic carbon, available phosphorus, available sulfur, total nitrogen. These parameters were determined according to the standard methods [1]. To determine the total Cd and Pb content of soil 4 M HNO3 was used as extracting solution. Two grams of soil was digested with 12.5 ml extracting solution at 80^{o}C for 24 hours. Then it was made of 50 ml and filtered. Copper (Cu) and Lead (Pb) content of soil extracts were determined directly by Atomic Absorption Spectrophotometer (AAS) following the procedure of [15]. Zn was determined by soil extraction method using NOV AA-300 Atomic Absorption Spectrophotometer (AAS). It was measured by Atomic Absorption Spectrophotometer on undiluted soil extracts.

2.4 STATISTICAL ANALYSIS OF DATA

All the ends of data collection, data were compiled, tabulated and analyzed. Microsoft Office, Excel 2007 software ware used for data analysis and presentation. Various descriptive statistical measures such as range, percentage, mean, standard deviation (SD), etc were used for categorization and describing the variables. Different tables, graphs, charts, etc. were used for the presentation.

3 RESULT AND DISCUSSION

This segment represents the results of analysis of soil quality parameters. The chemical parameters of soil in and around the Zirani municipal area obtained from the analyses are described in the Table 3.1

Table 3.1. Present status of the soil properties in and around the sampling area

Sampling Points	Sampling Stations	pH	OC%	Total Nitrogen %	Available K ppm	Available S ppm	Available P ppm	Zn ppm	Cd ppm	Cu ppm	Pb ppm
P1	S1	5.64	1.22	.09	5.01	13.91	20.76	2.03	.125	.080	.762
	S2	5.71	1.13	.08	4.91	14.08	18.51	2.10	.112	.077	.621
	S3	5.33	1.33	.05	6.31	12.10	19.31	1.90	.130	.075	.747
P2	S4	5.88	1.11	.06	5.08	11.61	14.66	1.99	.201	.079	.589
	S5	5.77	1.22	.04	4.38	12.05	15.67	2.01	.199	.067	.575
	S6	6.12	2.01	.07	4.90	14.11	16.23	2.10	.235	.071	.645
P3	S7	6.22	1.81	.10	3.90	13.01	16.49	3.05	.104	.089	.735
	S8	7.19	2.13	.08	5.53	11.49	15.69	2.99	.183	.067	.713
	S9	6.35	2.03	.07	3.82	12.08	17.97	3.03	.169	.065	.673

PH

All the stations of the sampling points indicate the lower pH value considering the standard value of 7 except station 2 under the point of 3 which indicates the acidic condition of the soil. In the three points from nine stations the highest value of pH is 7.19 in the 2nd station of 3rd point which is slightly basic and the lowest value of pH 5.33 at the 3rd station of 1st point which is slightly acidic. The average value of pH at different points is 6.02. This indicates slightly acidic condition of soil. The

acidic agents of soil may come from the nearby industries which make the soil that condition. The pH value of different points has been presented in the graph.

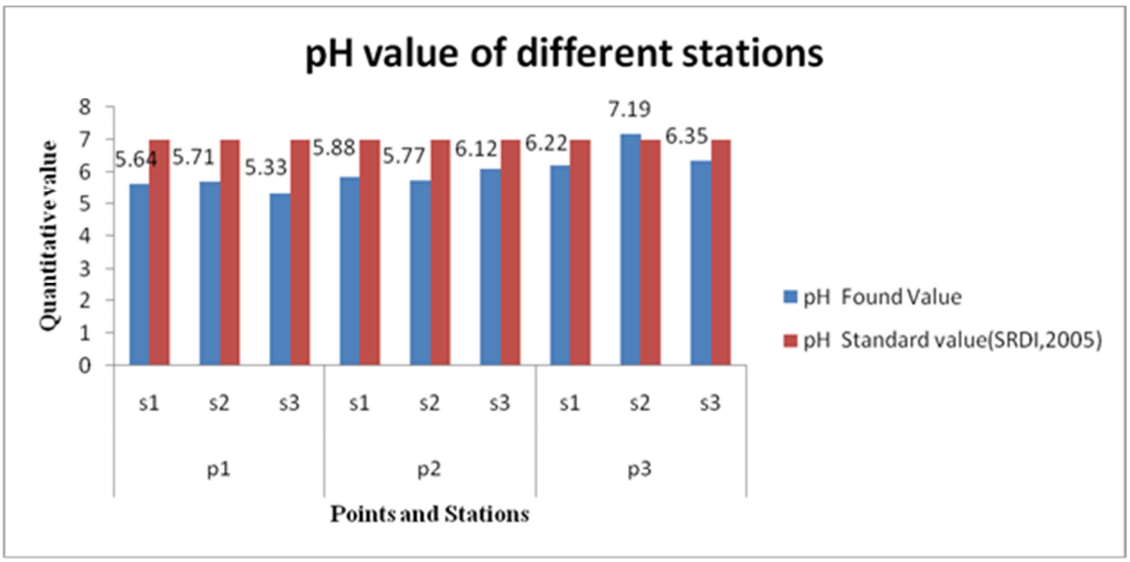


Fig3.1. pH value of different points

OC (ORGANIC CARBON)

The lowest value of organic carbon 1.11% is found station 1 under point 2 and the highest value 2.13% is found in the station 2 under point 3. A standard soil contains 2.89% organic carbon in optimum condition [16]. Higher organic content represents fertile soil condition consequences to higher agricultural production. The point 3 which is almost 50m away from dumping point of industry shows the highest value of organic carbon percentage. The anticipation lies behind is that this point is less polluted.

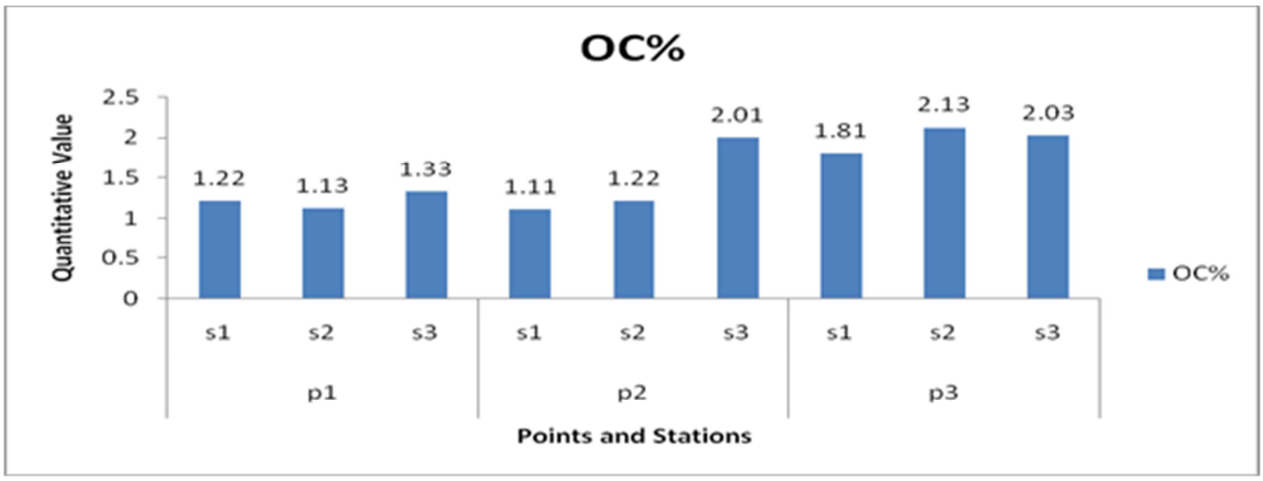


Fig3.2. Available organic carbon of different points

TOTAL NITROGEN (N)

The total nitrogen (N) content in the sampling soils varies from 0.04 to 0.10% which is presented in the following figure. The highest total N content in the surface soils (0.10%) was recorded at the station 1 under point 3 and the lowest value was 0.04% at station 2 in point 2. Analyzed values were lower than the standard value 0.12% [16]. It might be due to continuous release of untreated industrial waste through dumping point. Total nitrogen content in a soil represents the how nutrious the soil is. Higher value indicates higher nitrogen content for crop plants leading to higher crop production.

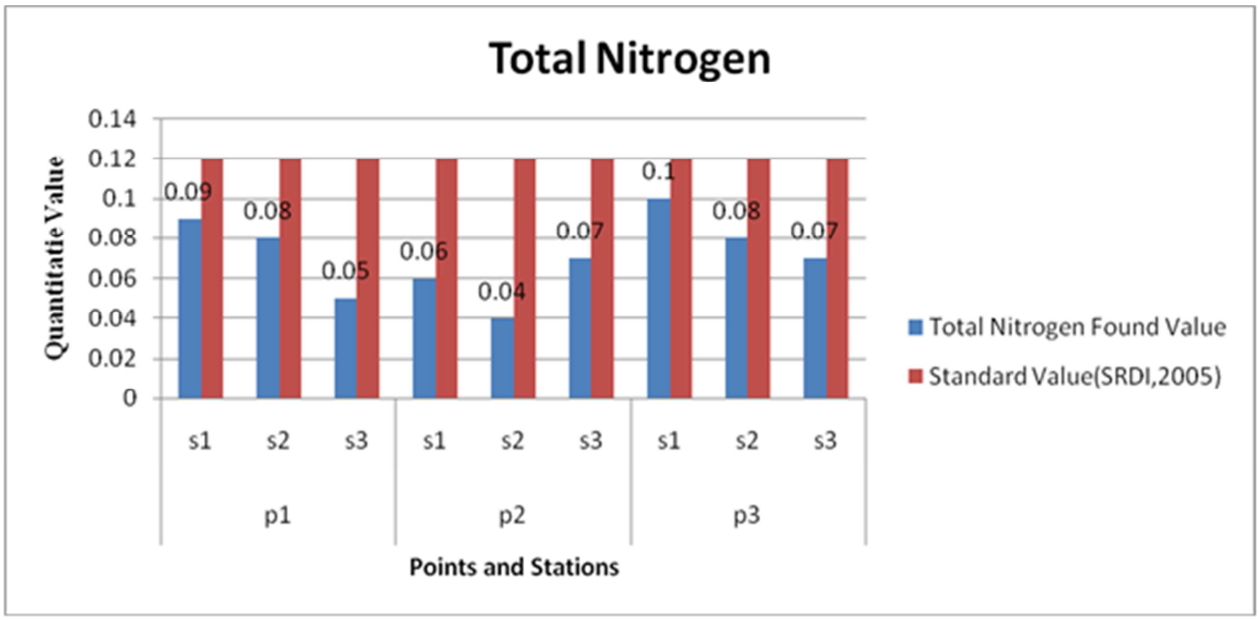


Fig3.3. Total Nitrogen of different points

AVAILABLE POTASSIUM (K)

The following figure shows that the value of available K of collected soil samples from different stations. The highest value 6.31 ppm of available k is found in point 1 at station 3 and the lowest 3.82ppm value is found in point 3 at station 3. It represents the higher value than standard level [16]. The concentration of potassium of all points lies between 3.82-6.31ppm. And the higher concentration which indicated the larger amount for crops production. It is over nutritious soil especially rich in potassium

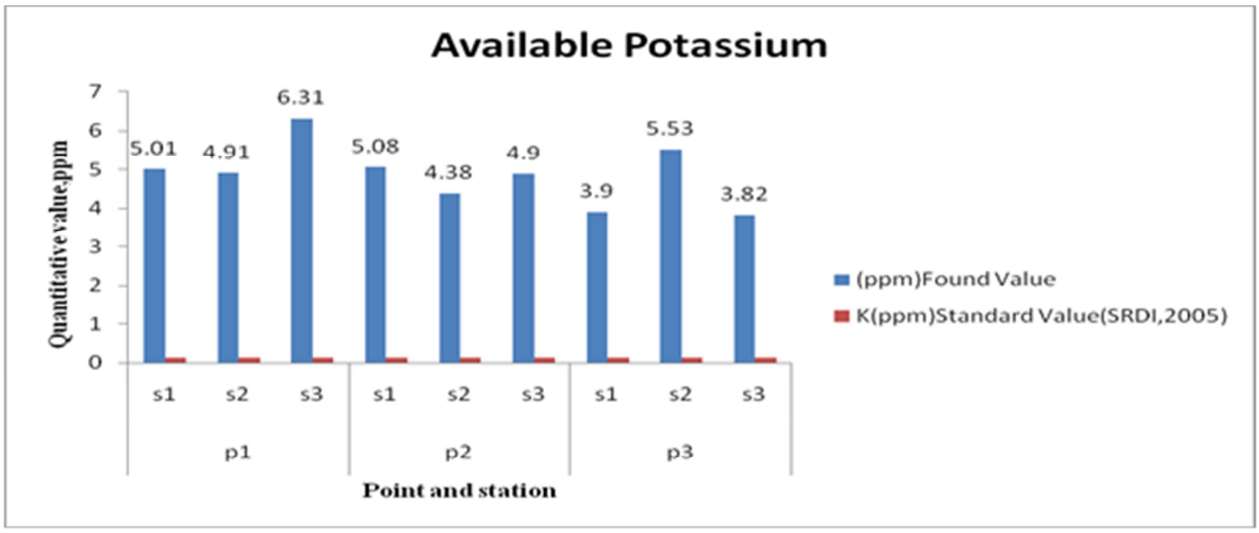


Fig.3.4. Available potassium of different points

AVAILABLE SULPHUR (S)

The conducted research showed that the variation of available Sulpher at different sampling station. The highest value 14.11ppm of available S is found in station 3 under point 2 and the lowest 11.49ppm value is found in point 3 at station 2. The available sulphur concentration was higher than the standard limit of sulpher [16]. Sulphur is used to crops production as macro nutrients of plant but excessive amount of sulpher in soil may cause of detrimental effects of crops production. In this study the lowest limit of the value is much higher than the acceptable limit and the highest value is intolerable for plants.

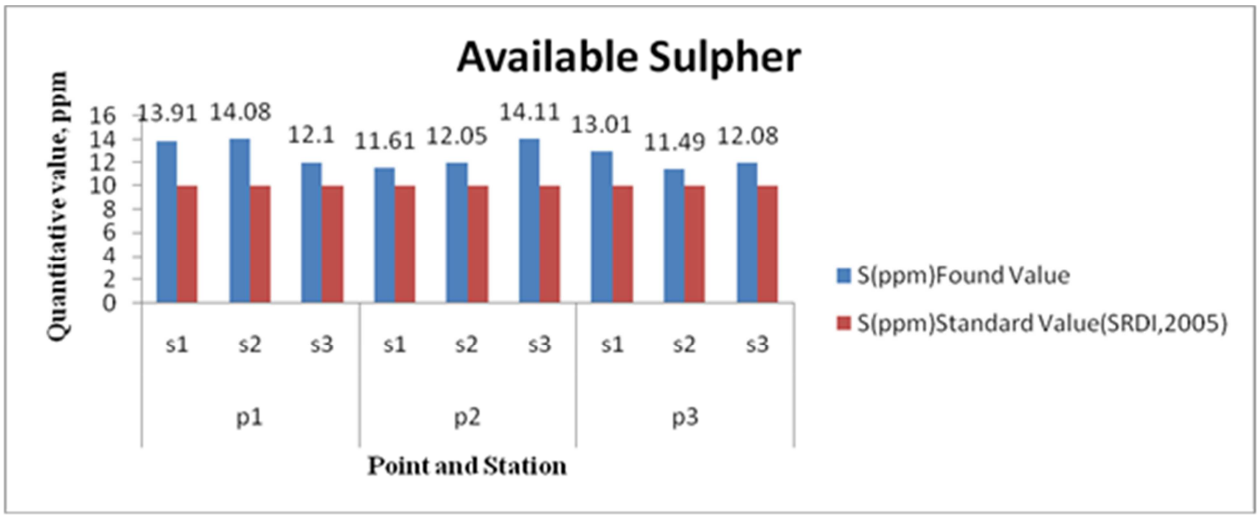


Fig.3.5. Available sulphur of different points

AVAILABLE PHOSPHORUS (P)

The highest value 20.76ppm of available P is found in station 1 under point 1 and the lowest 14.66ppm value is found in station 1 under point 2.The available phosphorus concentration is much higher than the standard limit [16] of phosphorus. Phosphorus is used to crops production as macro nutrients of plant but excessive amount of phosphorus in soil may cause of detrimental effects of crops production. The lowest limit of the value is much higher than the acceptable limit and the highest value is intolerable for plants. It may be due to the excess release of waste from industry.

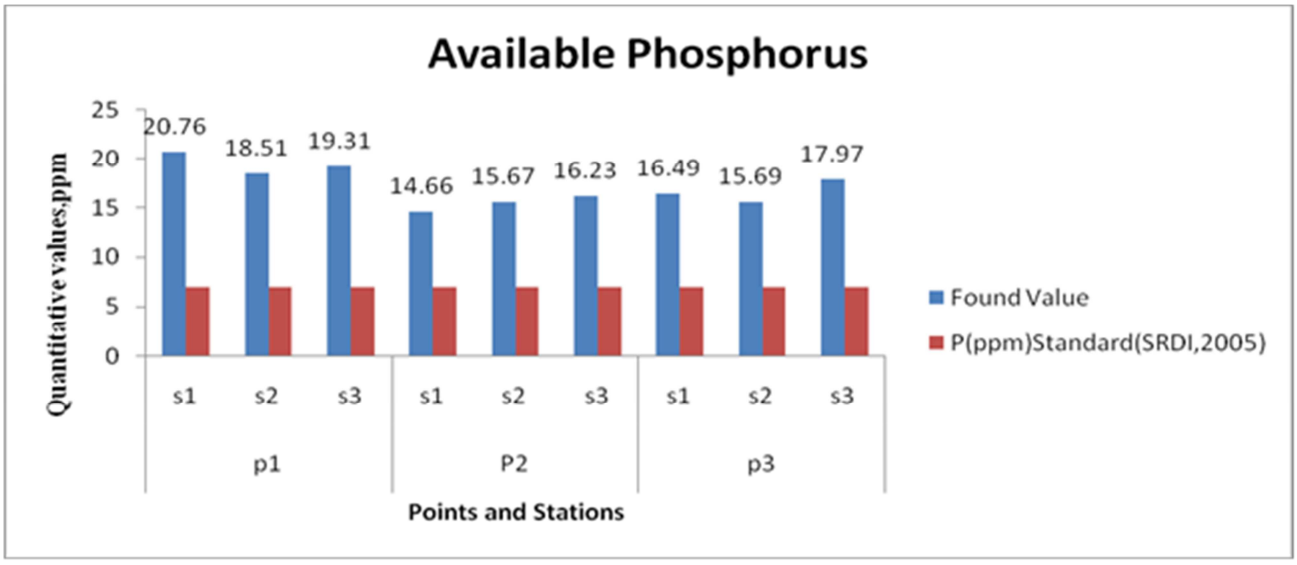


Fig.3.6. Available phosphorus of different points

ZINC (ZN)

The highest value 3.050ppm of available Zn is found in station 1 under point 3 and the lowest 1.909ppm value is found in station 3 under point 1. Zinc plays role in the environment especially in soil as a micronutrient or is used as a trace element. But the concentration of zinc is detrimental for the plants or organisms if it is available in higher amount. The concentration of all stations of P1 and P2 is in the tolerable limit but the three stations of third point exceed the standard limit [16]. There were battery industries in that area so it may be the consequence of that industry.

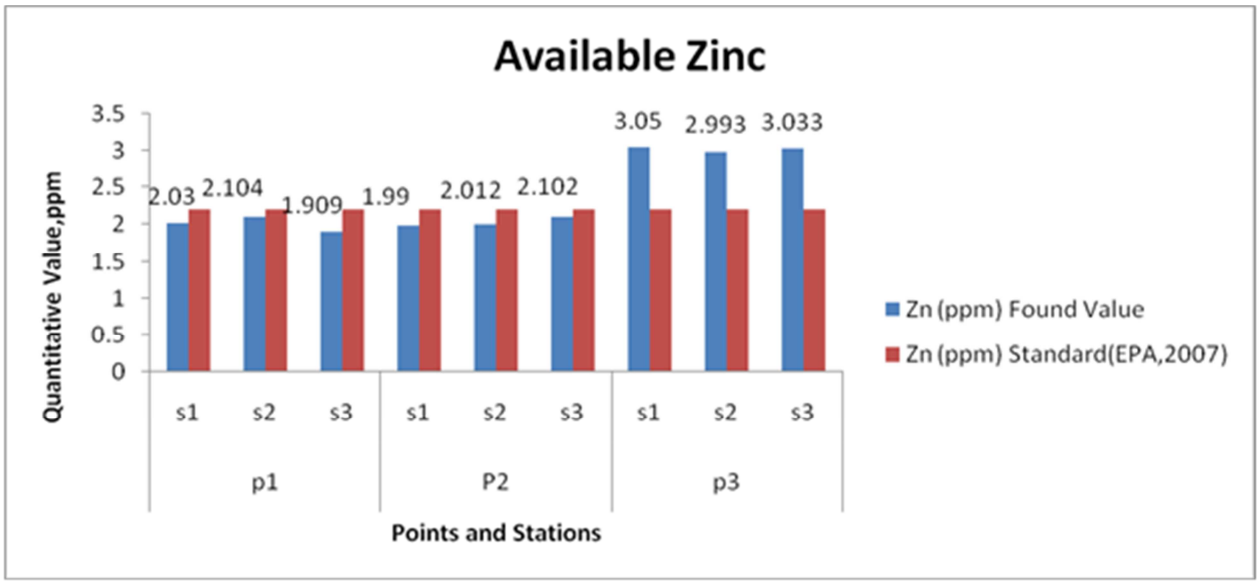


Fig.3.7. Concentration of zinc at different points

CADMIUM (CD)

From the figure (3.8) the analyzed value of Cd of different sampling points that the highest value .235ppm of available Cd was found in point 2 at station 3 and the lowest .104ppm value was found in point 3 at station 1. The point 2 of station 3 has relatively higher Cd concentration than the other stations. The continuous deposition and accumulation of industrial wastes and effluents might be responsible for this high concentration of Cd.

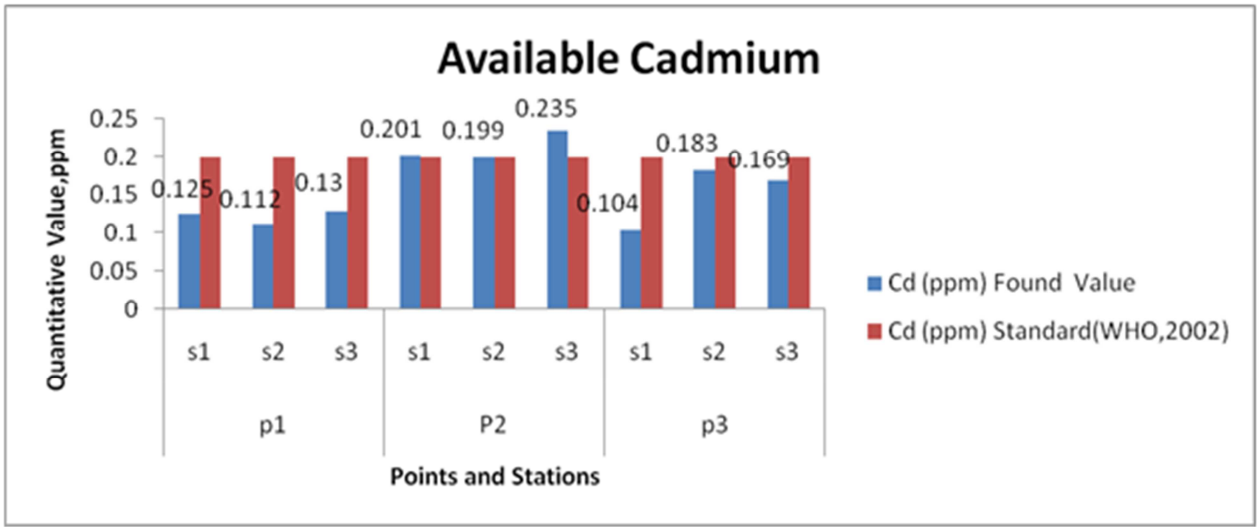


Fig.3.8. Concentration of Cadmium at different points

COPPER (CU)

Analyzed result of the study showed that concentration of Cu at different sampling stations The highest value .089ppm of available Cu was found in point 3 of station 1 and the lowest .065ppm value was found in point 3 of station 3. All the stations contain the value higher than the standard value [17]. It may be the consequences of release of waste from battery industries.

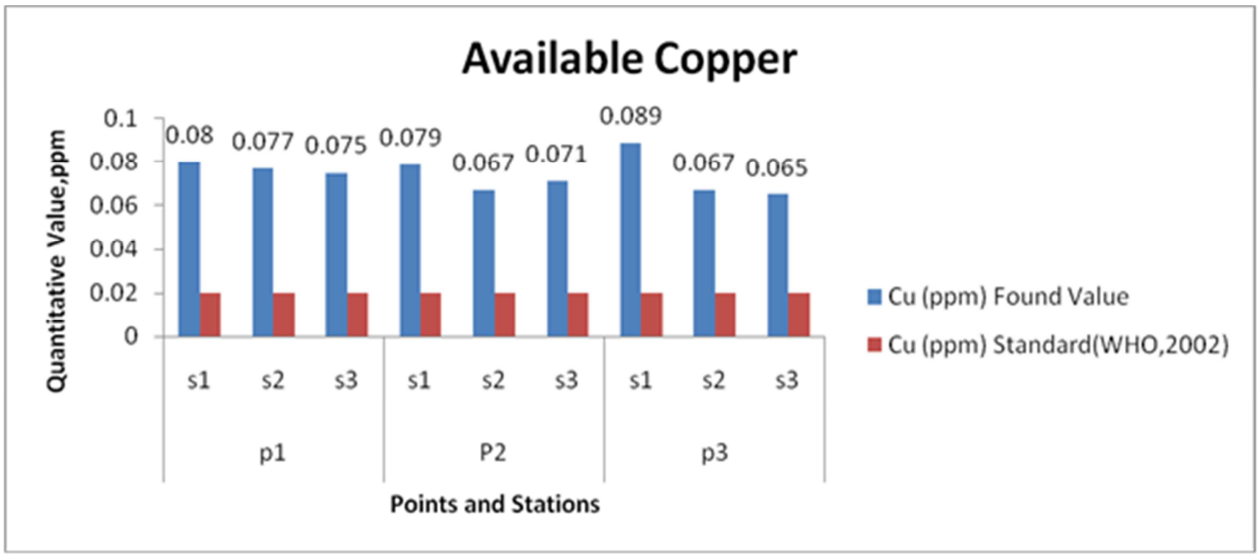


Fig.3.9. Concentration of copper of different points

LEAD (PB)

The highest value .762ppm of available Pb is found in station 1 under point 1 and the lowest .575ppm value is found in station 2 under point 2, but the standard value of lead for soil is 0.2ppm [17] and all the values of lead in all sampling point are greater than the standard value. There were a number of battery industries here so the concentration of Pb may be present here for this reason.

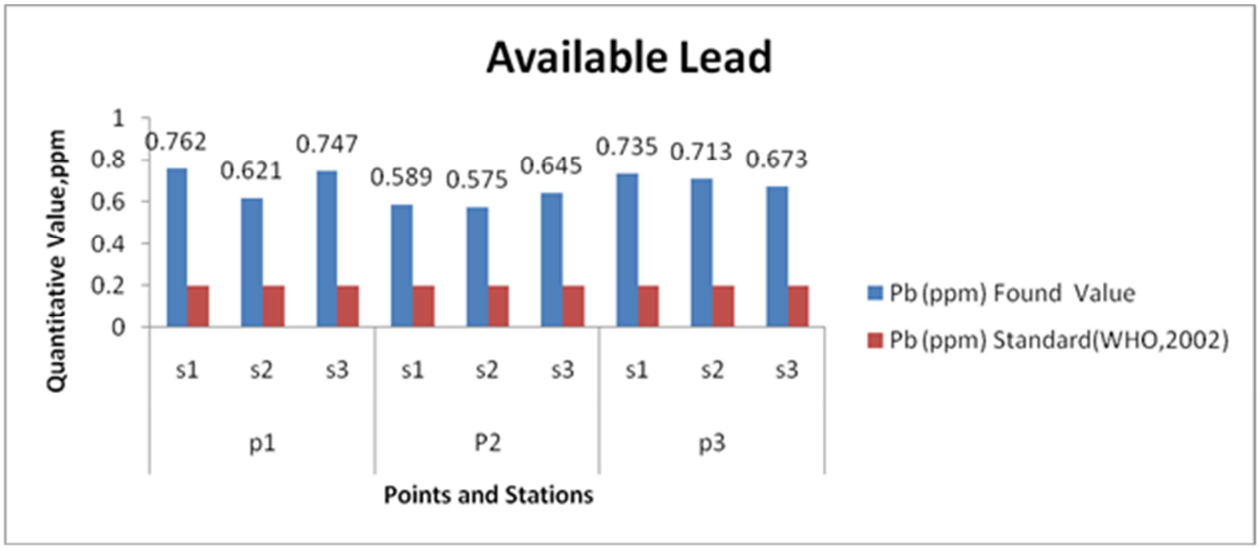


Fig.3.10. Concentration of lead of different points

4 CONCLUSION

The contamination of soil by heavy metals from industrial sources had become a serious environmental issue. Bangladesh is a developing country and there are many industries like garment, battery, plastics, glass, leather factory and tannery etc situated here. Zirani of Savar is an important industrial area of the country which provides wide range of potentiality for economic development. The analyzed result revealed the soil surrounding the dumping site was slightly acidic which is not harmful for agricultural production. The highest value of OC was recorded 2.14% at point 3 and the lowest value was 1.92% which was found point 2 that is greater than the reference value. Except total N concentration, the amount of available P, K, and S were greater than their recommended level. In addition the result showed that the concentration of Cu and Pb were much higher than their recommended level and the maximum value of Cu was 0.089 ppm and 0.762 ppm was the maximum

concentration of Pb. and the concentration of Zn and Cd were within tolerable limit. Zn at point 3 showed higher concentration which was 3.050ppm. The maximum value of Cd was 0.089ppm that was found at station 1 under point 3. From present research it has been stated that the soil quality was not satisfactory during study period. So ETP should be establish and properly maintain to reduce heavy metals concentration in soil.

REFERENCES

[1] APHA, 1998. Standard Methods for Examination of Water and Wastewater. America Public Health Association,20th Ed, Washington D.C.

[2] Begum, A., M. Ramaiah, K. Irfanulla and K. Veena, 2009.Analysis of heavy metal concentrations in soil and lichens from various localities of Hosur Road, Bangalore, India. CODEN ECJHAO, E-J. Chem., 6(1): 13-22.

[3] De, A.K., 2003. Environmental Chemistry, Fifth edition, New Age International Publishers, 89-116.

[4] El-Motaium, R.A. and S.H. Badawy.2000. Effect of Irrigation Using Sewage Water on the Distribution of Some Heavy Metals in Bulk and Rhizosphere Soils and Different Plants Species: Cabbage Plants (Brassica plercea L.) and Orange trees (Ctirussenensis L.), Egyptian J. Soil Sci., 40(1-2): 285-303.

[5] El-Nennah, M., T.El-Kobbia, A.Shehata and I. El-Gamal.1982. Effect of Irrigation Loamy Sand Soil by Sewage Effluence on Its Content of Some Nutrients and Heavy Metals,Pl. Soil, 65: 289-292.

[6] Fereidoun, H., Nourddin, M. S., Rreza, N. A., Mohsen, A., Ahmad, R. &Pouria, H., 2007. The Effect of Long-Term Exposure to Particulate Pollution on the Lung Function of Teheranian and Zanjanian Students, Pakistan Journal of Physiology, 3(2), pp. 1-5.

[7] Islam, M.S. 1983. Soil Management, Agricultural Research in Bangladesh, BARC, Dhaka, pp. 6-5.

[8] Kaklova, M., j, Kukla and F. Hnilicka, 2010. The Soil-to-Herbs Transfer of Heavy Metals in Spruce Ecosystems, Polish J.of Environ. Stud. Vol. 19, No, 6(2010), 1263-1268.

[9] Kromm, D. E. 1973. Response to Air Pollution in Ljubljana, Yugoslavia, Annals of the Association of American Geography.

[10] Olayinka, K, O, A, O. Oyeyiola, F, O. Odujebe and B. Oboh, 2011, Uptake of potentially toxic metal by vegetable plants grown on contaminated soil their potential bioavailability using sequential extraction, Journal of Soil Science and Environmental Management Vol.2(8), 220-227

[11] Sultana, M. S., .Kabir S. E., Kabir M., Mia C. M., Begum N., Chowdhury D., and Rahman M. S. (2003) Assessment of Effluent Quality of Dhaka Export Processing Zone with special Emphasis to that of the Textile and Dyeing Industries; Jahangirnagar. University. J. of Science. 25: 137-143

[12] Samical, A, I., V. Oros, J. Juhasz and E. Pop, 2008, Studies on transfer and management journal,September/October2008, Vol. 7, No.5,609-615.

[13] Tarradellas J., Bitton G., Russel D., (Eds), (1996), Soil Ecotoxicology, CRC Lewis Publisher, New York.

[14] Wolnik, KA, Fricke FL, Capar SG, Braude GL, Meyer MW, Satzger RD, Bonnin E (1983). Elements in major raw agricultural crops in the united States. Cd and Pb in lettuce, peanuts, potatoes, soyabeans, sweetcorn and wheat, J. Agric. Food Chem., 31: 1240-1244.

[15] Markert, B. 1993.Plants as Biomonitors, Indicators of Heavy Metals in the Terrestrial Environment.VCH Verlags GasellschaftmbH.D-6940 Weinheim (FRG).

[16] SRDI, 2005. Land and Soil Resources Utilization Guide (in Bengali). Upazila Nirdeshika series. Soil Resources Development Institute, Dhaka. pp. 45-63.

[17] WHO, 2002. Codex Alimentarus- General standards for contaminants and toxins in soil. Schedule 1 Maximum and Guideline levels for contaminants and toxins in food, Joint FAO/WHO Food Standards Programme, Codex Committee, Rotterdam. Reference CX/FAC 02/16.

International Journal of Innovation and Scientific Research
ISSN 2351-8014 Vol. 10 No. 1 Oct. 2014, pp. 99-110

http://www.ijisr.issr-journals.org/

Efficient Detection of Relative Position for Multicasting of Warning Messages in VANET

Ms. Niyoti Pathak, Prof. Kanchan Dhote, and Prof. Jayant Rohankar

Wireless Communication and Computing,
TGPCET, Nagpur,
Affiliated to Nagpur University, India

ABSTRACT: The Global Positioning System (GPS) is a space-based global navigation satellite system (GNSS) that provides reliable location and time information in all weather and at all times and anywhere on or near the Earth when and where there is an unobstructed line of sight to four or more GPS satellites. The Global Positioning System (GPS) is actually a constellation of 27 Earth-orbiting satellites (24 in operation and three extras in case one fails). In VANET, this location information is shared with the Roadside Units and the vehicles to determine accident affected vehicle and to send alert packets to these vehicles. Generally, in VANET, broadcasting scenario can be seen, which is not required as all the vehicles in the network are not affected when emergency event occurs. Instead, multicasting of alert packets is more useful. Therefore, in this paper proposed system is used to design and develop vehicle node having travelling direction and the location information. This node will work as a road side unit and it will manage all vehicles location information and also manage detection of failure node in the network. Once the failure node is detected it will calculate the relative position of other vehicle and multicast the messages to particular vehicle.

KEYWORDS: Global positioning system (GPS), Road Side Units (RSU's), Safety Applications.

1 INTRODUCTION

The development and wide utilization of wireless communication technologies have transformed human lives by providing the most convenience and flexibility ever in accessing Internet services and various applications. Lately, researchers conceptualized the idea of communicating vehicles, giving rise to vehicular ad hoc networks (VANETs), which are the main focus of engineers who yearn to turn cars into intelligent machines that communicate for safety and comfort purposes. A VANET is composed of vehicles that are equipped with wireless communication devices, positioning systems, and digital maps [23]. VANETs allow vehicles to connect to roadside units (RSUs), which may be interconnected with each other through a high-capacity mesh network. Current research trends for VANETs focused on developing applications that can be grouped into the following two classes: 1) improving the safety level on the road and 2) providing. The last decade has witnessed a rising interest in vehicular networks and their numerous applications. Although the primary purpose of VANET standards is to enable communication-based automotive safety applications, they allow for a range of comfort applications. Many services could be provided by exploiting RSUs as delegates to obtain data on the user's behalf. These services span many fields, from office on-wheels to entertainment, downloading files, reading e-mail while on the move, and chatting within social networks.

Due to lack of real time implementation one cannot understand the real problems and the real time scenario issues. In VANET, V-2-V is most demanded scenarios for communication but with who to communicate is the issue. As, in VANET, information sharing is the most important point but it's still a problem to define who is the exact message receiver. Human can decide to send message to particular person after looking toward its position, but machine cannot do this. Many interesting application is provided by VANET but the primary goal of VANET is to provide transportation efficiency and road safety measures where information about vehicle current speed location co-ordinates are exchanged with or without the deployment of road side infrastructure.

Corresponding Author: Ms. Niyoti Pathak

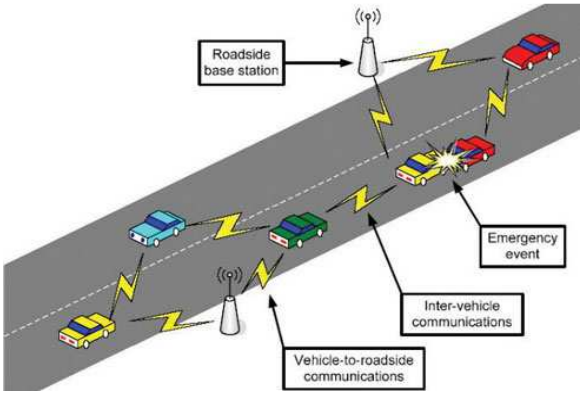


Fig. 1.1 Communication in VANET (V2V and V2I)

As shown in fig.1 Communication in VANET can be seen. In this communication takes place in two ways. Firstly, when emergency event occurs, Roadside base station will communicate with vehicles to send alert packets. Secondly, vehicles will communicate with other to exchange alert packets.

Data exchange in VANET is a challenging task as the topology is highly dynamic and constantly changing. The nodes in VANET are highly mobile and consequently network is frequently fragmented. When the emergency event occurs i.e. car accident or emergency breaking early alert message is given to the drivers which are behind it. The vehicle drivers who receive this message have enough time to react to the emergency situation because the wireless propagation delay is significantly smaller than the cumulative driver reaction. Vehicles which receive this early alert message have plenty of time to react to the situation and number of vehicle collision can be potentially reduced.

VEHICULAR ad hoc networks (VANETs) promise great enhancement to traffic safety and traffic management with wireless vehicle-to-vehicle and vehicle-to-roadside communications. Specifically, enabling nearby vehicles to wirelessly share driving states, VANETs enable various traffic safety applications such as collision avoidance and lane change assistance. In addition, in VANETs, real-time traffic data can be collected from vehicles to improve traffic management. Thus, the potential to improve traffic safety and traffic management will push VANETs to be massively deployed in the future. Furthermore, with free vehicular communications, VANETs provide a handy platform to more cost effective solutions to various value-added applications, e.g., on-road entertainment and automatic survey. Comparatively, existing cellular communications [third-generation (3G) and fourth-generation (4G)] will incur service fees to support such value-added applications.

2 RELATED WORK

Earlier, broadcasting in vehicular adhoc networks (VANET) emerged as a critical area of research. One of the challenges posed by this problem is confinement of the routing problem to vehicle-to-vehicle (V2V) scenarios as opposed to also utilizing the wireless infrastructure (such as cellular networks). At a Fundamental level, safety and transport efficiency is mandate for current car manufacturers and this has to be provided by the cars on the road as opposed to also using the wireless communication infrastructure. Such applications with these real-world constraint calls for a new routing protocol for vehicular broadcasting in VANET. In this, Ozan Tonguz, Nawapom Wisitpongphan, Fan Bai, Priyantha Mudalige, and Varsha Sadekar[1] author reports the first comprehensive study on the subject whereby the extreme traffic situations such as dense traffic density, sparse traffic density, and low market penetration of cars using DSRC technology are specifically taken into account. This paper shows that our Distributed Vehicular Broadcasting protocol can cope with all of the important considerations. VEHICULAR ad hoc networks (VANETs) have emerged as one of the most successful commercial applications of mobile ad hoc networks. Much of the literature assumes radio ranging VANET CP systems, which is not viable. Here the author Nima Alam, Asghar Tabatabaei Balaei, and Andrew G. Dempster consider this technologies emerging for vehicular communication presented [2] Cooperative positioning (CP) techniques, fusing data from different sources, can be used to improve the performance of absolute or relative positioning in a vehicular ad hoc network (VANET).

In [3] Sok-Ian Sou proposes an analytical model for evaluating the performance of emergency messaging via wireless CA systems. Routing protocols developed for ad hoc wireless networks use broadcast transmission to either discover a route or disseminate information. However, the conventional broadcast mechanism may lead to the so-called broadcast storm problem.

In [4] Sok-Ian Sou and Ozan K. Tonguz analyze and quantify the improvement in VANET connectivity when a limited number of roadside units (RSUs) are deployed and to investigate the routing performance for broadcast-based safety applications in this enhanced VANET environment. In a Vehicular Ad Hoc Network (VANET), the wireless Collision Avoidance (CA) system issues warnings to drivers before they reach a potentially dangerous zone on the road.

In [5] author Aghdasi et al. suggests some applications which inherently need multicast routing protocols and introduce them .Then, precisely look over the usefulness of current multicast routing protocols for VANETs..

In [6] Ozan K. Tonguz et al. explores how serious the broadcast storm problem is in both MANET and VANET by examining how broadcast packets propagate in a 2-dimensional open area and on a straight road or highway scenarios

In [7], Mahmoud Abuelela et al. introduced a novel incident detection technique for non-dense traffic flow by taking advantage of communication between cars and some roadside infrastructure installed on the road every mile or so. The proposed technique can provide a great enhancement to the existing Automatic Incident Detection techniques especially under sparse traffic where most of them fail to detect non-blocking incidents. Cooperative positioning (CP) can potentially improve the accuracy of vehicle location information, which is vital for several road safety applications.

In [8] Jun Yao et al. proposed simple easily deployable protocol improvements in terms of utilizing as much range information as possible, reducing range broadcasts by piggybacking, compressing the range information, tuning the broadcast frequency, and combining multiple packets using network coding Vehicular ad hoc networks play a critical role in enabling important active safety applications such as cooperative collision warning. These active safety applications rely on continuous broadcast of self-information by all vehicles, which allow each vehicle to track all its neighboring cars in real time. The most pressing challenge in such safety-driven communication is to maintain acceptable tracking accuracy while avoiding congestion in the shared channel.

In [8] Gustavo Marfia et al. is presenting a detailed description of the greatest experiments (a few thousand throughout the streets of Los Angeles), to date, ever performed with an accident warning system specifically devised for highway scenarios. In particular, among all the possible candidate schemes, ran a few thousand experiments with the accident warning system algorithm that was proven to be optimal in terms of bandwidth usage and covered distance in realistic scenarios. The experiments confirm what has been observed before in theory and simulation, i.e., the use of such a system can reduce, by as much as 40%, the amount of vehicles involved in highway pileups.

In [9] Ching-LingHuang et al. proposes a transmission control protocol that adapts communication rate and power based on the dynamics of a vehicular network and safety-driven tracking process. In [10] and [11], Tonguz et al. proposed a distributed vehicular broadcasting protocol (DV-CAST), based on a vehicle's connectivity the local routing decisions are made.

In [12] F. Farnoud et al. used a positive orthogonal code to distribute a transmission pattern for broadcast messages performance in terms of the success probability and the average delay in message delivery was reported.

M. Torrent-Moreno et al. [13] proposed a distributed transmit power control method based on a strict fairness criterion to control the load of periodic messages on the channel and to avoid saturated channel conditions

In [14] P. Li, X. Huang et al., the authors investigated the problem of placing gateways in VANETs to minimize the power consumption and the average number of hops from access points to gateways. Lochert et al. studied in [15] how the infrastructure should be used to improve the travel time of data dissemination over large distances.

In [16], C. Lochert et al., the author used stationary support units to improve the refreshing rate of the information dissemination in city scenarios. In [17], Bilal Munir Mughal1 et al. evaluates techniques and highlight following major drawbacks first: using only power control techniques do not satisfy requirements of envisioned beacon-dependent safety applications, second: methods used for measuring channel usage level in transmission rate control technique may not be as effective under real world conditions.

There are number of work proposed to study DSRC technology that improves safety on road in [18] S. Biswas et al., gives an overview of vehicle cooperative collision avoidance application based on emerging DSRC device and improve the highway traffic safety along with demonstrating the need for data prioritization for safety critical application. Xue et al. proposed a communication protocol for collision avoidance and computed the MAC transmission delay [19].

Naumov et al. Studied in [20] VANET routing protocols by using mobility information that is obtained from a vehicular traffic simulator based on real road maps ratio.

In [21], Y. Zhang et al. the author focused on network fragmentation scenarios in VANETs with real-world vehicular mobility models and provided a store–carry–forward solution to routing in disconnected networks. The existing literature

shows that, when the VANET is well-connected, Car accidents can be significantly reduced when traffic-related data can be successfully collected. On the other hand, in sparse VANET, two vehicles are probably disconnected and the message delivery is taken by the store-carry forward scheme.

This paper [22] proposes a position base broadcast module, named Broadcast Control Unit (BCUnit), in order to reduce the re-broadcast nodes and minimize emergent message conflict. This module can be easily implemented to WAVE/DSRC devices without any additional transmission overhead and explicit coordination among vehicles. The simulation results show significant progress in multi-hop delay.

3 PROPOSED WORK

Based on result which is reported in previous studies we find that design of early alert message advertising model with reliable routing protocol for multicast messaging that can cope with network fragmentation problem is crucial. To reduce the re-healing time for a sparse VANET and the number of re-healing hops for a dense VANET, we investigate the use of RSUs to assist the traffic safety messaging, which aims at delivering safety message alert to dedicated vehicles using relative positioning by multicasting the alert message to only those vehicle which is going to get affected by the event with high reliability, few hop counts, and low delay. Our goal is to improve the VANET connectivity for safety message delivery between the vehicles and the RSUs.

3.1 MULTICASTING OF ALERT MESSAGES

VANETs topology is highly dynamic and rapidly changing. There is temporary network fragmentation in VANET due to unique characteristics such as special mobility patterns. The transportation safety is enhanced by VANETs provide traveler information, develop comfort applications and traffic flow is improved. VANETs' routing protocol faces many new challenges based on realizing these applications. Popularity of multicast routing protocols has increased the cause is, the VANET routing protocol provides many to many and one to many communication for different application of VANET.

Most of the existing multicast routing protocols are designed to satisfy safety applications. However there are some non-safety applications that also need multicast routing protocol. In recent years vehicles role is important in human life. Since human spend plenty of time driving their cars daily. The growing number of cars within the cities and along the highways requires a precise management to improve traffic flow and decrease the number of deaths and injuries in vehicular collisions, and eventually make travels more pleasant. In the highways, the most dangerous accidents are Rear-end and Chain Vehicle Collisions that occur because of sudden speed decrease.

If any vehicle collision or anomaly event imposed a sudden speed decrease to front vehicle, all the vehicles in the risk area i.e. Region of Interest should be announced to avoid Rear-end and Chain Collisions. In case of emergency not all the vehicles get effected in the network so broadcasting of alert packet is not feasible rather it should be multicast, but defining the list of node to be considered for multicast is challenging task as every vehicle cannot hold the location information of the entire vehicle in the network. However, the communication can be interrupted when the density of vehicles is not enough. In the other words, the communication suffers the Hole Problem therefore RSU is employed to overcome this.

3.2 ENHANCING VANET CONNECTIVITY WITH EMPLOYING ROAD SIDE UNIT (RSU)

Road side unit will manage all the vehicle information and detect the failure vehicle and calculate the detail of the vehicles get affected by the failure vehicle using the relative positioning and multicast alert packet to identified vehicles as shown in Fig.2. The relative position can be found out to calculate to which vehicles the alert message should be multicast. Relative position is calculated using great circle algorithm.

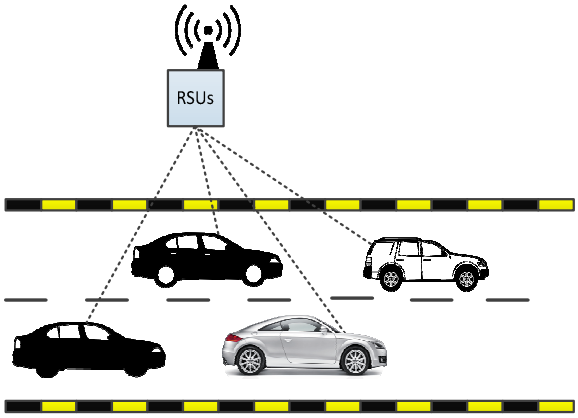


Figure 3.1: RSU communicating with affected vehicle by sending alert message by the store-carry forward scheme

Global positioning system is used to get the vehicle position and can be shared with other nodes in the network. The sparse vehicle traffic leads to network fragmentation, is challenging task for safety application. In case of emergency not all the vehicle get affected in network so broadcasting of alert packet is not feasible rather it has to be multicast, but defining the list of node for multicast is challenging task as every vehicle cannot hold the location information of the entire vehicle in the network. Calculating the list of relative vehicles position is depending on the travelling direction, bearing angle and distance. Road side unit manage all the vehicle information and detect the failure vehicle and calculate detail of the vehicles get affected by the failure vehicle.

4 RESEARCH METHODOLOGY

The paper proposes a system which is designed and developed to find out the relative position between multiple vehicles. In this, road side unit will manage all the vehicle information and detect the failure vehicle and calculate the detail of the vehicles which are affected by the failure vehicle using the geo positioning and multicast alert packet to identified vehicles. This will narrow down the broadcasting scenario and prevent the traffic congestion due to wrong message delivery to unwanted vehicles.

Proposed system is used to design and develop vehicle node having travelling direction and the location information. It is used to develop a node which will work as a road side unit and manage all vehicle location information and also manage detection of failure node in the network. Once the failure node is detected it will calculate the relative position of other vehicle and multicast the messages to particular vehicle. By using socket programming, logical network is established between entire nodes in the network.

The relative vehicle position is depending on three aspects:

Travelling direction: Using GPS device protocol data system can get the direction for which system need to parse & process GPS data
Bearing angle: Degree on earth co-ordinate system with respect to vertical center of earth is called as bearing angle.
Distance: The great circle algorithm is used to calculate the distance and the angle between two Geo point on the earth.

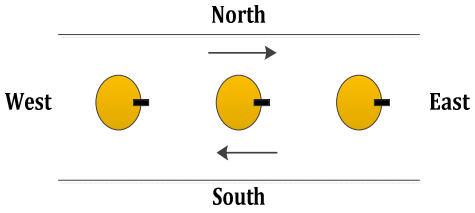


Fig.4.1 Relative position with respect to Travelling Direction

Relative position with respect to travelling direction is given in Fig.2. Travelling direction can be detected through GPS device itself but relative positioning cannot be gathered from GPS device while travelling. As Travelling direction can change the relative position.

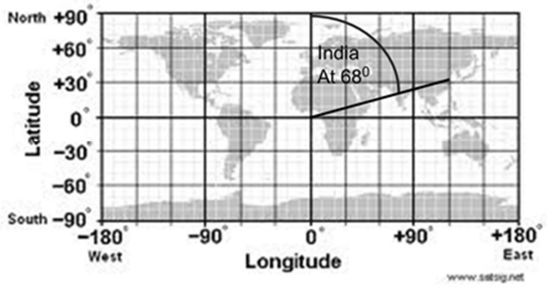


Fig.4.2 Relative Position with respect to bearing angle

Every object on earth co-ordinate stands at particular angle with respect to vertical center of the earth this can be called as bearing angle. India stands at 68 degree on the earth.

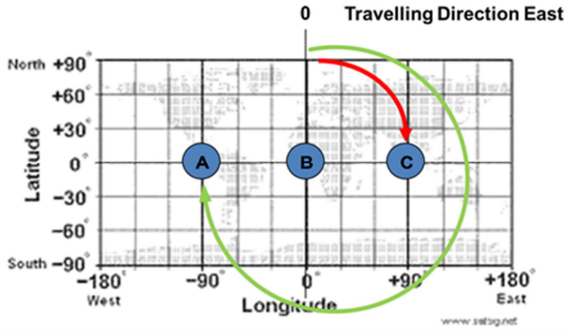


Fig. 4.3 Relative position with respect to distance

Consider a scenario, Vehicle B met with the accident and travelling direction is east so after calculating angle of 'C' and 'A' we get that 'C' is at minor angle and 'A' at major angle hence 'C' is Leading vehicle and 'A' is Following vehicle so alert will go to 'A'.

4.1 GREAT CIRCLE ALGORITHM

The scenario can be worked out by using an algorithm called **Great circle Algorithm**. The great-circle distance or orthotropic distance is the shortest distance between any two points on the surface of a sphere measured along a path on the surface of the sphere (as opposed to going through the sphere's interior). Because spherical geometry is rather different from ordinary Euclidean geometry, the equations for distance take on a different form. The distance between two points in Euclidean space is the length of a straight line from one point to the other. On the sphere, however, there are no straight lines. In non-Euclidean geometry, straight lines are replaced with geodesics. Geodesics on the sphere are the *great circles* (circles on the sphere whose centers are coincident with the center of the sphere).

Between any two different points on a sphere which are not directly opposite each other, there is a unique great circle. The two points separate the great circle into two arcs. The length of the shorter arc is the great-circle distance between the points. A great circle endowed with such a distance is the Riemannian circle.

Between two points which are directly opposite each other, called *antipodal points*, there are infinitely many great circles, but all great circle arcs between antipodal points have the same length, i.e. half the circumference of the circle, or πr, where r is the radius of the sphere.

Because the Earth is nearly spherical (see Earth radius) equations for great-circle distance can be used to roughly calculate the shortest distance between points on the surface of the Earth (*as the crow flies*), and so have applications in navigation.

To calculate the direction of movement enough to know coordinates of two consistently received landmarks. If you use the Cartesian coordinate system and adopt the longitude on the axis "X", latitude on the axis "Y" - then it is possible to

calculate the vector of movement. The following image demonstrates how to calculate the vector of the movement and the angle of the vector:

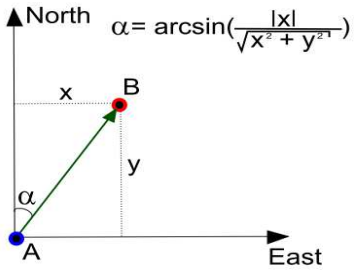


Fig. 4.4

Depending on the direction, you must perform correction of meaning angle. The following code snippet demonstrates how to calculate the angle of the movements (relative to north), knowing consistently received two landmarks.

All recreational GPS units can tell you your current bearing, e.g. North, South, East, West and all the points in between.

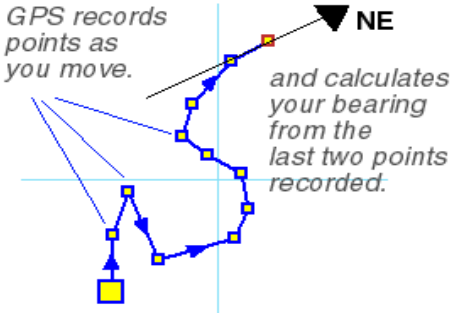


Fig. 4.5

This is an alternative way to take a bearing. You must be moving and it is essential to know your precise position so it is perfect for GPS. As you move through the countryside the GPS periodically records your position as shown in fig.4. By comparing where you were to where you are now the GPS can work out which direction you are heading and uses this to indicate the current.

4.2 RELATIVE POSITION IDENTIFICATION

Figure 4.6 describes the intervehicular information sharing in VANET where every vehicle having location information of all vehicles in the network. The major problem in this scenario is that vehicles are not having information about relative position of all other vehicles. Consider an emergency situation if wrong message get delivered to other vehicle it may create a panic situation and hence create a traffic jam.

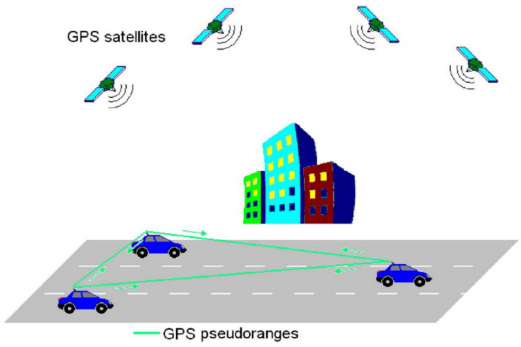


Fig. 4.6 Locations Relation Identification

Figure 5 describes the intervehicular information sharing in VANET where every vehicle having location information of all vehicles in the network. The major problem in this scenario is that vehicles are not having information about relative position of all other vehicles. Consider an emergency situation if wrong message get delivered to other vehicle it may create a panic situation and hence create a traffic jam. While finding the relative position most important aspect should be kept in consideration is the direction of travelling because that the only parameter decides the travelling time relative position between vehicles. In case of emergency like accident there is no point in sharing informing with front vehicle, it is not necessary to message front vehicle. Hence by calculating the vehicles behind the accident vehicle, system can prevent broadcasting the packet rather then it will multicast the messages. Road side unit will manage all the vehicle information and detect the failure vehicle and calculate the detail of the vehicles get affected by the failure vehicle using the relative positioning and multicast alert packet to identified vehicles.

5 PARSING THE GPS DATA AND DISPLAYING

The proliferation of consumer GPS products has provided engineers with a wide variety of low-cost, high-quality GPS modules that are ideally suited for embedded location and navigation applications. Embedded and hand-held GPS devices provide raw output through a serial connection in the form of comma delimited, CrLf (carriage return/line feed) terminated NMEA strings, typically at 4800 baud. Each string begins with a unique identifier and contains one or more fields; for example: $GPRMC,032606,A,3410.2358,N,11819.0865,W,0.0,207. 2,180211,13.5,E,A*32 Sample program execution to read the GPS data. GPS provide different protocols to provide different information GPS device can connect to PC using USB or Bluetooth. Both are physical connection. For programming we need Logical port i.e. COM port. O.S Map physical device to logical Application use these. Once device is connected to the system need to read data from device i.e. from COM port. As the GPS data fetched from device is in multiple line and every line holding specific information separated by ‘,’ so we need to identify the proper protocol data and parse it in order to get the exact data. Using the split()function system will parse the data. Using the Google API the parsed geo data is mapped on the Google map.

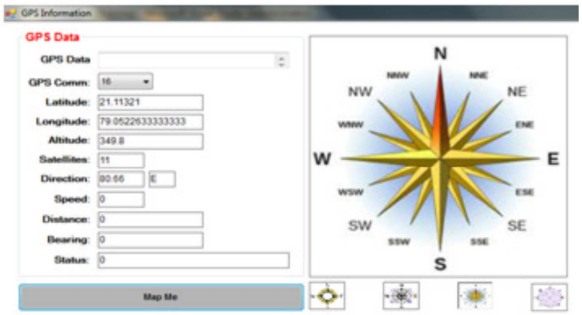


Fig 5.1.Parsing of Data

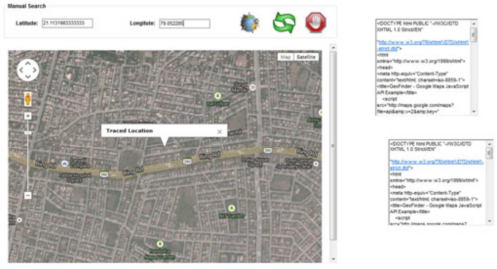


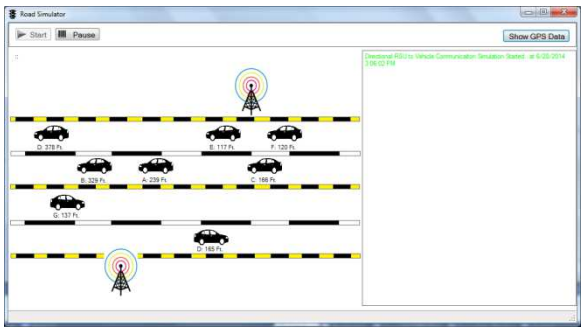
Fig 5.2 Mapping Geo Data on Google Map

Figure 5.1 shows the parsed data from the fetched data from the GPS device. After parsing the data system will get the travelling direction. Figure 5.2 shows the mapping of the parsed data from the GPS device by using the Google API. So that

the vehicle will give the current location of its own, this can be shared with the RSU to notify the RSU of its current position. RSU can find the relative positioning between multiple vehicles and multicast the alert packet to identified vehicles.

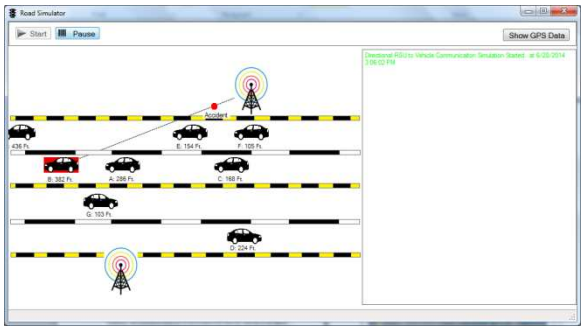
6 RESULT ANALYSIS

A. Vehicle to Roadside Unit Communication



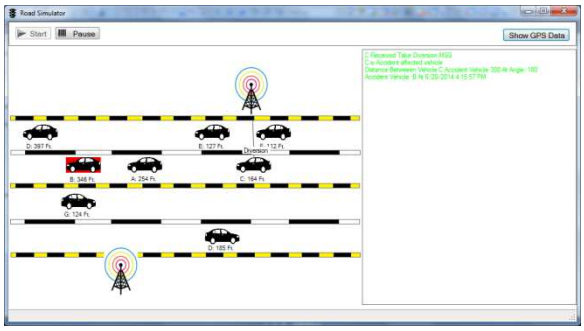
In a typical scenario of Vehicle to Roadside Unit Communication, Roadside Unit communicates with all the vehicles in the network. These vehicles have its own location information. This location information of vehicles is shared with Roadside Units in the region. When simulation starts, RSU communicates with the vehicles in the network. Next step would be to perform an accident of a vehicle, which can be done by clicking on a vehicle. When we click a particular vehicle a dialog box will appear

B. Collision Detection by RSU



'B' met with an Accident which is shown in Red area. This B Vehicle then communicates with Road Side Unit (RSU). RSU will get all the location information through GPS. RSU then calculates the position of the vehicle by using great circle algorithm and bearing angle.

C. Multicasting of Warning Messages to Affected Vehicles



When RSU receives Accident Alert from a vehicle, it has all the location information of that vehicle through GPS. When RSU will get the location information it will identify other vehicles position by calculating their positions by Great Circle Algorithm and Bearing Angle. In the above scenario fig 7.4, RSU will multicast an alert message to the vehicles which are affected by the accident. C will get an alert message "Take Diversion" as C is less affected by the accident, and it can change its route. A will get an alert message as "Stop" as this vehicle is more affected by the accident so this vehicle cannot change its route instead it has to stop.

The simulation results shows the distance between the vehicle and bearing angle which met with an accident and the affected vehicle. Thus, giving the relative position of the vehicles as shown in the output screen. In the fig 7.6 we can see four different colored zones to show the status of the vehicles in the network. These four different colored zones are RED, ORANGE, and PURPLE, GREEN.

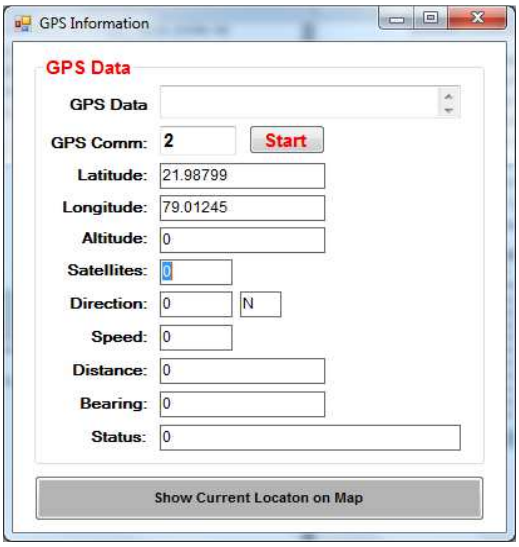
1) RED Zone vehicles are the ones which met with an accident.
2) ORANGE Zone vehicles are the ones which are highly accident affected vehicles.
3) PURPLE Zone vehicles are the ones which are less affected by the accident so they can change their routes or may slow down.
4) GREEN Zone vehicles also called as Safe Zone vehicles are the ones which are not at all affected by the accident.

RSU calculate the relative position on the basis of Great circle algorithm i.e. on basis of every vehicle location and the distance between each other. RSU will take the decision on the basis of travelling direction and the every vehicle location and calculate the relative position between all the vehicle. RSU can find the relative positioning between multiple vehicles and multicast the alert packet to identified vehicles. Even after GPS device having its own few meters of error term but, as system is working in open air so it is expected that the system will calculate the exact relative vehicle position and identity and send proper messages to dedicated vehicle.

We can see that the vehicle 'B' met with an accident. So, A and C are the accident affected vehicles. Therefore Roadside Unit will send an alert message to accident affected vehicle for e.g. 'Danger Ahead' or 'Change the Route'.

Therefore, the simulation result gives the distance and the bearing angle between the vehicle which met with an accident and the accident affected vehicle in the network. It can be given as: "Distance between Vehicle A Accident Vehicle 111 at Angle: 0", "Distance between Vehicle E Accident Vehicle 240 at Angle: 213".

D. Parsed Data from GPS



This information is the location information of a particular vehicle. This information from GPS is given the form of Latitude, Longitude, Altitude, Satellites, Direction of the vehicle, Speed of the vehicle, Distance from the RSU, Bearing angle, etc. This information is used by RSU to detect the accident affected vehicle. After detecting RSU multicasts alert messages to particular vehicles. We can see there is a button which reads "Show Current Location on Map. After clicking on that button, a Location Tracker will open which will give the exact location of the vehicle.

7 CONCLUSION

One promising aspect of VANET is that it can considerably improve road safety and travel comfort. In case of emergency not all the vehicle get affected in network so broadcasting of alert packet is not feasible rather it has to be multicast. This will narrow down the broadcasting scenario and prevent the traffic congestion due to wrong message delivery to unwanted vehicles in highway scenario. The number of vehicle collisions can potentially be reduced. Reduce the number of fatal roadway accidents by providing early Alert message.

Results show improved VANET connectivity for safety message delivery between the vehicles and the RSUs which is possible with the use of RSUs to assist the traffic safety messaging, which aims at delivering safety message alert to dedicated vehicles using relative positioning by multicasting the alert message to only those vehicle which is going to get affected by the event with high reliability, few hop counts, and low delay.

As a final remark, the impact of RSU deployment and multicasting on the performance of safety applications for VANETs in highway scenarios has been investigated in this paper and further research is needed to extend this model to urban scenarios, where the occurrence of accident are not distributed uniformly on the road, because of the complication of traffic intersection, and more prone to accidents

REFERENCES

[1] O. K. Tonguz, N. Wisitpongphan, F. Bai, P. Mudalige, and V. Sadekar, "Broadcasting in VANET," in Proc. IEEE INFOCOM MOVE Workshop, May 2007, pp. 7–12

[2] Nima Alam, Asghar Tabatabaei Balaei, and Andrew G. Dempster**, "**Relative Positioning Enhancement in VANETs: A Tight Integration Approach," IEEE 2012.

[3] Sok-Ian Sou**, "**Modeling Emergency Messaging for Car Accident over Dichotomized Headway Model in Vehicular Ad-hoc Networks**,"** IEEE 2013.

[4] Sok-Ian Sou and Ozan K. Tonguz, "Enhancing VANET Connectivity Through Roadside Units on Highways," IEEE 2011

[5] Aghdasi, H.S. Torabi, N. Rahmanzadeh, A. Aminiazar, M. Abbaspour, M. , "Usefulness of multicast routing protocols for vehicular Ad-hoc networks," IEEE 2012.

[6] Ozan K. Tonguz*, Nawaporn Wisitpongphan*, Jayendra S. Parikh, Fan Bai, Priyantha Mudaliget, and Varsha K. Sadekart , "On the Broadcast Storm Problem in Ad hoc Wireless Networks," IEEE 2006

[7] Gustavo Marfia, Marco Roccetti, Alessandro Amoroso, and Giovanni Pau. "Safe Driving in LA: Report from the Greatest Intervehicular Accident Detection Test Ever" IEEE 2013.

[8] Mahmoud Abuelela Stephan Olariu Gongjun Yan "Enhancing Automatic Incident Detection Techniques Through Vehicle To Infrastructure Communication," Proceedings of the 11th International IEEE Conference on Intelligent Transportation Systems Beijing, China, October 12-15, 2008

[9] Jun Yao, Asghar Tabatabaei Balaei, Mahbub Hassan, Nima Alam, and Andrew G. Dempster "Improving Cooperative Positioning for Vehicular Networks"IEEE 2011

[10] Ching-LingHuang, Yaser P.Fallah, and Raja Sengupta Hariharan Krishnan "Adaptive Intervehicle Communication Control For Cooperative Safety System".

[11] Ozan k. Tonguz and Nawaporn Wlisitpongphan, Fan Bei. "DV-Cast: A Distributed Vehicular Broadcast Protocol for Vehicular Ad-Hoc Networks" IEEE 2010

[12] M. Torrent-Moreno, J. Mittag,P.Santi, and H.Hartenstein,"Vehicle-to -vehicle communication: Fair transmit power control for safety-critical information,"IEEE Trans. Veh. Technol., vol. 58, no. 7, pp. 3684–3703, Sept. 2009.

[13] F. Farnoud and S. Valaee, "Reliable broadcast of safety messages in vehicular ad hoc networks," in Proc. IEEE INFOCOM, Apr. 2009,pp. 226–234.

[14] P. Li, X. Huang, Y. Fang, and P. Lin, "Optimal placement of gateways in vehicular networks," IEEE Trans. Veh. Technol., vol. 56, no. 6, pp.3421–3430, Nov. 2007

[15] C. Lochert, B. Scheuermann, C. Wewetzer, A. Luebke, and M. Mauve,"Data aggregation and roadside unit placement for a vanet traffic information system," in Proc. 2008 ACM International Workshop Veh.Inter-Netw., pp. 58–65

[16] C. Lochert, B. Scheuermann, M. Caliskan, and M.Mauve, "The feasibility of information dissemination in vehicular ad-hoc networks," in Proc. 2007 Conf. Wireless Demand Netw. Syst. Services, pp. 92–99.

[17] Bilal Munir Mughal1, Asif Ali Wagan2, Halabi Hasbullah. "Efficient Congestion Control in VANET for Safety Messaging" IEEE 2010

[18] S. Biswas, R.Tatchikou, and F. Dion, "Vehicle-to vehicle wireless communication protocols for enhancing highway traffic safety," IEEE Commun. Mag., vol. 44, no. 1, pp. 74–82, Jan. 2006.

[19] X. Yang, J. Liu, F. Zhao, and N. H. Vaidya, "A vehicle to-vehicle communication protocol for Cooperative collision warning," in Proc. 2004 International Conf. Mobile Ubiquitous Syst.: Netw. Services, pp. 114–123.

[20] V. Naumov, R. Baumann, and T. Gross, "An evaluation of inter vehicle ad hoc networks based on realistic vehicular traces," in Proc. 7th ACMMobiHoc, 2006, pp. 108–119.

[21] Y. Zhang, E. K. Antonsson, and K. Grote, "A new threat assessment measure for collision avoidance systems," in Proc. 2006 IEEE Intelligent Transportation Syst. Conf., pp. 968–975, Sept. 2006

[22] Cheng-Wei Fan, Ke-Chian Su, Hei-Min Wu, Wei-Lin Chang and Yao-Hsin Chou "An Effective Multi-Hop Broadcast Control Mechanism for Emergency Alert Message in VANET," IEEE 2012 12th International Conference on ITS Telecommunications.

[23] Khaleel Mershad and Hassan Artail "A Framework for Secure and Efficient Data Acquisition in Vehicular Ad Hoc Networks" IEEE Transactions on Vehicular Technology, VOL. 62, No. 2, Feb. 2013.

International Journal of Innovation and Scientific Research
ISSN 2351-8014 Vol. 10 No. 1 Oct. 2014, pp. 111-117

http://www.ijisr.issr-journals.org/

Importance du statut hydrique et de l'indice chlorophyllien de la feuille drapeau du Sorgho (*Sorghum vulgare L.*) dans l'élaboration du rendement grainier en présence de contraintes hydriques et salines

[Impact of flag leaf water status and chlorophyll index of Sorghum (Sorghum vulgare L.) on yield components under water and saline stresses]

Nesrine Aissa and Leila Radhouane

Institut National de la Recherche Agronomique de Tunis,
Avenue Hédi Karray, 2049 Ariana, Tunisie

ABSTRACT: Drought and salinity are the major problems of Mediterranean agriculture. From an agronomic point of view, adaptation to stress is the ability of a plant to maintain reasonable yields. Various physiological traits related to stress tolerance (relative water content and chlorophyll content) and their impact on yield components were studied in Sorghum (Sudan Grass III).

Experimental design consists of five treatments: a control (100% ETM = 1 g / l), two water regimes (70% and 35% ETM) and two salt diets (3g / l and 6g / l).

Results showed that under moderate water stress, the relative water content and chlorophyll index have decreased slightly and penalized yield components. In response to severe stress, relative water content dropped from 89% to 78% and chlorophyll index fell by about 38% which acted unfavorably on all yield components.

Different intensity of salinity generates a slight increase in TRE but decreased chlorophyll content and size of main panicles.

All the parameters studied shows that there are positive correlations between plant water status and its yield: sorghum maintains high TRE under salinity and drought which indicating that this plant is of type "stay green" that keeps green and photosynthetically active leaves to have reasonable yields under abiotic stresses.

KEYWORDS: Abiotic stresses, Sorghum, Chlorophyll content, Relative water content, Yield components.

RESUME: L'agriculture méditerranéenne est confrontée à plusieurs problèmes tels que la sécheresse et la salinité. Du point de vue agronomique, l'adaptation à ces contraintes serait la capacité d'une plante à maintenir des rendements raisonnables.

Divers caractères physiologiques liés à la tolérance aux stress (teneur relative en eau et teneur en chlorophylle) et leurs impacts sur les composantes du rendement ont été étudiés chez le Sorgho (Sudan Grass III).

Le dispositif expérimental comporte cinq traitements: un témoin (100% ETM= 1g/l), deux régimes hydriques (70% ETM et 35% ETM) et deux régimes salins (3g/l et 6g/l).

Les résultats ont montré que sous la contrainte hydrique modérée, la teneur relative en eau et l'indice chlorophylliens ont subi une légère diminution et ont légèrement pénalisé les composantes de rendement. Par contre, en réponse à un stress plus important, la teneur relative en eau a chuté de 89% à 78% et l'indice chlorophyllien a baissé d'environ 38%. Ce qui a agi défavorablement sur toutes les composantes du rendement.

L'application d'une eau saumâtre d'intensité différente a engendré une légère augmentation de la TRE mais a diminué la teneur en chlorophylle et les dimensions des panicules principales.

L'ensemble des paramètres étudiés montre qu'il existe des corrélations positives entre l'état hydrique de la plante et son rendement: le sorgho a gardé une TRE élevée en présence de stress hydrique et salin, ce qui indique que cette plante est de

Corresponding Author: Leila Radhouane

type « stay green » qui conserve des feuilles vertes et photosynthétiquement actives permettant d'avoir des rendements raisonnables mêmes en présence de contraintes abiotiques.

MOTS-CLEFS: Contrainte abiotique, Sorgho, Teneur en chlorophylle, Teneur relative en eau, Composantes de rendement.

1 INTRODUCTION

L'eau est une ressource rare dans les pays du sud de la méditerranée [1]. Sa disponibilité se faisant de plus en plus rare met en péril dans beaucoup de cas, la durabilité des systèmes [2]. De plus, la surexploitation grandissante de la ressource a engendré d'autres problèmes environnementaux, particulièrement la salinisation des sols [3].

L'agriculture étant dans les régions méditerranéennes le premier secteur consommateur d'eau, se trouve en situations de concurrence très nettes avec les autres secteurs d'utilisation d'où la nécessité d'établir une meilleure gouvernance basée sur d'autres modalités d'usage de la ressource et qui sont plus durables et plus compétitifs [4].

La Tunisie, est parmi les pays menacés par le problème de manque d'eau (surtout les eaux de qualité). Face à ce problème, il serait judicieux d'adopter une économie d'austérité dans laquelle les besoins réels en eau des plantes seraient déterminés avec exactitude et aussi vers la possibilité d'utilisation des eaux de moindre qualité pour l'irrigation. Ces stratégies d'économie d'eau ont été pratiquées sur de nombreuses cultures dont le maïs [5], la canne à sucre [6], le riz [7], le mil [8] et le sorgho [9].

De nombreuses études ont montré que, lors d'un stress abiotique quelconque, les plantes développent des réactions différentes affectant divers processus morphologiques, physiologiques et biochimiques dont le but de diminuer l'impact de ces stress sur le rendement et sur la croissance des plantes [9; 10; 11].

Parmi les paramètres physiologiques indicateurs de la résistance des espèces vis-à-vis du stress, la teneur relative en eau ou (TRE) est largement utilisée. Il s'agit d'un indicateur qui mesure le changement relatif dans le volume cellulaire des plantes [12].

En pratique, la TRE est plus caractéristique de l'état hydrique des végétaux que le potentiel hydrique. On peut, à cet effet, la comparer à un potentiel hydrique ou osmotique fixé. En effet, les espèces végétales qui maintiennent des teneurs foliaires relatives en eau élevées sont considérées comme étant des espèces résistantes à la sécheresse et/ou à la salinité [13] et sont caractérisées par une grande capacité d'ajustement osmotique [14].

Un autre paramètre physiologique indicateur relatif de l'état de santé de la plante est le taux chlorophyllien [15]. En effet, les pigments chlorophylliens sont à l'origine de l'activité photosynthétique et toute augmentation de rendement ne peut être obtenue que par la recherche d'une meilleure efficacité photosynthétique [16] dépendant fortement de la teneur en chlorophylle [17]. Cette dernière varie dans les conditions optimales de croissance entre 450 à 500 mg de chlorophylle/m^2 [18].

Dans l'objectif de voir la variation de la TRE et de l'indice chlorophyllien en présence de contraintes hydriques et salines et leurs effets respectifs sur le rendement et ses composantes, nous avons entamé une série d'expériences dans lesquelles, la plante étudiée est le sorgho (*Sorghum vulgare L..).* Le choix de cette culture est justifié tout d'abord par l'aspect adaptatif du sorgho et aussi par ses avantages aussi bien nutritifs qu'économiques. En effet, il possède des valeurs nutritives plus importantes en protéines que certains aliments de base utilisés par les éleveurs tunisiens. De plus, le sorgho apparaît comme une culture attractive, dont le développement de la production devrait permettre de faire face à la flambée des prix de l'orge, du maïs et du soja qui est de nature à affecter l'élevage des ovins, des bovins et des volailles.

L'objectif de ce travail est de tester cette variété de sorgho (famille des Poaceae) dans des conditions de stress hydriques et salins afin de l'inclure dans un programme de sélection de génotypes adaptés aux conditions contraignantes.

2 MATÉRIEL ET MÉTHODES

2.1 MATÉRIEL VÉGÉTAL

L'essai a porté sur la variété Sudan Grass III appartenant à l'espèce *Sorghum vulgarae l.*

2.2 MÉTHODOLOGIE

L'expérimentation a été réalisée au champ sous une parcelle grillagée à la station expérimentale de l'INRAT (Institut Nationale de la Recherche Agronomique de Tunis).

Le dispositif expérimental est en Split-Splot à 2 facteurs avec comme facteur principal la variété de sorgho et comme facteur secondaire les différents traitements hydriques et salins. La densité de semis est de 200.000 plants /ha. Une fertilisation azotée a été apportée sur la base de 100 kg /ha. En adoptant les valeurs de l'évaporation de référence mesurées à la station de Tunis au niveau des cases lysimétriques [19] et celles des coefficients culturaux déterminés selon la méthode de la FAO [20], nous avons estimé les besoins théoriques en eau (ETM) du sorgho à 600 mm (100%). L'eau d'irrigation est délivrée aux parcelles par submersion et la fréquence d'irrigation étant une fois par semaine. Les différents essais ont été démarrés au stade 4 feuilles.

Les traitements appliqués pour le stress hydrique sont :

T_0: témoin irrigué à 100% ETM
T_{70}: traitement irrigué à 70% ETM.
T_{35}: traitement irrigué à 35% ETM.

(ETM= 600mm et la charge en sel est de 1g/l= eau de robinet)

Les traitements appliqués pour le stress salin sont:

T_0: témoin irrigué à l'eau douce titrant 1g/l (100% ETM)
T_3: traitement T_0 auquel nous avons ajouté 2g/l pour avoir une concentration de 3g/l.
T_6: traitement T_0 plus 5g/l de sel pour avoir une concentration de 6g/l.

2.3 MESURES RÉALISÉES

Les paramètres sont mesurés aux stades floraison et maturité et concernent:

- Teneur relative en eau **(TRE),** calculée selon la formule suivante

$$TRE(\%) = (PF-PS) \times 100/ (PT-PS)$$

PF= poids frais.
PS= poids sec.
PT= poids turgescent.

Le principe de la méthode repose sur la détermination des poids frais, turgescent et sec. Il s'agit d'hydrater des feuilles drapeaux à l'obscurité et à température ambiante durant 12h. Puis, le poids sec est déterminé après passage à l'étuve à 80°C pendant 48h.

- Indice chlorophyllien **(ICH)** est mesuré par le SPAD (Soil Plant Analysis Development).
- Longueur de la Panicule principale **LOC** en (cm).
- Largeur de la Panicule principale **LAC** en (cm).
- Poids de la Panicule principale **PCP** en (g).
- Rendement en grain de la panicule principale **RGC** en (g).

2.4 ANALYSES STATISTIQUES

L'analyse statistique a été réalisée par le logiciel SAS (Statistical Analysis System). Toutes les mesures ont été répétées trois fois. Les résultats ont été soumis à une analyse de la variance à un facteur et les moyennes ont été comparées selon la méthode de Newman et Keuls. Chaque moyenne est affectée d'une lettre. Les moyennes suivies d'une même lettre ne sont pas significativement différentes, au seuil de probabilité 5 %.

3 RÉSULTATS

3.1 STRESS HYDRIQUE

Les résultats ont montré que la teneur relative en eau diminue avec l'intensité du stress hydrique appliqué: elle passe de 89% chez le témoin à 85% pour le traitement modéré et à 78% pour la contrainte sévère (tableau 1).

Concernant l'indice chlorophyllien, la diminution a été faible sous contrainte hydrique modérée (13%) et sévère (38%) lorsque le manque d'eau est très restrictif (tableau 1).

Pour les composantes de rendement, il a été remarqué que les panicules du sorgho ont raccourci proportionnellement à l'intensité du stress appliqué: respectivement de 17% et de 58% pour le stress hydrique modéré et sévère. Egalement, les panicules sont devenues moins larges: la diminution atteint 63% pour le stress hydrique sévère. Par contre, le poids et le rendement en grains des panicules principales n'ont été touchés que par la sécheresse sévère: les pertes ont été respectivement de 56% et de 53%.

3.2 STRESS SALIN

L'application d'une eau saumâtre d'intensités différentes a engendré une amélioration significative de la teneur relative en eau (tableau 2).

Par tout ailleurs, la teneur en chlorophylle et les différents composants de rendement ont baissé par l'usage de l'eau saumâtre. Les réductions les plus importantes sont celles relatives aux dimensions de la panicule principale. En effet, les chandelles sont devenues moins longues et moins larges. Le rendement en grains de la panicule principale n'a diminué que de 16%.

Tableau1. Effet de traitements hydrique sur les différents paramètres mesurés

Paramètres Traitements	TRE	SPAD	LOC	LAC	PCP	RGC
T_0	89 a	55 a	36 a	11 a	80 a	60 a
T_{70}	85 b	48 b	30 b	9 b	71 b	53 b
T_{35}	78 c	34 c	15 c	4 c	35 c	28 c

T_0: Témoin irrigué à 100% ETM; T_{70} : Traitement irrigué à 70% ETM; T_{35} : Traitement irrigué à 35% ETM.
TRE: Teneur relative en eau ; SPAD: Indice chlorophyllien ; LOC: Longueur de la panicule principale ;
LAC: Largeur de la panicule principale ; PCP: Poids de la panicule principale ; RGC: Rendement en grains de la panicule principale.

Tableau 2. Effet de traitements salins sur les différents paramètres mesurés

Paramètres Traitements	TRE	SPAD	LOC	LAC	PCP	RGC
T_0	89 b	55 a	36 a	11 a	80 a	60 a
T_3	100 a	41 b	24 b	6 b	60 b	48 b
T_6	100 a	43 b	25 b	7 b	64 b	50 b

T_0: témoin irrigué à l'eau douce titrant 1g/l (100% ETM) ; T_3: T_0 plus 2g/l pour avoir une concentration de 3g/l.;
T_6: T_0 plus 5g/l pour avoir une concentration de 6g/l; TRE : Teneur relative en eau ; SPAD: Indice chlorophyllien ;
LOC: Longueur de la Panicule principale ; LAC: Largeur de la Panicule principale ; PCP: Poids de la panicule principale;
RGC: Rendement en grains de la panicule principale.

4 DISCUSSION

Les stress hydrique et salin sont les contraintes abiotiques majeures de la production agricole. Pour pouvoir survivre, les plantes développent plusieurs stratégies adaptatives pour lutter contre ces contraintes. La capacité d'une plante à tolérer le stress peut être définie, à cet effet, comme étant sa capacité à survivre et à s'accroître et aussi à produire plus que des plantes sensibles [21].

Parmi les éléments essentiels à la vie de la plante, l'eau occupe une place de choix. Sans elle, toute forme de vie disparaît. L'état hydrique d'une plante peut être exprimé par sa teneur relative en eau [22].

L'application de différents niveaux de stress hydrique s'est traduit par un abaissement de la TRE, mais d'une manière générale, la TRE a gardé une valeur élevée par rapport à d'autres plantes. (23] ont attribué ce phénomène à la capacité d'ajustement osmotique.

En revanche, le stress salin aussi bien modéré que sévère a légèrement augmenté la TRE**.** Ce phénomène a été constaté chez *Sorghum bicolor* par [24] et sur d'autres espèces [25,26]. Cette stabilité ou légère augmentation de la TRE indique que l'espèce étudiée est tolérante à la salinité [27] et possède une réelle capacité d'ajustement osmotique [28].

Il est à remarquer que le sorgho a gardé une TRE élevée en présence de stress hydrique et salin ce qui contribue au maintien de l'ouverture stomatique et de l'activité photosynthétique [29]. A cet effet, le sorgho peut être qualifié de plante de type « stay green », autrement dit qui conserve des feuilles vertes, succulentes et photosynthétiquement active même en présence de contraintes abiotiques [30].

L'étude de l'effet de stress abiotique sur la teneur en chlorophylle revêt de l'importance du fait que l'activité photosynthétique est largement tributaire de la teneur en chlorophylle [31]. En effet, il a été remarqué qu'en conditions limitantes en eau, la teneur en chlorophylle dépend de l'intensité du stress appliqué. Cette teneur est d'autant plus faible que la sécheresse est intense. Ce résultat est corroboré par [32] sur le sorgho.

En présence de stress salin aussi bien modéré que sévère, la diminution de la teneur en chlorophylle est moins importante que pour le stress hydrique sévère. [33] attribue cette diminution à une dégradation des pigments par l'augmentation de l'activité des enzymes hydrolytiques. Il faut signaler le fait qu'il existe une relation étroite entre le taux de la chlorophylle et la nutrition azotée et le SPAD est un excellent outil pour estimer l'azote foliaire. En effet, des valeurs élevées de SPAD renseignent sur le bon développement de la plante et la possibilité de produire des rendements acceptables [34].

Outre son rôle dans la croissance et le développement, l'eau joue un rôle essentiel dans la production des espèces cultivées. Ainsi, l'application d'une irrigation déficitaire a affecté toutes les caractéristiques propres à la panicule principale et a réduit le rendement. En effet, les panicules sont devenues plus effilées, plus courtes, plus légères et moins garnies. Des résultats semblables ont été constatés par [35] sur le sorgho et [36,37] sur le blé.

L'irrigation saline (aussi bien modérée que sévère) a diminué de façon similaire les composantes de rendement. Ce résultat a été mentionné par [38] sur de nombreuses céréales. [39] expliquent cette diminution de rendement par une augmentation de la teneur d'ABA ou de l'invertase qui est un enzyme responsable de l'inhibition de remplissage des grains au cours de stress abiotique. Les différentes observations constatées montrent que la sécheresse est plus néfaste que la salinité pour le sorgho. De nombreux auteurs ont rapporté de tels résultats sur le maïs [40] sur le riz [41] et sur le mil [42].

5 CONCLUSION

L'état hydrique de la plante et la transpiration, en agissant sur la croissance d'une part et sur le développement d'autre part, peuvent intervenir dans la détermination du rendement en biomasse et en grains chez une espèce donnée. De plus, le maintien d'un bon état hydrique et d'une faible transpiration sont les signes d'une bonne adaptation des plantes à la sécheresse et à la salinité. Ainsi, le maintien de la production dépend des mécanismes de tolérance physiologiques qui assurent l'hydratation cellulaire et diminuent la perte en eau en maintenant un état hydrique favorable à l'élaboration du rendement dans ses différentes phases. A cet effet, il a été trouvé que le sorgho soumis à différents types de stress a su maintenir une TRE élevée indiquant une bonne capacité à retenir une importante quantité d'eau sous l'effet de contraintes (déshydratation ou salinité).

REFERENCES

[1] Leonardo, O.; Medicia, F.R.; Daniel, F. C.; Marcin, K. and Ricardo, A. A.; 2014. What about keeping plants well watered? Environmental and Experimental Botany, 99: 38–42.

[2] Cia, M.C.; Guimarães, A.C.R.; Medici, L.O.; Chabregas, S.M. and Azevedo, R.A.; 2012. Antioxidant responses to water deficit by drought-tolerant and sensitive sugarcane varieties. Ann. Appl. Biol., 161: 313–324.

[3] Mahajan, S. and Tuteja, N.; 2005. Cold, salinity and drought stresses: an overview. Arch. Biochem. Biophys., 444: 139–158.

[4] Radhouane, L.; Aissa, N. et Romdhane, L.; 2014. Effets d'un stress hydrique appliqué à différents stades de développement des semences chez un écotype autochtone de sorgho grain, Journal of Applied Biosciences, 74: 6149–6156

[5] Paknejad, F.; Nasri, M.; Moghadam, H.R.T.; Zahedi, H. and Alahmadi, M.F.; 2007. Effects of drought stress on chlorophyll fluorescence parameters, chlorophyll content and grain yield of wheat cultivars. J. Biol. Sci., 7: 841–847

[6] Oliveira, E.A.; Freire, F.J.,; Oliveira, A.C.; Simões Neto, D.E.; Rocha, A.T. and Carvalho, L.A.; 2011. Productivity, water use efficiency, and technological quality of sugarcane subjected to different water regimes. Pesq. Agropec. Bras., 46: 617–625

[7] Yadav, S.; Li, T.; Humphreys, E.; Gill, G.and Kukal, S.S.; 2011. Evaluation and application of ORYZA2000 for irrigation scheduling of puddle transplanted rice in North West India. Field Crops Res., 122: 104–117

[8] Radhouane, L.; 2013. Yield and Growth Responses of Autochthonous Pearl Millet Ecotype (*Pennisetum glaucum* (L.) R. Br.) Under Saline Water Irrigation in Tunisia. in " Developments in Soil Salinity Assessment and Reclamation. Shahid Shabir A.; Abdelfattah Mohamed A.; Taha Faisal K. (Eds) 2013 LL 808 p. Chapter 30. pp:437-450

[9] Farooq, M.; Basra, S.M.A.; Wahid, A.; Cheema, Z.A.; Cheeman, M.A. and Khaliq, A.; 2008. Physiological role of exogenously applied glycinebetaine in improving drought tolerance of fine grain aromatic rice (Oryza sativa L.). J. Agron. Crop Sci., 194: 325–333

[10] Ashraf, M.; 2010. Inducing drought tolerance in plants: recent advances. Biotech. Adv., 28:199–238

[11] Khan, M.I.R.; Iqbal, N.; Masood, A.and Khan, N.A.; 2012. Variation in salt tolerance of wheat cultivars: role of glycinebetaine and ethylene. Pedosphere, 22: 746–754.

[12] Lawlor, D.W. and Cornic, G.; 2002. Photosynthetic carbon assimilation and associated metabolism in relation to water deficits in higher plants. Plant, Cell and Environment, 25: 275-294.

[13] Berka, S.and Aïd. F; 2009. Réponses physiologiques des plants d'Argania spinosa (L.) Skeels soumis à un déficit hydrique édaphique. Science et changements planétaires/ Sécheresse, 20(3): 296-302..

[14] Ali Dhib, T. et Monneveux, P.H.; 1992. Adaptation à la sécheresse et notion d'idéotypes chez le blé dur. I. Caractères morphologiques d'enracinement. Agronomie, 12: 371-379.

[15] Carter, G.A.and Spiering, B.A.; 2002. Optical properties of intact leaves for estimating chlorophyll concentration. J. Envir. Quality, 31: 1424-1432.

[16] Planchon, C. 1976. Essai de détermination de critères physiologiques en vue de l'amélioration du blé tendre. Les facteurs de photosynthèse de la dernière feuille. Ann. Amélior. Plantes, 26(2): 717-744.

[17] Reynolds, M.P.; Delgado, B.M.I.; Gutérrez-Rodriguez, M. and Larqué-Saaverdra, A. 2000. Photosynthesis of wheat in a warm irrigated environment.I: Genetic diversity and crop productivity. Field Crops Research, 66(1): 37-50.

[18] Ommen, O. E.; Donnelly, A. Vanthoutvin, S. and Oijen, M.V.; 1999. Chlorophyll content of spring wheat flag leaves grown under elevated CO_2 concentrations and other environmental stresses within the 'espace wheat' project. Europ. J. of Agron., 12 :197-203.

[19] Damagnez, J.; Riou, C.; De Villèle, O. et El Amami, S. ; 1962. Problèmes d'évaporation potentielle en Tunisie. Ann. Inst. Nat. Rech. Agron. de Tunisie, 35: 161-184.

[20] FAO, 1998. Crop evaporation. Guidelines for computing crop water requirements. FAO irrigation and drainage. Paper n° 56. FAO. Rome.

[21] Kara, Y. et Bellkhiri, C.E. ; 2011. Etude des caractéristiques d'adaptation au déficit hydrique de quelques variétés de blé dur et d'espèces sauvages apparentées : intérêt potentiel de ces variétés pour l'amélioration de la production. Courrier de Savoir, pp119-126.

[22] Mehani, M. ; Bissati, S. et Djeroudi, Q. ; 2012. Effet de l'eau de mer sur deux paramètres hydriques de jeunes plants d'Atriplex canescens. J. Mater. Environ. Sci., 5: 840-845.

[23] Bajji, M. ; Lutts, S. and Kinet, J.M.; 2001. Water deficit effects on solute contribution to osmotic adjustment as a function of leaf ageing in three durum wheat cultivars performing differently in arid conditions. Plant sciences, 160: 669-681.

[24] Yang, Y.W. ; Newton, R.J. and Miller, F.R. ; 1990. Salinity Tolerance in Sorghum. I. Whole Plant Response to Sodium Chloride in S. bicolour and S. halepense. Crop Sci., 30: 775-781.

[25] Lu, C.M.; Qiu, N.W., Lu, Q.T.; Wang, B.S. et Kuang, T.Y.; 2002. Does salt stress lead to increased susceptibility of Photosystem II to photoinhibition and changes in photosynthetic pigment composition in halophyte suaeda salsa grown outdoors? Plant Sci., 163: 1063-1068.

[26] Sahraoui, I. et Zid, E. ; 2003. Réponses différentielles des feuilles de betterave rouge (Beta vulgaris L.) à la contrainte saline. Les XIII Journées Nationales de Biologie de la SSNT. « L'essor des bioressources » Djerba, le 16-19 Mars 2003. p: 110-111

[27] Katerji, N., and Bethenod, O. ; 1997. Comparaison du comportement hydrique et de la capacité photosynthétique du maïs et du tournesol en conditions de contrainte hydrique. Conclusions sur l'efficience de l'eau. Agronomie, 17: 17-24.
[28] Meloni, D. A. ; Gulotta, M. R.; Martinez, C. A. and Oliva, M. A. ; 2004. The effects of salt stress on growth, nitrate reduction and proline and glycinebetaine accumulation in Prosopis alba. Braz. J. Plant Physiol., 16(1): 39-46.
[29] Sinclair, T.R.; Shekoofa, A. and Balota, M.; 2014. Limited transpiration trait evaluated in growth chamber and field for sorghum genotypes. Environmental and Experimental Botany, 99:175-179.
[30] Tolk, J.A.; Howell, T.A. and Miller, F.R.; 2013. Yield component analysis of grain sorghum grown under water stress. Field Crops Research, 145: 44–51.
[31] Radhouane, L.; 2006. Diversité morpho-phénologique, caractérisation agro-physiologique et mécanismes d'adaptation aux contraintes hydriques et salines de populations autochtones de mil. Thèse de doctorat d'état, INAT, Université de Carthage, 289p.
[32] Ahmed, M.; Ul Hassen, F. and Khurchid, Y.; 2011. Does silicon and irrigation have impact on drought tolerance mechanism of sorghum? Agricultural Water Management, 98:1808-1812.
[33] Santos, C.V.; 2004. Regulation of chlorophyll biosynthesis and degradation by salt stress in sunflower leaves. Scientia Horticulturae, 103: 91-99.
[34] Lin, F.F.; Qui, L.F.; Deng, J.S.; Shi, Y.Y.; Chen, L.S. and Wang, K.; 2010. Investigation of SPAD meter based indices for estimating rice nitrogen status. Computers and electronics in Agriculture, 715: 560-565.
[35] Mutava, R.N.; Prasad, P.V.V.; Tuinstra, M.R.; Kofoid, K.D. and Yu, J.; 2011. Characterization of Sorghum genotypes for traits related to drought tolerance. Field Crop Research, 123:10-18.
[36] Monneveux, P. ; Sánchez, C. ; Beck, D. and Edmeades, G.O. ; 2006. Drought tolerance improvement in tropical maize source populations : evidence of progress. Crop Sci., 46: 180 191
[37] Jatoi, W.A.; Baloch, M.J.; Kumbhar, M.B.; Khan, N.U. and Kerio, M.I.; 2011. Effect of water stress on physiological and yield parameters at anthesis stage in elite spring Wheat cultivars. Sarhad. J. Agric., 27 (1): 59-65
[38] Rudy, D., Xuemei, J.and Richard, A.; 2011. Abiotic stress and control of grain number in cereals. Plant Science, 181: 331–341.
[39] Boyer, J.S. and Westgate, M.E.; 2004. Grain yield with limited water. J Exp. Bot, 55: 2385-2394.
[40] Isla, R. and Aragüés, R.; 2010.Yield and plant ion concentrations in maize (*Zea mays* L.) subject to diurnal and nocturnal saline sprinkler irrigations. Field Crops Res., 116(1–3):175–183
[41] Zeng, L.; Shannon, M.C. and Grieve, C.M.; 2002. Evaluation of salt tolerance in rice genotypes by multiple agronomic parameters. Euphytica 127:235–245
[42] Hussain, K.; Ashraf, M.and Ashraf, M.Y.; 2008. Relationship between growth and ion relation in pearl millet (*Pennisetum glaucum* (L.) R. Br.) at different growth stages under salt stress. Afr. J. Plant Sci., 2(3):23–27

International Journal of Innovation and Scientific Research
ISSN 2351-8014 Vol. 10 No. 1 Oct. 2014, pp. 118-124

http://www.ijisr.issr-journals.org/

Trade Liberalization and Employment Generation in Nigeria

Kayode AKINYEMI[1], Victor EBIEFIE[2], Tinuola Adenike ADEKOJO[3], and Ibrahim Adeniyi IBIYEMI[4]

[1]Centre for Continuing Education,
Federal University of Technology, Akure,
PMB 704, Akure Ondo State, Nigeria

[2]Department of Economics (Research Student),
University of Lagos- Akoka Lagos, Nigeria

[3]Department of Economics (Research Student),
University of Ibadan, Oyo State, Nigeria

[4]Department of Politics and International Relation,
Lead City University Ibadan, Nigeria

ABSTRACT: This study investigates the relationship between trade liberalization and employment generation in Nigeria using secondary data on the quoted variables for the period 2003-2007. Panel regression model (Pooled Least Squares) was employed to examine the nexus between trade liberalization and employment generation. The study found that employment generation as result of trade liberalization the key determinant is tariff structure as a percentage increase will generate 73.4% of employment while other variables (wages, openness and FDI) effect on employment is not much. Also, the cumulative significant of the study shows that trade tariffs, wage rate, openness, and foreign direct investment have simultaneous significant effect on employment rate in the Nigeria's manufacturing, transport, agriculture and mining and quarrying sectors. Consequently, it was recommended that government, through legislative actions and mutual collaboration between the newly created Ministry of Trade and Investment and other trade-related agencies should continue to design policy measures directed toward the increase in tariff for the importable goods to facilitate more employment generation. Also, government should create the enabling environment for Foreign Direct Investment (FDI) to strive. Public-private partnerships toward the development of the considered real sectors should be encouraged in order to enhance employment generation.

KEYWORDS: Trade liberalization, tariff, wages, openness, employment and Nigeria.

1 BACKGROUND

Trade has been considered as the main engine of its development strategies by Nigeria's government, because of the implicit belief that trade can create jobs, expand markets, raise incomes, facilitate competition and disseminate knowledge (WTO 2005). The main drive of trade policy is therefore the enhancement of competitiveness of domestic industries, with a view to, inter alia, stimulating local value-added and promoting a diversified export base. Trade policy also seeks (through gradual liberalization of the trade regime) to create an environment that is conducive to increased capital inflows, and to transfers and adoption of appropriate technologies. The resultant domestic costs of adjustment must not outweigh the benefits the government is expecting in pursuing the liberalization of its trade regime in a very measured manner.

Nigeria's trade policy since the 1960s reflects a trend which has been known to characterize uncertain and unpredictable trade regimes the world over by assessment. Trade policy since the 1960s has witnessed extreme policy swings from high

protectionism in the first few decades after independence to its current more liberal stance [1]. Tariffs have at various times been used to raise fiscal revenue, limit imports to safeguard foreign exchange or even protect the domestic industries from competition. In addition, various forms of non-tariff barriers such as quotas, prohibitions and licensing schemes have on various occasions been extensively used to limit imports of particular items. The overall pattern portrays the long-held belief that trade policy can be used to influence the trade regime in directions that can promote economic growth. Attempts were made to use trade policy to promote manufactured exports and enhance the linkages in the domestic economy, to increase and stabilize export revenue, and scale down the country's reliance on the oil sector. Trade policies were accordingly directed at discouraging dumping; supporting import substitution; stemming adverse movements in the balance of payments; conserving foreign exchange; and generating government revenue.

1.1 TRADE POLICY TREND BETWEEN 1960 – 1970S

Nigeria pursued an import substitution industrialization strategy during the first decade of independence. This involved the use of trade policy to provide effective protection to local manufacturing industries, through such measures as quantitative restrictions and high import duties. Many items were accordingly placed on import prohibition. During this period, all imports from Japan were placed under import license. Machinery and spare parts imports were restricted and exchange controls on the repatriation of dividends and profits were enforced. Restrictions were also applied on capital goods, spare parts and non-essential imports. Although the import substitution industrialization strategy continued even after the Nigerian civil war in 1970, trade policy between 1970 and 1976 assumed a less restrictive stance, ostensibly because of demands necessitated by the post-war reconstruction. Thus, only items that were regarded as non-essential consumer goods were restricted, while tariff rates on raw materials were reduced and quantitative restrictions on spare parts, agricultural equipment and machinery were relaxed. Similarly, the reconstruction surcharge on imports was reduced from 7.5 percent to 5 percent and later completely eliminated, while exchange controls and profit repatriation were also relaxed. The 1960s and early 1970s also saw the application of export duties ranging from 5 to 60 percent on agricultural exports such as cocoa, rubber, cotton, palm oil, palm kernel and ground nuts. In 1973 however, these duties were eventually abolished, as a result of the oil boom and the need to promote agricultural exports as part of the export diversification strategy. However this spurt of liberalization ended in 1977, when a wide range of imported finished goods requiring licenses came to be placed on very high duties or were banned outright. This transformed restrictive trade policy culminated in the banning of 82 items in 1979, while a further 25 items were compulsorily placed on import authorization.

1.2 TRADE POLICY TRENDS BETWEEN 1980 - 90S

Policy shift towards exports promotion and a move to intensify the use of local raw materials in industrial production was more pronounced form 1980. However, the increase in the value of imports led to a worsening of the balance of payments (with, in addition, the backdrop of the collapse in world oil prices), which forced the government to promulgate the Economic Stabilization (Temporary Provisions) Act in April 1982. Under this Act, tariffs on 49 items were raised, while a prohibition was imposed on gaming machines and frozen poultry. Further, 29 commodities were removed from the general import license regime and placed under specific license, while the use of pre-shipment inspection became widespread. During 1983 - 1985, 152 items were brought under specific import license, and foreign exchange regulations became more stringent. The central objective of trade policy was to provide protection for domestic industries and reduce the perceived dependence on imports; a consequence to that objective was a desire to reduce the level of unemployment and generate more revenues from the non-oil sector. as a result, tariffs on raw materials and intermediate capital goods were reduced.

1.3 THE STRUCTURAL ADJUSTMENT PERIOD

There was a significant shift in trade policy direction towards greater liberalization as of 1986. This shift in policy is directly attributable to the adoption of the structural adjustment programmes. The Customs, Excise, Tariff etc (Consolidation) Decree, enacted in 1988, was based on a new Customs goods classification, the Harmonized System of Customs Goods Classification Code (HS). It provided for a seven-year (1988 -1994) tariff regime, with the objective of achieving transparency and predictability of tariff rates. Imports under the regime thus attracted ad-valorem rates applied on the Most Favoured Nation (MFN) basis. A new seven-year (1995 - 2001) tariff regime, established by Decree No. 4 of 1995 succeeded the previous (1988 – 1994) regime. The tariff structure over the period 1988 - 2001 increased import duties on raw materials, and on intermediate and capital goods, while tariffs on consumer goods were slightly reduced. This was aimed at reducing distortions in resource allocation and combating smuggling. Both the 1988 and 1995 tariff schedules had provisions for reviews and amendments. However, they maintained the familiar mixed trends in tariff regimes. Three types of changes

were subsequently common, namely, reduction in rates; increase in rates and/or removal from or addition to the import prohibition list.

1.4 TRADE POLICY UNDER THE NEEDS ERA (1999 - 2006)

As pointed out above, Nigeria's trade policy regime as currently contained in the NEEDS and trade policy documents, has been geared to enhancing competitiveness of domestic industries, with a view to, inter alia, encouraging local value-added and promoting as well as diversifying exports. The mechanism adopted to this end is gradual liberalization of the trade regime. Thus, the government intends to liberalize the trade regime in a manner, which will ensure that the resultant domestic costs of adjustment do not outweigh the benefits. This is the fundamental basis on which to gauge the direction and implementation of policy. The clarion call is "steady liberalization". This addresses the question as to what is the kind of trade strategy the government has adopted in furtherance of its development agenda. Current reform packages are therefore designed to allow a certain level of protection of domestic industries and enterprise. Concretely, this has translated into tariff escalation, with high effective rates in several sectors and lower import duties on raw materials and intermediate goods unavailable locally. Highly import duties on finished goods were the result of the policy perspective on finished goods which compete with local production.

The summary of the above trade policies that has been adopted by government is highlighted bellow.

- Partial abolition of import license scheme.
- Granting of special tax incentives and tax holidays to enable local industries build up enough funds for expansion purposes and to encourage firms invest in economically disadvantaged areas.
- Reduction of corporate income tax rate and introduction of tax-free dividends, for foreign persons and to encourage local research and development (R&D).
- The Export Incentives Decree was promulgated in which various incentives to enhance export promotion were stipulated.
- The Export Credit Guarantee and Insurance Scheme was established to assist Nigerian Companies compete effectively in the international market.
- Government granted up to 140% tax relief to firms in respect of research and development (R&D) expenses in the development of raw materials.
- The Export Stimulation Loan (ESL) Scheme was put in place to provide foreign exchange producers that require imported inputs essential to the production of export products.
- Firms were allowed to open and maintain domiciliary accounts to keep their export earnings in foreign currencies.
- Several institutional support were put in place by the government through the establishment of Industrial Development Coordinating Committee, (IDCC), Industrial Data Bank, Raw Materials Research and Development Council, (RMRDC), Project Development Agency (PRODA), Federal Institute of Industrial Research (FIIRO), Export Processing Zone (EPZ), Nigerian Investment Promotion Council.
- Simplification of industrial licensing.
- The exchange market was deregulated to enhance access of firms to foreign exchange. Devaluation and full convertibility of the Naira on trade account were embarked upon to bring it nearer to acceptable parity and make Nigerian products enhance greater profitability of Nigerian manufactured export.

1.5 LITERATURE REVIEW

Empirical literature on trade liberalization and employment across-country studies have been undertaken, including [6], [10], [13], [14], [15] and [18],

According to [18] examines trade liberalization and employment generation in Turkey using OLS. His finding shows that trade liberalization led to real wage cut to stabilize the economy and to boast competitiveness of exporters because lower wages were thought to be essential to lower inflation rates (by reducing production costs and restraining domestic absorption), and to secure real depreciation. Also, his estimate of labour demand function for Turkish manufacturing industries shows that trade policy variables and macroeconomic variables are quite important for employment generation.

Reference [6] examined trade liberalization and employment effects in Ukraine using generalized method of moments (GMM) estimator to account for potential endogeneity problem. Trade openness does affect job flows in Ukrainian manufacturing disproportionately according to trade orientation. They find that while trade with CIS decreases job destruction, trade with the EU increases excess reallocation mainly through job creation.

Also, [13] investigated the effect of trade liberalization on employment performance of textile industry in Tanzania. The basic issue of concern is that the implementation of trade liberalization has differential impact on employment and wage in many African countries. In addressing this issue as well as achieving the objective, econometric models of employment and wage are estimated using co-integration method of analysis. The analysis shows that effective rate of protection and export intensity have an insignificant positive impact on demand for labour, but import penetration has a significant negative impact on employment. Also, only import penetration has a significant negative impact on wage. The impact of import penetration is larger than that of export orientation, as the increase in import competition leads to a decline in labour demand. According to [14], in a study that adopted the use of OLS regression technique to calculate the impact of. The outcome of the study established that the existence of a positive relationship between global competitiveness and employment level in the manufacturing sector and confirmed that employment in the sector usually based their current employment decision on the previous level of employment.

Reference [10] found that trade openness and social and political dimensions of globalization have not any impact on the employment generation in Pakistan. Nevertheless the proxy variables of globalization (foreign direct investment and workers' remittances) are statistically highly significant and more responsive to generate employment opportunities in Pakistan. Similarly, [15] investigated the effect of trade liberalization on employment during the post-reform period in India's organized manufacturing sector using Ordinary Least Square (OLS) regression model. The analysis shows that, trade seems to be having negative effect on employment, globalization and employment generation in Nigeria's manufacturing sector which is contrary to H-O theory.

2 MATERIALS AND METHODS

In order to achieve the basic objective of this paper, model used by [19] which was developed by Njikam was adopted to analyze the relationship between trade liberalization and employment in Nigeria. The Cobb-Douglas Production function in the following format is adopted.

$$Q = A^{\lambda} K_i^{\alpha} L_i^{\beta} \quad (1)$$

Where A^{λ} represent technological efficiency index, Q represent output, K represent Capital stock, L represent

Labour, α and β signify capital and labour factor inputs share coefficients while λ speed up the efficiency of production by allowing factors changing. As a point of departure from this model employment is assumed mobile within different sectors. Hence a profit maximizing firm employs capital up to the point where marginal revenue product of capital is equal to user costs (MRPK =Z), and marginal revenue product of labour is equal to wage (MRPL=W).

In order to eliminate capital in the specification of firm output, equation (1) is solved simultaneously hence the following expression:

$$q\text{-}\ A^{\lambda}(^{\alpha Lt}/_{\beta X} / {}^{w}/_{z})^{\beta} L_i \quad (2)$$

Where q is output, L, total employment, Z user costs, other variables are defined as above.

By applying the natural logarithm (2), becomes firm and industry demand for Labour which is a derived demand becomes:

$$LnL_i\text{-}q_o + q_1 Ln\ (^{w}/_{z}) q_1 Lnq_1 \quad (3)$$

Where $qo = -(\underline{\lambda InA + \alpha In\alpha - \alpha In\beta})$, $q1 = -\alpha(\alpha+\beta)$, $q2 = \frac{1}{\alpha+\beta}$

Theoretically, demand for Labour is negatively related to technology while positive related to output. Hence more improvement in technology reduces the demand for unskilled Labour.

Equation (3), assumes that the impact of technology in different sectors is the same and uniform, but empirical evidences show that technology is determined by trade patterns. Thus, as stated by Njikam (2009) "technology depends on import penetration, domestic industry protection and export orientation". Thus if technology is substituted in (3), the empirical equation is stated;

$$InL_{it} = In\beta_o + \beta_1 InTRT_{it} + \beta_2 InWAG_{it} + \beta_3 InOPN_{it} + \beta_4 InFDI_{it} + \mu_{it} \quad (4)$$

β_o denotes the intercept term, L_{it} and WAG_{it} represent total employment wages of the considered real sectors in the time period (t) respectively, TRT_{it} is the tariff rate across the sectors, OPN_{it} is the trade openness, FDI_{it} is the Foreign Direct Investment and μ_{it} is the stochastic error term. β_1, β_2,β_3, β_4 are unknown slope parameter to be estimated. With the exception of TRF all variables are transformed by taken natural logs because TRF is already measure as a rate.

3 RESULTS AND DISCUSSION

Descriptive statistics results: The analysis begins by looking at the minimum and maximum value employments (EMP) for the sample of real sectors considered.

Table 1 Descriptive Statistics Of The Basic Data

	EMP?	TRF?	WAG?	OPN?	FDI?
Mean	7668456.	17.37000	162917.5	22.08000	59766.07
Median	820628.0	18.69000	141267.1	16.06500	28248.80
Maximum	30682234	21.10000	326529.0	53.42000	219512.0
Minimum	66150.00	11.00000	32319.64	0.820000	1209.000
Std. Dev.	12755879	3.937900	106524.1	22.00623	70969.88
Skewness	1.158016	-0.876363	0.179509	0.180259	1.035467
Kurtosis	2.353091	2.138637	1.586582	1.239263	2.979718
Jarque-Bera	4.818748	3.178332	1.772204	2.691807	3.574314
Probability	0.089872	0.204096	0.412260	0.260304	0.167436
Sum	1.53E+08	347.4000	3258349.	441.6000	1195321.
Sum Sq. Dev.	3.09E+15	294.6340	2.16E+11	9201.212	9.57E+10
Observations	20	20	20	20	20
Cross sections	4	4	4	4	4

Source: computed from the data

Table 1 presents the descriptive statistics of the data employed in this study. The minimum and maximum value employments (EMP) for the sample of real sectors considered are 30682234 and 66150.00 with an average of 7668456. While tariff (TRF), vary from a minimum of 11 percent to a maximum of 21.1 percent with an average of 17.4 percent. The wage rate also ranges from a minimum of 32319.64 to a maximum of 326529.0 with an average of 162917.5. The estimated trade openness (OPN) also ranged from a minimum of 0.82 million to a maximum of 53.42 billion with an average of 22.08 million. Foreign Direct Investment (FDI), range from a minimum of1209.00 million to a maximum of 219512.0 million with an average of 59766.07 million. Employment, wages, openness and Foreign Direct Investment (FDI) are positively skewed but tariff is negative. The probability significant levels for all the variables (Employment, Tariff, Wages, Openness and Foreign Direct Investment) are not statistically significant.

Panel regression (Pooled Least Squares) results:

Dependent Variable: LOG(EMP?)
Method: Pooled Least Squares
Date: 09/28/12 Time: 13:28
Sample: 2003 2007
Included observations: 5
Cross-sections included: 4
Total pool (balanced) observations: 20

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	25.43204	9.237942	2.752999	0.0148
TRF?	0.733823	0.154537	4.748539	0.0003
LOG(WAG?)	-1.731137	1.053003	-1.644001	0.1210
OPN?	-0.023539	0.021150	-1.112954	0.2832
LOG(FDI?)	-0.369177	0.079085	-4.668079	0.0003

R-squared	0.949141	Mean dependent var	13.79202
Adjusted R-squared	0.935579	S.D. dependent var	2.236854
S.E. of regression	0.567742	Akaike info criterion	1.918020
Sum squared resid	4.834972	Schwarz criterion	2.166953
Log likelihood	-14.18020	Hannan-Quinn criter.	1.966614
F-statistic	69.98375	Durbin-Watson stat	1.802801
Prob(F-statistic)	0.000000		

Source: computed from the data

The estimated panel regression model (Pooled Least Squares) for the all the variables revealed the following outcomes. A percentage increase in trade tariff (TRF) enhances changes in employment rate by 73.4%. In other word increase in tariff by one percent will generate employment. The policy prescription is based on the belief that a liberalized trade regime is capable of increasing employment generation in the developing countries of the world. A percentage change increase in wage rate result to 1.73% decline in changes in employment rate across the considered real sectors. That is employment rate across the considered real sector will reduce as result of increase in wage rate. 2.35% decline in employment rate is a result of a unit change in trade openness in Nigeria's real sectors. It shows that opening of borders in Nigeria to facilitate trade openness lead to decrease in employment rate in the country. During the considered timeframe and cross-sections of four selected real sectors, recorded percentage change in flow of investments from abroad (FDI) deteriorated or worsened the employment rates by 0.37%. Also, the t-statistic for individual significance of the incorporated estimates indicated that among the considered set of series, it is only trade tariff and foreign direct investment that were found to be statistically significant at 5% critical level. This statistical evidence instigate policy insights for enhance employment level in the real sectors of the economy. However, the F-statistic as a robust test of joint significance of estimates indicated that estimated coefficients of trade tariffs, wage rate, openness, and foreign direct investment have simultaneous significant effect on employment rate in the Nigeria's manufacturing, transport, agriculture and mining and quarrying sectors. Thus, the earlier stated null hypothesis is rejected at 5% significance level based on the Prob.(F-Stat) value that is less than 0.05.

Similarly, the adjusted R-squared result reported that 93.6% of changes in employment rate is explained by changes in trade tariffs, wage rate, openness, and foreign direct investment in Nigeria's real sectors. Two sets of diagnostic tests were performed to examine the structural stability of estimated pooled regression model that capture the effect of trade liberalization on employment generation in Nigeria. The value of the standard error of regression (0.5677) is found to be less that a unit and relatively small compared with outcomes of other iterated regression models. This indicates that error of biasness is significantly minimized with the adopted estimation technique. Also, the adjusted R-squared (0.9356) is found to be less than the Durbin-Watson Stat (1.8028), thus signifies the non-spurious nature of the estimated regression model. The main policy implication of this outcome is that the reported results are reliable and consistent for drawing policy inference

and designing policy recommendations of enhancing employment generation arte via trade interactions in Nigeria's real sector.

4 CONCLUSION

This study has utilized the data on the quoted variables for the period 2003-2007 to address important issue in area of trade liberalization and employment generation in Nigeria. The study made use of both descriptive analytical tools to provide answers to the various research questions posed in the introductory chapter. The regression results present in chapter four have also shown that the results we obtain are robust under estimation technique adopted. The results in many cases are broadly consistent with the theoretical expectations and also with some empirical findings in the literature. In terms of employment generation as result of trade liberalization the key determinant is tariff structure as a percentage increase will generate 73.4% of employment while other variables (wages, openness and FDI) effect on employment is not much. The major contribution to the Nigeria literature on trade liberalization and employment is the explicit incorporation of the impact of tariff structure. This has been omitted in most previous studies. The findings of the study however show that this has a profound impact on both trade liberalization and employment. The cumulative significant of the study shows that trade tariffs, wage rate, openness, and foreign direct investment have simultaneous significant effect on employment rate in the Nigeria's manufacturing, transport, agriculture and mining and quarrying sectors. The government, through legislative actions and mutual collaboration between the newly created Ministry of Trade and Investment and other trade-related agencies should continue to design policy measures directed toward the increase in tariff for the importable goods because this will result into employment generation in Nigeria based on the finding of this study. On the final note, government should create the enabling environment for Foreign Direct Investment (FDI) to strive. Public-private partnerships toward the development of the considered real sectors should be encouraged in order to enhance employment generation.

REFERENCES

[1] Adenikinju, A. F. (1996). Structural Adjustment Programme and performance efficiency in the Nigeria manufacturing sector. Selected Paper for the 1996 Annual conference. Ibadan: NES.

[2] Anyanwu, J. C. (1997), The Structure of The Nigerian Economy (1960-1997), Joanee Educational Publishers, pp 113-126.

[3] Appleyard, D., Alfred J., and Steven, L. (2008), International Economics. The McGraw Hill International, 6th Edition.

[4] Central Bank of Nigeria (2007) "Statistical Bulletin Nigeria", Central Bank of Nigeria, Vol. 18, December 2007.

[5] Central Bank of Nigeria (2009), Annual Report and Statement of Accounts.

[6] Christev, Kupets and Lehmann (2005), Trade Liberalization and Employment Effects in Ukraine. Institute for the Study of Labour.

[7] Gujarati, D. N. and Porter, D.C. (2009) Basic Econometrics, Fifth Edition, McGraw Hill Education.

[8] Granger, C. W. J. (1969). "Investigating Casual Relationship by Econometric Model and Cross Spectral Methods," Econometrica, 37, 424-438.

[9] Greene, W. H. (1995) LIMDEP Version 7.0 User's Manual Econometrics Software Inc.

[10] Malik, Chandhry and Javed (2011), Globalization and Employment: Evidence from Pakistan. *Pakistan Journal of Social Sciences (PJSS) Vol. 31, No. 2 (December 2011), pp. 215-226*

[11] National Bureau of Statistics (NBS) (2009), Quick National Employment General Survey, Annual Bulletin.

[12] Nigeria custom service and Manufacturing Association of Nigeria (MAN) volume 3 of Common External Tariff (CET), Federal Republic of Nigeria.

[13] Olayiwola & Rutaihwa (2010), Trade Liberalization and Employment Performance of Textileand Clothing Industry in Tanzania, International Business Research Vol. 3, No.3 Liberalization, Carnegie Mellon University.

[14] Oluranti (2010), Globalization and Employment Generation in Nigeria's Manufacturing Sector. European Journal of Social Sciences – Volume 12, Number 4 (2010)

[15] Sankaran, Abraham & Joseph (2010), Trade Liberalization and Employment an experience of India's Manufacturing Industry. Centre for Development Studies, Trivandrum, Kerala (INDIA).

[16] Sen, Kunal (2008), "International Trade and Manufacturing Employment Outcomes in India – A Comparative Study", Research Paper No.2008/87, UNU-WIDER.

[17] Sen, Kunal (2009), "*Trade Policy, Inequality and Performance in Indian Manufacturing*", Routledge Advances in South Asian Studies, Routledge.

[18] Taymaz (1999), Trade Liberalization and Employment Generation: The Experience of Turkey in the 1980s, Volume II Technical Papers, Washington, D.C.: World Bank, 1998.

[19] Thindwa and Seshamani (2014), Trade liberalization and the performance of the tobacco sector in Malawi. Journal of Emerging Issues in Economics, Finance and Banking (JEIEFB), 2014, Vol: 3 Issue 1

International Journal of Innovation and Scientific Research
ISSN 2351-8014 Vol. 10 No. 1 Oct. 2014, pp. 125-134

http://www.ijisr.issr-journals.org/

Quantitative Determination of Sugar Levels in Natural Plants of Cactus Pear (Opuntia ficus indica) and Votre-Coach Alimantaire Cultivated in Adigrat, North of Ethiopia

D. Worku Batu and T. Wunesh Solomon

Department of Chemistry, Adigrat University, Adigrat, Tigray, Ethiopia

ABSTRACT: In this work, a quantitative study for sugar concentration determination was conducted using Uv-Visible Spectroscopy. Glucose and Sucrose of three extracted plants fruit were analysis by refractometer and thin layer Chromatography before applied for quantitative determination. The TSS values recorded have a good agreement with the Sucrose standard and previously analyzed sugar in fruit and vegetables. TSS of Coach-fruit, Cactus Opuntia and Peel is 18Bix%, 18Brix% and 21Brix% respectively. These results have a good precision with the TSS sugar found in Apple species (18.83Brix %), Potato species (19.10%) and Grape (17.50Brix %) fruit-vegetables.The single spot observed on TLC, assay the purity of sample. Calibration models for Glucose and Sucrose determination were developed using the standard solution. Sugar concentrations were determined from single standard and calibration curve. The mean concentrations of Sucrose and Glucose in Coach-fruit, Cactus pear and Cactus peel, were 143.035mg/ml, 42.420mg/ml, and 0.943mg/ml for Sucrose; and 86.912mg/ml, 18.938mg/ml and 8.810mg/ml for Glucose determined.

KEYWORDS: sugar, carbohydrate, glucose, sucrose, cactus pear.

INTRODUCTION

Sugar is the generalized name for sweet, short-chain, soluble carbohydrates, many of which are used in food. They are carbohydrates, composed of carbon, hydrogen, and oxygen [1, 2]. These carbohydrates are especially prominent constituents of plants and usually form over one-half of the total plant substance. They serve not only as a source of available energy but also as reserve food and as structural materials. They are one of the main groups of food substances (carbohydrates, proteins, and fats) to be synthesized in the plant from simple organic substances.

The empirical composition of carbohydrates may be expressed by the formula $C_nH_{2n}O_n$. With regard to their specific chemical properties, carbohydrates may contain a potential aldehyde, -CHO, or ketone, C=O, group [3, 4].

Scientifically, *sugar* loosely refers to a number of carbohydrates, such as monosaccharides, disaccharides, or oligosaccharides. Monosaccharides are also called "simple sugars," the most important being glucose. Almost all sugars have the formula $C_nH_{2n}O_n$ (n is between 3 and 7). Glucose has the molecular formula $C_6H_{12}O_6$. The names of typical sugars end with ***ose***, as in "glucose", "dextrose", and "fructose". Sometimes such words may also refer to any types of carbohydrates soluble in water. The acyclic mono- and disaccharides contain either aldehyde groups or ketone groups. These carbon-oxygen double bonds (C=O) are the reactive centers. All saccharides with more than one ring in their structure result from two or more monosaccharides joined by glycosidic bonds with the resultant loss of a molecule of water (H2O) per bond [5].

Corresponding Author: D. Worku Batu

TYPES OF SUGAR

MONOSACCHARIDES

Glucose, fructose and galactose are all simple sugars, monosaccharides, with the general formula $C_6H_{12}O_6$. They have five hydroxyl groups (−OH) and a carbonyl group (C=O) and are cyclic when dissolved in water. They each exist as several isomers with dextro- and laevo-rotatory forms that cause polarized light to diverge to the right or the left [5, 6]

Glucose, dextrose or grape sugar occurs naturally in fruits and plant juices and is the primary product of photosynthesis [7]. Most ingested carbohydrates are converted into glucose during digestion and it is the form of sugar that is transported around the bodies of animals in the bloodstream. It can be manufactured from starch by the addition of enzymes or in the presence of acids. Glucose syrup is a liquid form of glucose that is widely used in the manufacture of foodstuffs. It can be manufactured from starch by enzymatic hydrolysis [8, 9]

Fructose or fruit sugar occurs naturally in fruits, some root vegetables, cane sugar and honey and is the sweetest of the sugars. It is one of the components of sucrose or table sugar. It is used as high-fructose syrup, which is manufactured from hydrolyzed corn starch that has been processed to yield corn syrup, with enzymes then added to convert part of the glucose into fructose [10].

DISACCHARIDES

Sucrose, maltose, and lactose are all compound sugars, disaccharides, with the general formula $C_{12}H_{22}O_{11}$. They are formed by the combination of two monosaccharide molecules with the exclusion of a molecule of water [6, 11, 12].

Sucrose is found in the stems of sugar cane and roots of sugar beet. It also occurs naturally alongside fructose and glucose in other plants, in particular fruits and some roots such as carrots [6]. A molecule of sucrose is formed by the combination of a molecule of glucose with a molecule of fructose [12]

Maltose is formed during the germination of certain grains, the most notable one being barley, which is converted into malt, the source of the sugar's name. A molecule of maltose is formed by the combination of two molecules of glucose. It is less sweet than glucose, fructose or sucrose [6]. It is formed in the body during the digestion of starch by the enzyme amylase [13] and is itself broken down during digestion by the enzyme maltase [14].

Lactose is the naturally occurring sugar found in milk. A molecule of lactose is formed by the combination of a molecule of galactose with a molecule of glucose. It is broken down when consumed into its constituent parts by the enzyme lactase during digestion. Children have this enzyme but some adults no longer form it and they are unable to digest lactose [15].

FRUIT-VEGETABLES AS SOURCES OF SUGAR

Sugars are found in the tissues of most plants, but are only present in sufficient concentrations for efficient extraction in sugarcane and sugar beet [16]. Sugar occurs naturally in vegetables and fruits, as well as in some whole grains and dairy products. Naturally occurring sugars provide a healthy alternative to foods with added sugars, such as cakes, pastries, processed foods and refined breads and cereals. Fruits and vegetables have naturally low calorie and fat content and provide many important nutrients [4, 17].

CACTUS PEAR AND VOTRE-COACH ALIMANTAIRE AS SOURCES OF SUGAR

Cactus pear is an important resource for semiarid zones. Although used as forage, cactus pear fruit is primarily consumed as a fresh commodity. The processing of cactus pear fruit to obtain juices, marmalades and other kinds of processed foods in order to increase the shelf-life of the fresh fruit has been studied in recent years [18]. Similar to cactus, Votre-coach alimantaire is fruit plants consumed as food for the source of energy.

a. Cactus pear

b. Votre-coach alimantaire

Cactus pear was introduced to Ethiopia between 1848 and 1920 [19, 20, and 21]. The plant is widely distributed in the arid and semi arid regions of the country; especially in eastern and southern zones of Tigray Region of Ethiopia. Over the last few decades interest in cactus pear as food and feed has increased due to its drought resistance, high biomass yield, high palatability and tolerance to salinity [22]. Cactus pear has sweetener taste. But the literature review which support the sugar content of cactus nutritional values is limit. The awareness of the human being knowledge to words the carbohydrate content of cactus and Votre-coach/Fruit de la passion is limit to explain and uses of plant as energy sources. Plant-Fruit as source of carbohydrate deals; to prove the motivation for development of carbohydrate application for society and on their use. Therefore this paper was caused full fill the gap knowledge of society have on carbohydrate content in cactus and Votre-coach alimantaire.

QUANTITATIVE DETERMINATION OF FREE SUGAR IN FRUIT JUICE AND VEGETABLE

The principle of determination of sugar concentration in Fruit Juice and Vegetable Unknown sample: - Glucose is oxidized to gluconic acid and hydrogen peroxide by glucose Oxidase. Hydrogen peroxide reacts with o-Dianisidine in the presence of Peroxidase to form a colored product. Oxidized o-Dianisidine reacts with sulfuric acid to form a more stable colored product. The intensity of the pink color measured at 540 nm is proportional to the original glucose concentration [23-25].

Principles:-

$$\text{D-Glucose} + H_2O + O_2 \xrightarrow{\text{Glucose Oxidase}} \text{D-Gluconic acid} + H_2O$$

$$H_2O_2 + \text{Reduced o-Dianisidine (Colorless)} \xrightarrow{\text{Peroxidase}} \text{Oxidized O-Dianisidine (Brown)}$$

$$\text{Oxidized o-Dianisidine (Brown)} \xrightarrow{H_2SO_4} \text{Oxidized o-Dianisidine (Pink)}$$

EXPERIMENTAL

DESCRIPTION OF STUDY AREA

The study was conducted in April, may, 2011 in Adigrat, Tigray Regional State, Ethiopia. The local farms areas of Adigrat were purposively selected. Eastern zone (Adigrat) is located between 13° 41'–13° 46' N latitude and 39° 21'–39° 34' E longitude and lies at an altitude range of 1931– 2711 masl. The zone has a monomodal rainfall (June to early September) that ranges from 140– 671 mm annually. Similarly, the annual temperature ranges between 10 – 30 ^{O}C [22].

CHEMICALS AND REAGENTS

Chemicals that were used for these investigation: ethanol (98.5%), anhydrous D-Glucose ($C_6H_{12}O_6$). H_2O, Sucrose ($C_{12}H_{22}O_{11}$), Capsule.

Chromatographic Solvents:

Acid solvent: Acetone-Acetic acid-Water, 4:1:5 v/v Mixtures. Neutral solvent: Acetone-Ethanol-Water, 40:11:19 v/v mixture.

Glucose Oxidase/Peroxidase Reagent: 500 units of Capsule were dissolved in 39.5ml of distil water and stayed below 8^{o}C. It stable upto one month below 8^{o}C for at least six month.

O-Dianisidine Reagent: - The pre weighed vial contains 5mg of o-Dianisidine and 2ml of Conc.HCl were dissolved into 5.0ml of ethanol.

Assay Reagent: - A reagent prepared from 0.8ml of the o-Dianisidine reagent in 39.5ml of **Glucose Oxidase reagent.**

Spray Reagents*:* Silver nitrate spray reagent: In 20 ml of acetone, 0.1 ml of saturated silver nitrate was added. Sodium hydroxide spray agent: Mixed 5 ml of 50% sodium hydroxide solution with 100 ml of 95% ethyl alcohol.

Glucose, Sucrose and Starch Standard Solution: - A standard solution of 1.0mg/ml in 0.1% benzoic acid.

EXTRACTION AND PURIFICATION OF SAMPLES

Source of Plant Species

Plant materials belonging to a certain investigations were selected for the sample according to their Nature and their fruit food parts; Cactus Opuntia, Cactus peel and Votre-coach alimantaire fruit were collected, when it appeared that mature within a variety or species might be important, sequential harvests were used.

Selected samples were sliced or dried and 16.28 (Cactus Opuntia/pear and Votre-coach alimantaire) , 17.84gm for Cactus peel)_of raw material was placed in a 400ml Mason jar and covered with 300 ml of boiling 98.5% ethanol. Then Soxlet-extraction apparatus were applied for extraction of each sample separately. The residue in the funnel was extracted twice again, using 300 ml of 98.5% ethanol each time. The extracts were then combined and volume reduced on water bath below at 78^{o}C. This served to remove the alcohol. The extracts were then combined and concentrated until the extract contained sugars were have approximately the same with Sucrose and Glucose, refractive index range as indicated by refractive index measurements.

QUALITATIVE ANALYSIS OF EXTRACT PRODUCT AND PURITY OF EXTRACT SUGAR

The thin layer chromatographic were equilibrated with the solvent in the chamber and then developed for 3hours by the descending technique. The chromatograms were dried at room temperature and then spray reagents were applied for location of the sugar on the survey strips. Location of the sugars chemical constitute in sample of extracted plant; related with the reference of Sucrose in the acidic and neutral reagent thin layer chromatography is facilitated by calculating the Rf value for each sugar. Simultaneously a single spot of thin layer chromatography were observed for each sample, is indicating the purity of the extract sample.

QUANTITATIVE DETERMINATION OF SUGAR IN EXTRACT SAMPLE OF PLANTS

Sample Preparation

Method 1. **Glucose Concentration from a Single Standard**

The three extracted plant sugar were Votre-coach alimantaire (in150mlof ethanol solution), Cactus opuntia (in 85mlof ethanol solution) and Peel (in 75mlof ethanol solution). Cactus Opuntia/pear was diluted 1ml in 100ml, 5ml in 100ml and the Votre-coach alimantaire and Cactus Peel were diluted 1ml in 100ml with distilled water to bring them into the range of approximately 1 to 10mg glucose/ml.

A sample blank consisting of 0.02gm/ml of glucose (know standard of sugar) and 100ml of water and a reagent blank consisting of 1ml Reagent and 100ml of water were also prepared. After half hour the absorbance at 540nm was measured against deionized water blank. The cuvettes were measured in three trail terms.

Table 1:- Sugar determination from Single standard

Tube	Water (ml)	Sample (ml)	Glucose (ml)
Blank reagent	100	----	-----
Standard	95	-----	5
Cactus opuntia sample	99/95	1/5	------
Cactus peel sample	99	1	-------
Votre-coach alimantaire sample	99	1	--------

Milligram of Glucose = $\frac{\Delta A540\ 0 f\ test * mg\ Glucose\ in\ Standard}{\Delta 540\ of\ Standard}$

$= \frac{\Delta A540\ 0 f\ test * 0.02}{\Delta 540\ of\ Standard}$

Where, ΔA_{540}:- Absorbance of glucose at 540nm

Multiply the mg glucose determined above by the dilution factor made in sample preparation.

Method 2. Glucose Concentration from Standard Curve

Liquids samples 2ml, 4ml of extracted sample of Cactus opuntia (150ml of ethanol solution), Cactus peel (75ml of ethanol solution) and Votre-coach alimantaire (85ml of ethanol solution) were diluted into 50ml of distilled water to bring the contraction of sugar 10-100g/ml. At zero time, the reaction were started by addition of 2ml of assay reagent to each test tube and mixed with in 2minutes; then each tube reacts exactly 30 minutes at 37 °C in water bath. At the end the reaction were stopped by addition of 2.0ml of 12N H_2SO4 into each tube. The absorbance of each tube against the reagent blank was measured at 540 nm [24].

Table 2: - Determination of Sugar from calibration curve

Tube	Water (ml)	Sample (ml)	Sucrose or Glucose mg/l stock soln.(ml)	Sucrose Abs. at 540nm (blank reagent)	Glucose Abs. at 540nm (blank reagent)
Blank reagent	50	----	-----	0	0
Standard 1	49	-----	1	0.008	0.005
Standard 2	48	------	2	0.016	0.009
Standard 3	47	--------	3	0.023	0.015
Standard 4	46	--------	4	0.033	0.021
Standard 5	45	--------	5	0.04	0.027
Standard 6	44	------	6	0.048	0.033
Standard 7	43	-------	7	0.058	0.0365
Standard 8	48	-------	8	0.065	0.041
Standard 9	41	-------	9	0.071	0.047
Standard 10	40	-------	10	0.08	0.052
Cactus opuntia sample	**48/46**	**2/4**	**------**	**0.090/0.182**	**0.026/0.049**
Cactus peel sample	**48/46**	**2/4**	**------**	**0.0041/0.079**	**0.023/0.048**
Votre-coach alimantaire	**48/46**	**2/4**	**------**	**0.583/0.988**	**0.029/0.040**

RECOVERY TEST OF REAGENTS AND METHOD

Recovery of added Sucrose was nearly 99.87% (Tab. 3).

Table 3: Recovery Test of Sucrose

Results Sucrose (mg/l)	Added Sucrose (mg/ml)	540nmconcentration measured (mg/ml)	Theoretical concentration(mg/ml)	% Recovery
1.00	0.50	1.50	1.50	100
1.00	1.00	1.99	2.00	99.5
1.00	2.00	2.99	3.00	99.66
1.00	3.00	4.00	4.00	100.00
1.00	4.00	5.01	5.00	100.2

RESULTS AND DISCUSSION

MOISTURE CONTENT OF PLANT SPECIES

The moisture content is expressed as mass fraction, in percent, of the mass of the initial sample. A 350gm, 125gm and 350gm of fresh mature nutrient parts of Cactus opuntia, Votre-coach alimantaire and cactus peel were respectively dried with in air hot oven until all of the moisture was evaporated, from the plants. The 16.28gm, 16.28gm and 17.84gm of dry weight Votre-coach alimantaire, Cactus opuntia and Cactus peel were obtained respectively. These results are indicating; the moisture content of Votre-coach alimantaire 86.97%, 95.3% for Cactus opuntia, when moisture content of cactus peel is 94.9%. Cactus Opuntia is shows the highest water content, when cactus peel is the lowest one.

DETERMINATION OF TOTAL SOLUBLE SOLIDS AND R_F VALUE OF EXTRACTED SAMPLE

During the development of the flesh of a fruit, in many species, nutrients are deposited as starch, which during the ripening process is transformed into sugars. The progression of the ripening process leads to increasing sugar levels. This sugar concentrations' concentrated in sample of plants or total content of soluble solids (TSS) or sugar in a fruit were recorded by refractometer (Table 3). The method is especially suitable for ripe and juicy fruit, with significant sugar content, as the determination of TSS is based on the capacity of sugars in a juice to deviate light.

The results, obtained from chromatography are strongly recommended, the chemical composition of sugar extracted from Cactus Opuntia and Votre-coach alimantaire is similar to the known standard sugar of sucrose and glucose.

Table 3: - R_f value of sugar samples in acid and neutral solvent and Refractometer

Sugar	Rf value		Refractometer of TSS (Brix 0.1%)
	Acid Solvent	Neutral Solvent	
Known Sucrose	0.92	0.75	16
Coach-fruit	0.8	0.695	18
Cactus opuntia	0.82	0.786	18
Cactus Peel	0.846	0.717	21

The results of refractometer index in Table 3, indicate exceptional the TSS of cactus peel, 2l%Brix, the result obtained at Cactus opuntia (18% Brix) and Votre-coach alimantaire fruit (18% Brix) is approximately have a good agreement with the Sucrose (16% Brix).

DETERMINATION OF SUGAR

a. Determination of glucose from a single standard

The measured amount of glucose obtained by the assay, from single standard determination sugar method allocates the Sucrose concentration in extract plants are 102. 51mg/ml, 33mg/ml, 0.47mg/ml in Votre-coach alimantaire fruit, Cactus opuntia and cactus peel respectively. The sugar content of fruit and plants leaf consists mainly of glucose, fructose and sucrose and the profile of each of these depends strongly on the cultivar and region in which the fruit is grown.

b. Sucrose and Glucose Concentration from Standard Curve

Votre-coach alimantaire is marketed as a high energy vegetation to rapidly provide energy enhance after intense physical activity. This is reflected in the high level of sucrose and glucose which provides a ready source of carbohydrate that can be easily metabolized. The measured amount of glucose obtained in Cactus peel by the assay was found to be less than half of Cactus opuntia under the same environment. The mean concentration of Sucrose and Glucose recorded in Votre-coach alimantaire fruit, Cactus opuntia and Cactus peel; 143.035mg/ml, 42.420mg/ml and 0.0943 concentration of Sucrose, when 86.912mg/ml, 18.938 and 8.810mg/ml concentration of Glucose were obtained respectively. The sugar content of each fruit and plant species consists mainly of glucose, fructose and sucrose and the profile of each of these depends strongly on the cultivar and region in which the fruit is grown.

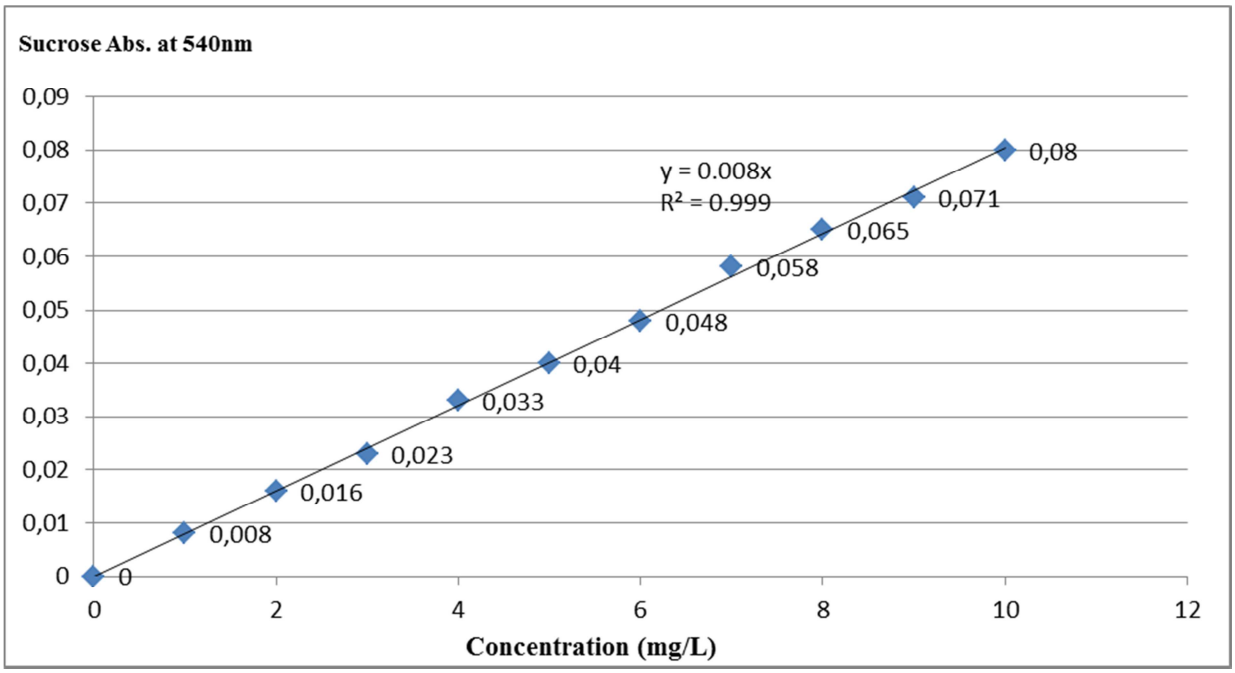


Figure 1:- Standard curve for the determination of glucose

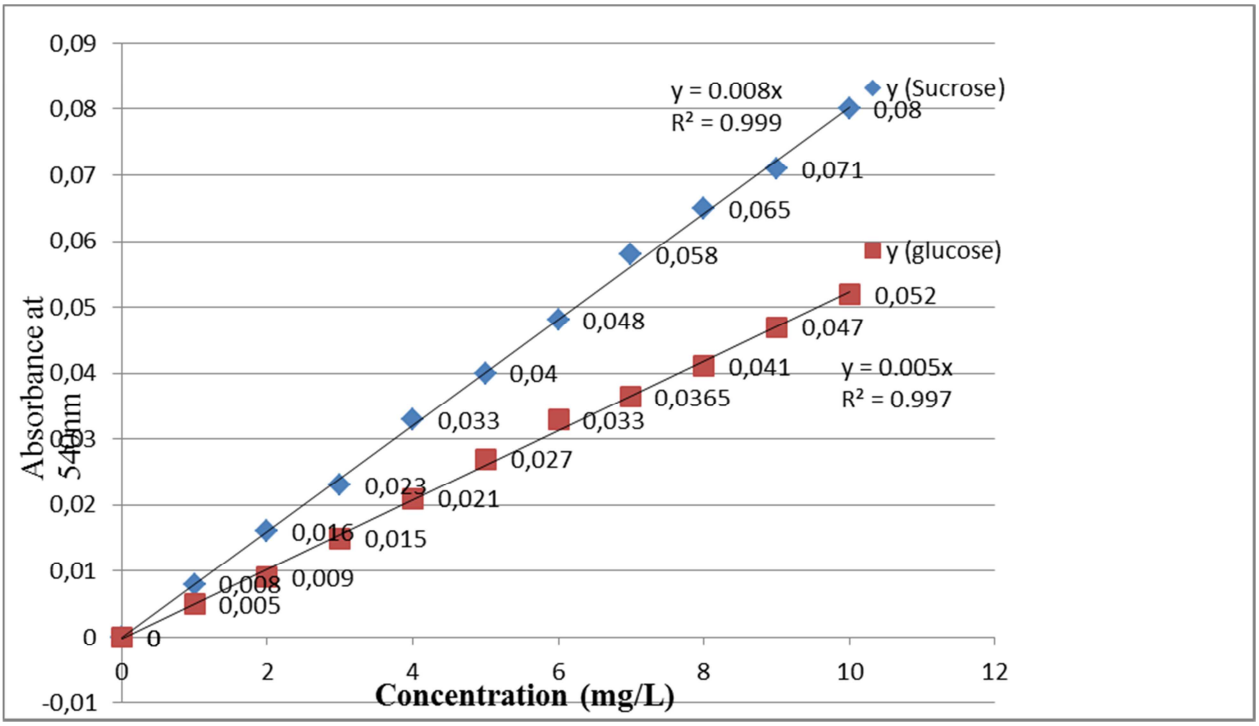


Figure 2:- Standard curve for the determination of Sucrose and glucose simultaneously originate from the same origin.

Table 4:- Concentration of Sucrose and Glucose in Votre-coach alimantaire, Cactus Opuntia and Cactus peel

Plants	volume of Sample	Sucrose Concentration(mg/ml)	Glucose Concentration(mg/ml)
Votre-coach A.	2ml	154.850	88.825
	4ml	131.220	85.000
	Average	143.035	86.912
Cactus Opuntia/pear	2ml	42.185	19.500
	4ml	42.656	18.375
	Average	42.420	18.938
Cactus peel,	2ml	0.961	8.625
	4ml	0.926	9.000
	Average	0.943	8.810

The sugar content of Votre Coach Alimantaire and cactus consists mainly of glucose and sucrose and the profile of each of these depends strongly on the nature and maturity age in which the fruit is grown. The glucose content of Votre coach alimantaire can range of 85.00 to 88.825 mg/ml, when the ranges of sucrose content can 131.00 to 154.850mg/ml in analyzed plant fruit. The contents of glucose and sucrose, 42.185 to 42.656mg/ml and 18.375 to 18.938mg/ml respectively were recorded in cactus pear fruit. The minimum glucose and sucrose were recorded in Cactus peel related to the remains two.

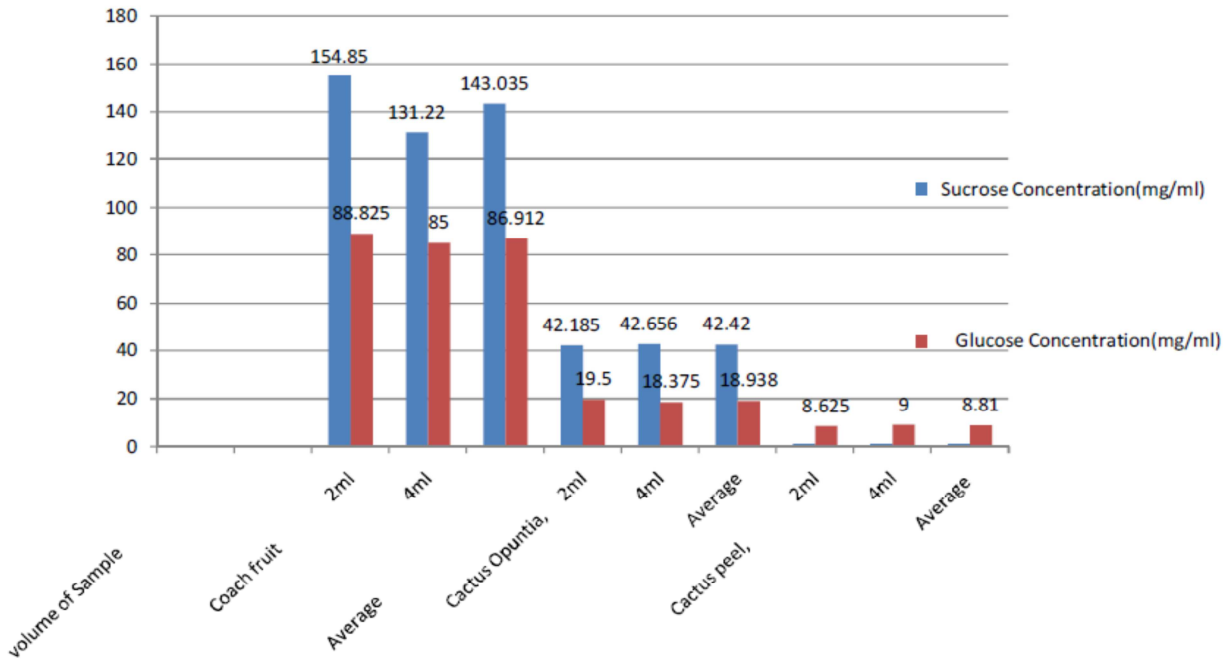


Figure 3:- The concentration of Sucrose and Glucose respectively recorded in Sample of fruit- vegetable plants

CONCLUSION AND RECOMMENDATION

The presented method allows for measurements of the content of glucose and sucrose in starch rich foods such as fruit – vegetables and maturing plants consumed as food sources. The method is quick, easy and reliable. The extraction of plants nutrient by Soxlet- extraction method one of the easiest method applied for extraction of Votre-coach alimantaire and Cactus plants. However, in the analyses, the Glucose and Sucrose needs to be precipitated using ethanol. The study showed that the maximum concentration of Sugar were determined in Votre-coach alimantaire Fruit, when lowest value was determine from Cactus Peel. Approximately more than twice values of Sucrose are found in each plant-fruit comparing to Glucose.

ACKNOWLEDGMENT

We would like to thank Mr. Hayelom. D. (M.Sc) for his giving constructive commitment on my first draft proposal, Mr. Simon G. and Mr. Haily. K. for his helped me during laboratory observation and analyses. We are like also grateful to Adigrat University, Department of Chemistry for creating a good educational environment.

REFERENCES

[1] *Western Kentucky University* (2013). "WKU BIO 113 Carbohydrates". wku.edu.
[2] Eldra Pearl Solomon, Linda R. Berg, Diana W. Martin; *Cengage Learning* (2004).*Biology*. Google.books.com. p. 52. ISBN 978-0534278281.
[3] *National Institute of Standards and Technology* (2011). "Material Measurement Library D-erythro-Pentose, 2-deoxy-". nist.gov.
[4] C. Y. Lee, R. S. Shallenberger, and M. T. Vittum (1970). Free Sugars in Fruits and Vegetables, *J. Food Science and Technology n, No 1.*
[5] Pigman, Ward; Horton, D. (1972). Pigman and Horton,1st ed. *The Carbohydrates: Chemistry and Biochemistry Vol 1A* (2nd ed.). San Diego: *Academic Press.* pp. 1–67.ISBN 0-12-556352-3
[6] Buss, David; Robertson, Jean (1976). Manual of Nutrition; Ministry of Agriculture, Fisheries and Food. London: *Her Majesty's Stationery Office*. pp. 5–9.

[7] Bryant DA, Frigaard NU (2006). "Prokaryotic photosynthesis and photo trophy illuminated". *Trends Microbiol.* **14** (11): 488–96.
[8] Campbell, Neil A., and Jane B. Reece (2005) Biology. 7th ed. San Francisco: *Pearson Education.*
[9] Fred W. Schenck (2006) "Glucose and Glucose-Containing Syrups" in Ullmann's Encyclopedia of Industrial Chemistry, *Wiley-VCH, Weinheim.* No.12 pp. 457
[10] Kretchmer, N; Hollenbeck CB (1991). *Sugars and Sweeteners*. CRC Press, Inc.
[11] Biose on www.merriam-webster.org
[12] IUPAC, *Compendium of Chemical Terminology*, 2nd ed. (the "Gold Book") (1997). Online corrected version: (2006–) "disaccharides".
[13] **(1)** Robert Hill and Joseph Needham (1970). The Chemistry of Life: Eight Lectures on the History of Biochemistry, *London, England: Cambridge University Press*, page 17 ; **(2)** Richard B. Silverman (2002), The Organic Chemistry of Enzyme-catalyzed Reactions, 2nd ed. *London, England: Academic Press*, page 1 ; **(3)** Jochanan Stenesh (1998). ,Biochemistry, vol. 2 *(New York, New York: Plenum),* page 83 ;
[14] Bruni, C.B., Sica, V., Auricchio, F. and Covelli, I. (1970). "Further kinetic and structural characterization of the lysosomal α-D-glucoside glucohydrolase from cattle liver". *Biochim. Biophys. Acta***212** (3): 470–477, "Maltase", *Encyclopædia Britannica Online*
[15] "Lactase", *Encyclopædia Britannica Online*
[16] *Beta Maritima: The Origin of Beets*. Springer. 2012. ISBN 978-1-4614-0841-3
[17] NAL USDA National Nutrient Database
[18] C.saenz`, A. Estevenz and P. Mecklenburg (1998). Cactus pear Fruit: A new source for natural sweetener. *Plant foods for Human Nutrition* 52: 141-149
[19] L. Habtu (2005) Cactus in southern Tigray: Current status, potential uses, utilization and threat. *M.Sc. Thesis, Addis Ababa University*.
[20] L. Neumann (1997) Opening speech. In: Proceedings of the International Workshop on "*Opuntia* in Ethiopia: State of Knowledge in *Opuntia* Research" February 23-27, 1997, Mekelle University, Ethiopia and Wiesbaden Polytechnic, Germany, pp 5-9
[21] G. Gebretsadik, G. Animut and F. Tegegne (2013). Assessment of the potential of cactus pear (*Opuntia ficus indica*) as livestock feed in Northern Ethiopia, *Livestock Research for Rural Development 25* (2)
[22] F. Karadeniz and A. Eksi (2002) Sugar composition of apple juices. *Eur. Food Res. Technol.* 215:145-148.
[23] H. U. Bergmeyer and Bernt E (1974). Methods of Enzymatic Analysis, H.U. Bergmeyer, Ed., New York, Academic Press, 2nd Edition, pp 1205-1212.
[24] D. A. T. Southgate, (1972). Determination of Food Carbohydrates, Applied Science Publishers, LTD, London.

International Journal of Innovation and Scientific Research
ISSN 2351-8014 Vol. 10 No. 1 Oct. 2014, pp. 154-170

http://www.ijisr.issr-journals.org/

Développement de modèles statistiques pour la prévision du débit de forage d'eau en milieux de socle cristallin et cristallophyllien en Côte d'Ivoire

[Development of statistical models for the prediction of the drilling water flow in the crystalline and cristallophyllian bedrock of Ivory Coast]

Amani Michel KOUASSI[1], Koffi Eugène KOUAKOU[1], Yao Blaise KOFFI[2], and Jean BIEMI[2]

[1]Institut National Polytechnique Félix Houphouët-Boigny (INP-HB) ; Département des Sciences de la Terre et des Ressources Minières (STeRMi) ; Laboratoire du Génie Civil, des Géosciences et des Sciences Géographiques ; BP 1093 Yamoussoukro, Côte d'Ivoire

[2]Université Félix Houphouët-Boigny d'Abidjan-Cocody, Unité de Formation et de Recherche des Sciences de la Terre et des Ressources Minières (UFR-STRM) ; Laboratoire des Sciences et Techniques de l'Eau et de l'Environnement (LSTEE) ; 22 BP 582 Abidjan 22, Côte d'Ivoire

ABSTRACT: The objective of this study is to develop statistical models to predict the drilling flow on rock aquifers. The study area is the former region of N'zi-Comoé (Central-East of Ivory Coast) that is located between longitude 3° 40' and 4°55' West and latitude 6° 20' and 8°10' North. The geological formations are composed of igneous rocks and metamorphic rocks. The methodology has been first applied to the approach of principal component analysis normalized, for identifying relevant and expressive variables of the drilling flow. Then, a calibration was performed with a sample of 100 drillings representing two thirds of the total sample to determine the coefficients of linear regressions and associated standard errors. Finally, an evaluation of the developed models was performed using the criteria of performance and robustness. The most relevant and expressive variables for modeling the drilling flow are the transmissivity, the thickness of healthy base drilled, the depth of the first significant water inlet and the total number of water inlet. Thus, two models were developed. Models assessment shows that they are performing with correlation coefficients ranging around 0.7, biases varying between 10^{-7} and 10^{-2} and quadratic errors in the order of 2.5 to 2.9. These models have also demonstrated their robustness with rates fluctuating between 3.2 and 5.3%. However, the model 2 is more efficient and more robust than model 1.

KEYWORDS: Productivity of drillings, Rock aquifers, Statistical modeling, Ivory Coast.

RESUME: L'objectif de cette étude est de développer et d'évaluer des modèles statistiques capables de prévoir le débit des forages en milieux de socle cristallin et cristallophyllien. La zone d'étude est l'ex-région du N'zi-Comoé (Centre-Est de la Côte d'Ivoire) qui est située entre les longitudes 3°40' et 4°55' Ouest et les latitudes 6°20' et 8°10' Nord. Les formations géologiques sont constituées de roches magmatiques et métamorphiques. La méthodologie utilisée a consisté d'abord à appliquer l'analyse en composantes principales normées (ACPN) pour l'identification des variables explicatives pertinentes et expressives du débit des forages. Ensuite, un calage a été effectué avec un échantillon de 100 forages représentant les 2/3 de l'échantillon total afin de déterminer les coefficients de régression linéaire et les erreurs-types associées. Enfin, une évaluation des modèles développés a été réalisée à partir des critères de performance et de robustesse. Les variables les plus pertinentes et expressives pour la prévision du débit de forage sont la transmissivité, l'épaisseur de socle sain foré, la profondeur de la première arrivée d'eau significative et le nombre d'arrivées d'eau. Ainsi, deux modèles ont été développés. L'évaluation des modèles montrent que ceux-ci sont performants avec des coefficients de corrélation variant autour de 0,7, des biais fluctuant entre 10^{-7} et 10^{-2} et des erreurs quadratiques dans l'ordre de 2,5 à 2,9. Ces modèles ont également

démontré leur robustesse avec des valeurs du critère de robustesse fluctuant entre 3,2 et 5,3%. Mais, le modèle 2 est plus performant et plus robuste que le modèle 1.

MOTS-CLEFS: Productivité des forages, Aquifères de socle, Modélisation statistique, Côte d'Ivoire.

1 INTRODUCTION

Disposer d'eau de qualité en quantité suffisante en milieux de socle cristallin et cristallopphyllien est un besoin vital qui n'est pas satisfait pour les populations en général et celles vivant en milieux de socle en particulier. Nous ne sommes tous égaux devant les situations et les capacités qui peuvent être mobilisées pour répondre à ce besoin, et l'alimentation en eau des populations menacées est la problématique de ce travail. Parce que l'eau souterraine est une ressource de choix, elle est souvent mobilisée pour répondre aux besoins des hommes. En milieux de socle, elle est difficile à appréhender d'où la nécessité d'appliquer des stratégies et des techniques spécifiques telles que la géophysique. En effet, les fonctions physiques (épaisseur d'altération, épaisseur de socle fissuré, profondeurs des fractures hydrauliquement actives et hydrauliques, etc.) et hydrauliques (coefficient d'emmagasinement, transmissivité, etc.) des aquifères peuvent être appréhendées par l'interprétation de sondages électriques et de sondages par résonance magnétique protonique (RMP) [1-7]. Etant en milieux de socle, les arrivées d'eau sont induites par les fractures hydrauliquement actives. Devant les nombreux échecs en matière de prospection des eaux souterraines en milieux de socle, les recherches sur l'eau ont été orientées vers une meilleure connaissance des aquifères des fissures qui sont censés être à l'abri des fluctuations saisonnières et moins exposés aux phénomènes de pollution du fait de la présence de niveaux altérés. C'est dans ce sens que des études visant à rechercher les relations entre la productivité des forages en milieux de socle et la fracturation ont été motivées [8-15].

Malgré l'évolution de la technologie avec le développement de l'utilisation des méthodes géophysiques, les images satellitaires, les modèles numériques de terrain (MNT), etc., il est encore aujourd'hui difficile de prévoir la productivité d'un forage en milieu de socle avant la foration et d'éliminer les sites les moins prometteurs. Plusieurs travaux [16-18] ont permis de jeter les bases d'une modélisation de la productivité des forages en milieu de socle. A chaque échelle de travail, on peut mettre en évidence des paramètres statistiquement corrélés à la productivité du socle [16-18]. Ces paramètres diffèrent d'une échelle à l'autre alors que la productivité n'est toujours due qu'à la fracturation ouverte des terrains. Des modèles statistiques avec pour variable expliquée le débit et pour variables explicatives la vitesse d'avancement de l'outil dans les altérites meubles (Vaa), la vitesse d'avancement de l'outil dans le socle (Vas), la profondeur de la première arrivée d'eau (Pae), le nombre d'arrivées d'eau (Nae), l'épaisseur d'altération (Alt) ou épaisseur des altérites meubles, l'épaisseur de socle traverse (Soc) ou épaisseur des formations recoupées sous la base des altérites meubles ont pu être établis à l'échelle locale [16-18]. Les différents modèles ont démontré leur capacité à prévoir le débit des forages. Il serait donc judicieux de tenir compte des paramètres corrélés à la productivité dans les implantations des forages d'eau. C'est donc dans l'optique de contribuer à la recherche de solutions en vue d'optimiser la prospection hydrogéologique en milieux de socle que cette étude a été menée.

L'objectif général de notre recherche est de concevoir des modèles statistiques capables de prévoir le débit des forages en milieux de socle à partir de paramètres hydrauliques et physiques estimables par les méthodes de prospection géophysique de surface. Il s'agit, d'une part, d'identifier des paramètres hydrauliques et physiques corrélés à la profondeur des forages, et d'autre part, de développer et d'évaluer des modèles statistiques dont les variables explicatives sont issues des résultats du premier objectif. Notre méthodologie a consisté à utiliser l'analyse en composantes principales normées (ACPN) pour l'identification des variables explicatives pertinentes et la modélisation statistique à partir de la régression linéaire multiple pour la prévision du débit des forages. L'originalité de cette étude réside sans doute, d'une part, dans le choix des variables explicatives et d'autre part, dans l'hypothèse selon laquelle ces différentes variables doivent pouvoir être estimées par les mesures géophysiques de surface (sondages électriques et sondages par résonance magnétique protonique(RMP)).

2 PRESENTATION DE LA ZONE D'ETUDE

L'ex-région du N'zi-Comoé, située au Centre-Est de la Côte d'Ivoire, est comprise entre les longitudes 3°40' et 4°55' Ouest et les latitudes 6°20' et 8°10' Nord (Fig. 1) avec une superficie de 19 560 Km². Elle est aujourd'hui divisée en trois (3) régions administratives:

- la région du N'zi avec pour chef-lieu Dimbokro, comprend les départements de Dimbokro, Bocanda et Kouassi-kouassikro ;

- la région du Iffou avec pour chef-lieu Daoukro, comprend les départements de Daoukro, Prikro, M'Bahiakro, Ouellé et Koffi Annoukro ;
- la région du Moronou avec pour chef-lieu Bongouanou, comprend les départements de Bongouanou, M'Batto et Arrah.

Le relief de la zone d'étude est monotone et constitué d'un plateau légèrement incliné de direction Nord-Sud, avec une altitude moyenne d'environ 150 m. Les collines de la chaîne Baoulé correspondent aux faciès volcano-sédimentaires, principalement les roches vertes. La végétation est constituée de lambeaux de forêt mésophile, et de larges mailles de savanes séparées par des forêts-galeries. Il existe à côté de ces végétations naturelles, des végétations liées à l'action anthropique (mosaïques forêt-cultures, mosaïques savanes-cultures, cultures). Le climat est de type tropical humide avec une alternance de 4 saisons dont deux (2) saisons pluvieuses et deux (2) saisons sèches. Le régime climatique est caractérisé par des précipitations moyennes mensuelles variant entre 11 mm et 198 mm. La hauteur pluviométrique interannuelle calculée sur la période 1950-2000 est de 1155 mm.

La région de l'ex-N'zi-Comoé appartient au domaine paléoprotérozoïque encore appelé domaine baoulé-mossi. Du point de vue lithologique, la zone d'étude est recouverte par un ensemble complexe de formations géologiques constituées essentiellement de roches ignées, métamorphiques et volcano-sédimentaires [19] (Fig. 2). On distingue les roches éburnéennes et les roches birimiennes. Les roches éburnéennes sont constituées essentiellement de granitoïdes notamment les granites à deux micas, les granites à biotite homogènes et hétérogènes, et les granodiorites. Les formations birimiennes sont essentiellement des métasédiments et des roches vertes (métavulcanites). Les métasédiments sont constitués en majeure partie de grès et de schistes. Les roches vertes sont constituées de métabasalte, métaandésite, métadolérite, métagabbro, amphibolite. Les différentes formations géologiques ont été affectées par plusieurs systèmes d'accidents majeurs [14, 19-21]. Ces fractures sont de direction préférentiellement Nord-Sud et elles sont susceptibles de faciliter la circulation de l'eau dans les roches. Ces formations géologiques ont été également touchées par le phénomène d'altération. Ainsi, l'altération sur le substratum schisteux est particulièrement épaisse et argileuse. Elle est en moyenne d'une trentaine de mètres et peut atteindre 60 m. En effet, les roches plus ou moins riches en minéraux ferromagnésiens, en minéraux calciques, en plagioclases, en silice et en oxydes, ont une altération qui conduit à la formation d'argiles. L'altération des granites est essentiellement sableuse et peu épaisse (inférieure à 10 m).

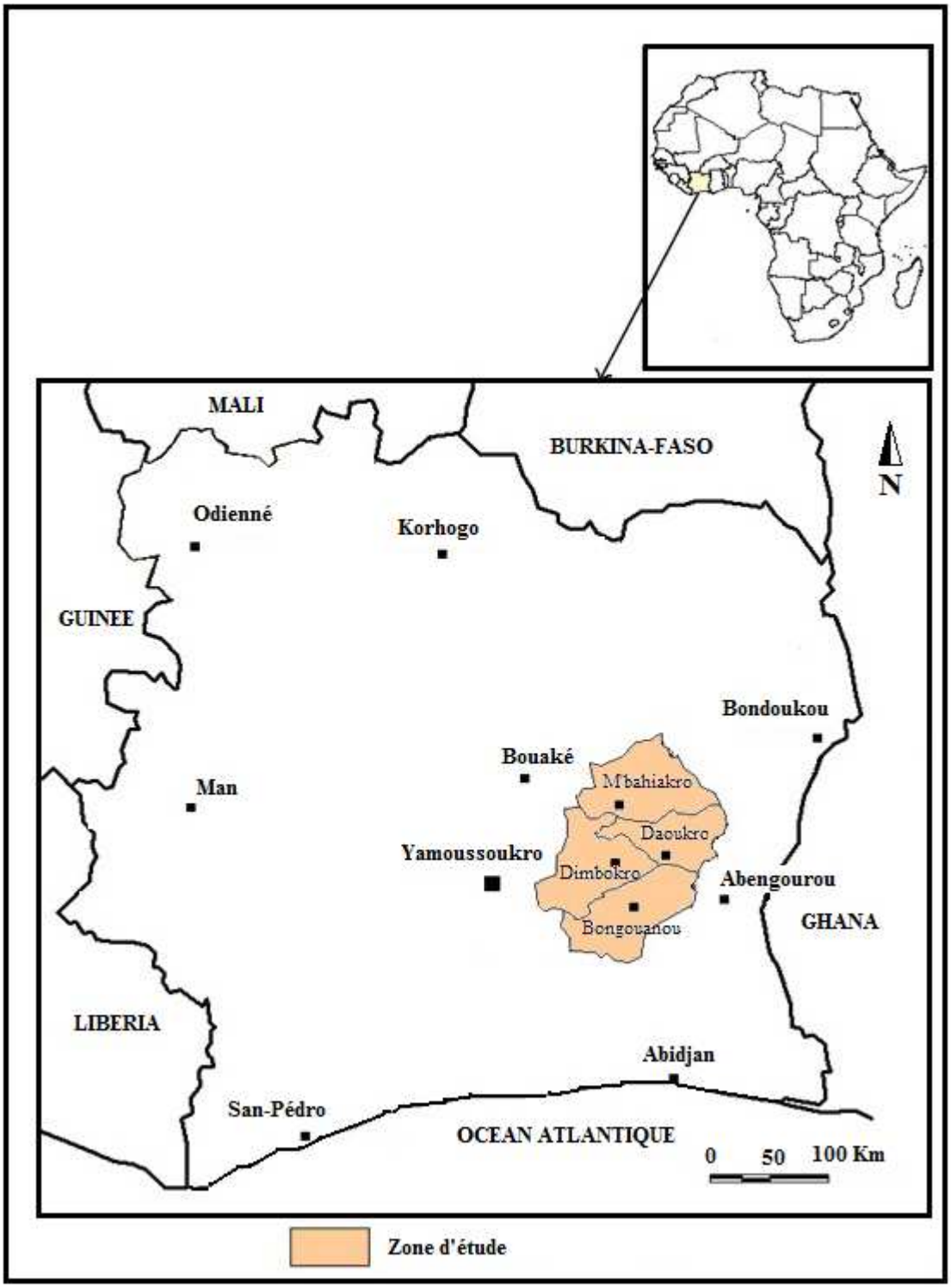


Fig. 1 : Présentation de l'ex-région du N'zi-Comoé (Centre-Est de la Côte d'Ivoire)

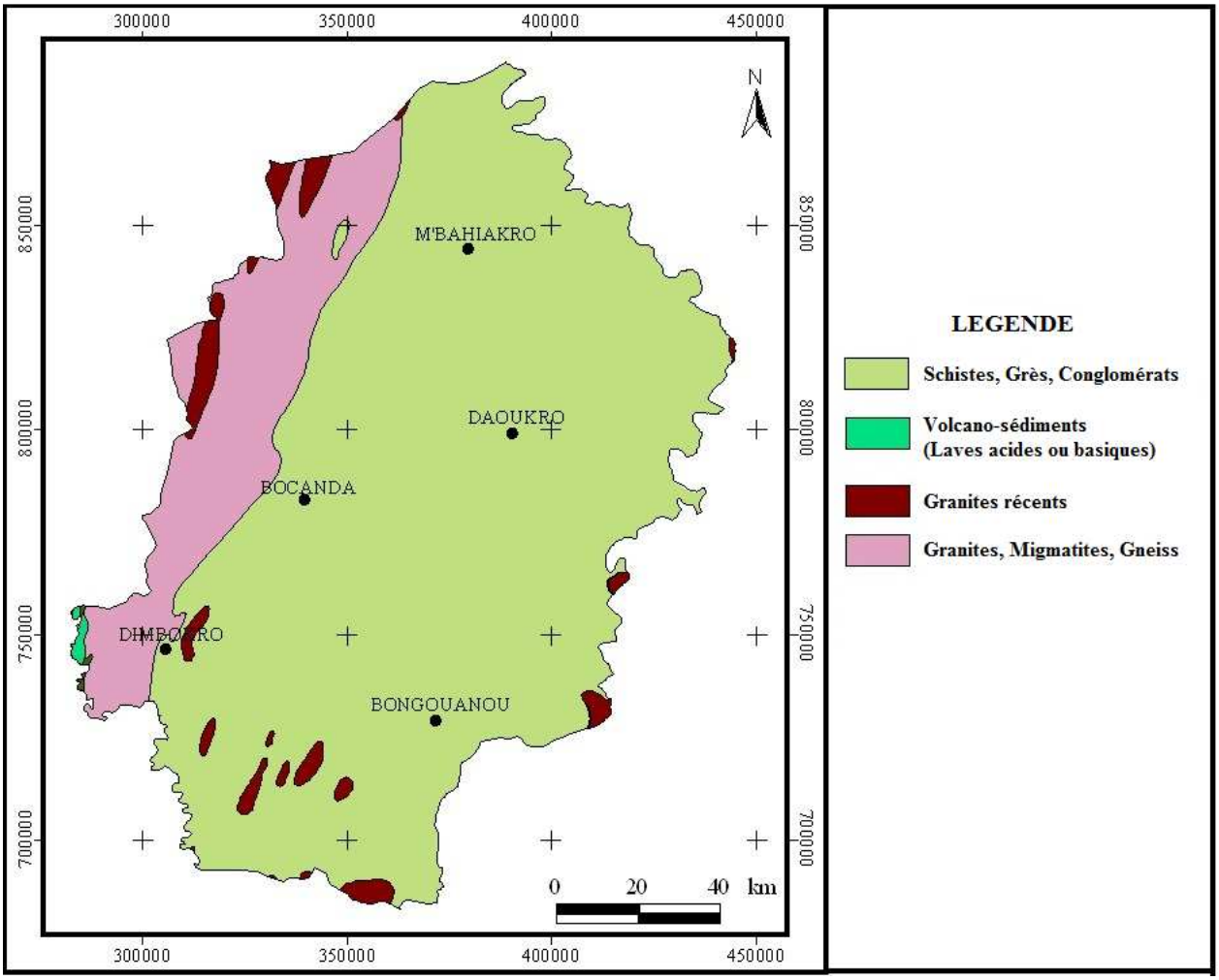


Fig. 2 : Carte géologique de l'ex-région du N'zi-Comoé (Centre-Est de la Côte d'Ivoire)

3 MATERIEL ET METHODES

3.1 DONNÉES

Les fiches techniques des forages des programmes d'hydraulique villageoise réalisés dans la région de l'ex-région du N'zi-Comoé de 1999 à 2000 « Don Japonais, AEP-II-3 » ont été utilisées. Au total 150 fiches techniques représentant 150 forages ont été retenues pour cette étude (Fig. 3). Ces fiches techniques de forage ont permis d'obtenir des données relatives aux paramètres physiques [l'épaisseur d'altération (Ep_Alt), l'épaisseur forée dans le socle fissuré (Ep_Soc), la profondeur de la première arrivée d'eau (Pae_1), le nombre total d'arrivées d'eau (Nae_1) et la profondeur totale du forage (Pt)] et hydrauliques [le débit de forage ou débit air-lift (Q_f), le débit de la première arrivée d'eau (Qae_1), le niveau statique (N_s), le débit spécifique (Q_s), la transmissivité (T), la conductivité hydraulique (K)]. Les valeurs de transmissivité ont été évaluées par la méthode de Cooper-Jacob en remontée [22] et celles de la conductivité hydraulique ont été estimées par la méthode de Hvorslev [23]. Les caractéristiques statistiques des paramètres hydrauliques et physiques sont consignées dans le tableau 1. L'analyse de ce tableau montre que les valeurs des coefficients de variation (rapport de l'écart-type à la moyenne) (CV) de la majorité des paramètres sont supérieures à 25%. En effet, celles-ci varient entre 33% et 125,09%. La valeur du coefficient de variation de la profondeur d'altération qui est de 21,83% montre que les profondeurs d'altération dans la zone d'étude sont relativement uniformes. Cependant, tous les autres paramètres sont plus variables.

Tableau 1: Caractéristiques statistiques des paramètres étudiés.

Paramètres	Minimum	Maximum	Moyenne	Ecart-type	CV
Qf	0,4	16	3,8	3,74	98,45
Qae_1	10^{-4}	16,2	2,27	2,83	125,09
Q_s	0,01	3,03	0,4	0,47	115,69
N_s	8,85	65,72	36,81	12,17	33,06
T	$1,7.10^{-6}$	$3,62.10^{-4}$	$5,45.10^{-5}$	$6,72.10^{-5}$	123,21
K	$1,79.10^{-8}$	$3,8.10^{-6}$	$6,35.10^{-7}$	$7,23.10^{-7}$	114
Ep_Alt	4	104	54,2	21,15	21,83
Ep_Soc	0	73,43	24,33	12,68	52,11
Pt	40,5	116,47	78,53	17,14	39,03
Pae_1	17	106,18	44,75	17,63	39,4
Nae	1	6	2,93	1,1	37,66

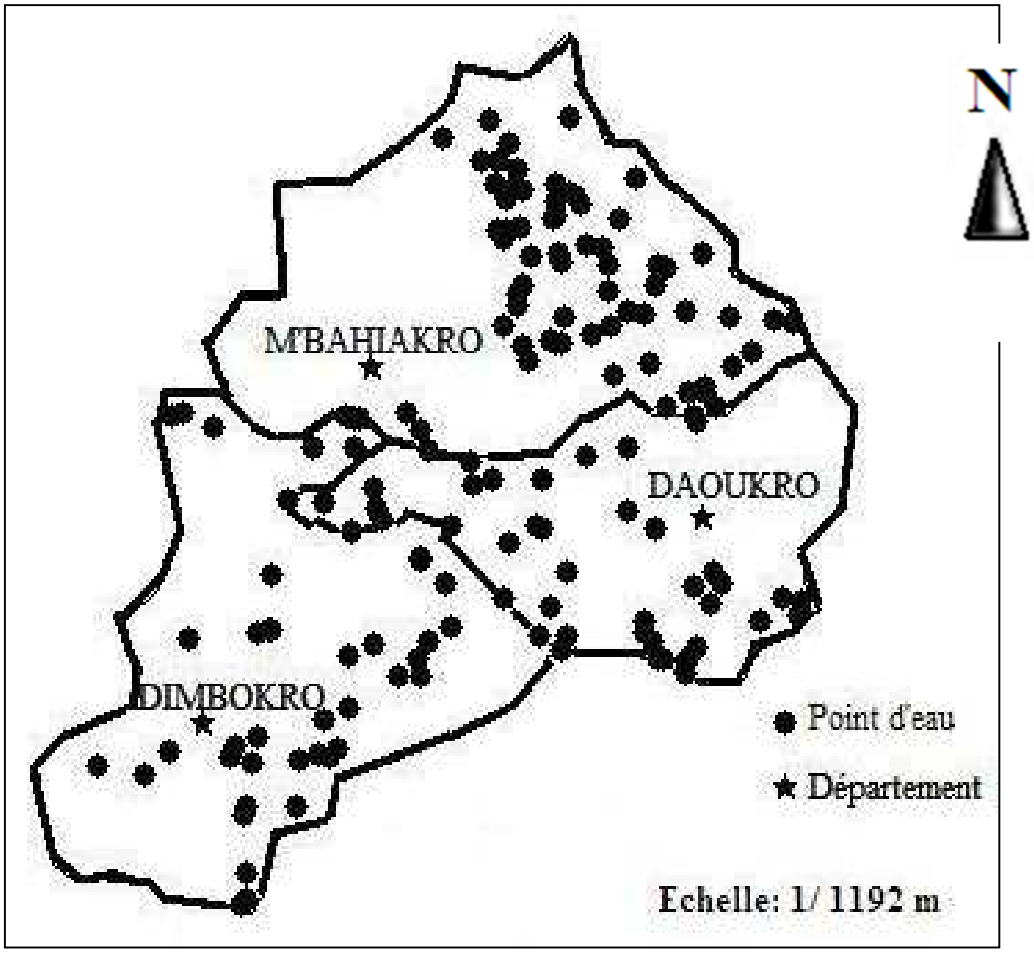


Fig. 3: Carte de répartition spatiale des points d'eau

3.2 IDENTIFICATION DES VARIABLES EXPLICATIVES DES MODÈLES

L'ACPN a été effectuée sur les données provenant de 150 forages d'eau afin de mettre en évidence les paramètres et partant les phénomènes physiques et hydrauliques cités précédemment et qui semblent influencer la productivité des forages en milieux de socle cristallin et cristallophyllien. Cette méthode a déjà fait l'objet de plusieurs applications dans le domaine de l'hydrodynamique en Côte d'Ivoire [12, 18, 24]. Les variables physiques des forages prises en compte sont l'épaisseur d'altération, l'épaisseur forée dans le roc fissuré, la profondeur de la première arrivée d'eau, le nombre total

d'arrivées d'eau et la profondeur totale du forage. Les variables hydrauliques utilisées sont le débit de forage, le débit de la première arrivée d'eau, le niveau statique, le débit spécifique qui est le rapport du débit de pompage au rabattement induit par ce pompage, la transmissivité et la conductivité hydraulique. Pour l'analyse des résultats, les éléments statistiques retenus sont les valeurs propres, les vecteurs propres des facteurs, la matrice de corrélation et le cercle de communauté. L'ACPN appliquée aux données d'une zone n'est valable que lorsque les plans factoriels donnent plus de 70% de l'information (variance totale exprimée). Une valeur propre est choisie lorsqu'elle est supérieure ou égale à 1 sachant que la somme des valeurs propres est égale au nombre de variables utilisées pour la réalisation de l'ACPN, laquelle a été effectuée à partir du logiciel Statistica 8.0.

3.3 CONCEPTION DES MODÈLES ET PROCÉDURE DE CALAGE

La régression linéaire multiple peut être utilisée pour prévoir les valeurs d'une variable dépendante à partir de variables explicatives ou indépendantes [25]. En effet, les régressions linéaires multiples sont utilisées pour déterminer la relation linéaire la plus satisfaisante pour prévoir la valeur dépendante qui produit l'erreur-type la moins grande. Dans un tel modèle, chaque variable indépendante est pondérée afin que la valeur des coefficients de régression maximise l'influence de chaque variable dans l'équation finale. Il est possible de manipuler plusieurs variables indépendantes à partir des régressions linéaires multiples, mais seulement une variable dépendante. La régression linéaire multiple a déjà été utilisée par plusieurs auteurs [16-18] pour l'étude de la productivité des forages d'eau en milieux de socle. Dans ces différents travaux, les modèles conçus ont démontré leur capacité à simuler la productivité des forages d'eau en milieux de socle de façon générale et particulièrement en Côte d'Ivoire et au Tchad. Dans cette étude, les caractères expliqués (variables dépendantes) sont la profondeur limite de forage et l'épaisseur de socle foré. En ce qui concerne les variables explicatives, il s'agit des paramètres des forages dont la relation avec la productivité serait prouvée par l'analyse statistique multivariée. Il s'agit des paramètres les plus pertinents et les plus influents mis en évidence par l'analyse statistique. Dans une régression linéaire multiple, l'équation est sous la forme suivante (équation 1) :

$$Y = C_1 X_1 + C_2 X_2 + \ldots + C_3X_3 + C_NX_N + C_0 \quad (1)$$

-Y : variable expliquée ;
-X_i : variable explicative ;
-C_0: constante ;
-C_i ($1 \leq i \leq N$): coefficients de pondération de la variable explicative X_i.

En effet, Y est un vecteur de valeurs observées de débit de forage d'eau, X_i est une matrice de variables indépendantes ou explicatives, C_i est un vecteur de paramètres ou coefficients de régression à estimer, et C_0 est un vecteur des résidus ou des perturbations aléatoires. La régression linéaire estime le vecteur C_i comme la solution des moindres carrés [26-27]:

$$C_i = \left(X_i^T X_i\right)^{-1} X_i^T Y \quad (2)$$

avec X^T la transposée de X.

La régression multiple est une variante de la méthode de régression simple qui peut aider à faire face à la colinéarité en choisissant itérativement les variables avec la plus grande valeur explicative. Une régression multiple ascendante commence avec aucune variable, ou un sous-ensemble des variables disponibles, et ajoute la variable la plus significative (celui avec la plus faible valeur de p, associée à des statistiques estimées F) à chaque étape du modèle. Une régression pas à pas descendante commence avec toutes les variables disponibles et supprime la variable la moins importante à chaque étape. C'est la deuxième forme de régression multiple qui a été utilisée.

L'estimation des paramètres d'un modèle constitue l'une des étapes les plus pertinentes de son développement [28]. Selon cet auteur, les méthodes d'estimation sont multiples ; ceci résulte du fait que la nature des paramètres est variée et qu'il n'y a aucune méthode d'estimation globalement satisfaisante. L'estimation implique de faire des choix pour établir une stratégie de calibration. Les stratégies sont bien entendu fonction de l'objectif visé par le modèle en tenant compte de sa pertinence et de sa performance. Le calage des modèles s'est appuyé sur le principe du « split-sample test » qui consiste à faire le calage sur les deux tiers (2/3) de l'échantillon des données disponibles et la validation sur le tiers (1/3) restant [29-30]. Ainsi, le calage des modèles a été effectué sur un échantillon de 100 forages et la validation sur un échantillon de 50 forages. Le calage a été réalisé de façon automatique avec le logiciel Excel 2013. L'estimation des coefficients de pondération des variables retenues a été réalisée par calage automatique avec le logiciel Excel 2013. Elle a consisté à ajuster les valeurs

numériques attribuées aux paramètres des modèles pour reproduire au mieux la réponse observée. Dans la présentation des résultats du calage, il est important d'associer à chacun des coefficients de régression, l'erreur-type associée, qui est un indicateur qui peut être assimilé à l'écart-type. En effet, l'erreur-type est au coefficient de régression ce que l'écart-type est à la moyenne d'une variable. Elle consiste donc en une mesure de la variabilité du coefficient de régression. Ainsi, si plusieurs régressions étaient effectuées sur autant de sous-échantillons tirés d'un même échantillon principal, la valeur des paramètres de régression ainsi obtenus différerait d'une fois à l'autre. La « robustesse » d'un coefficient donné sera d'autant plus grande que sa variation autour de la valeur la plus probable, soit le coefficient lui-même, est faible. C'est précisément ce que mesure l'erreur-type du coefficient. L'erreur-type a été calculé de façon automatique avec le logiciel Excel 2013.

3.4 CRITÈRES D'ÉVALUATION DES MODÈLES DÉVELOPPÉS

3.4.1 EVALUATION DE LA QUALITÉ DES MODÈLES DÉVELOPPÉS AU MOYEN DE LA PERFORMANCE

La performance des modèles et leur robustesse ont été évaluées à l'aide de critères numériques et graphiques. L'analyse des résultats de simulation est portée sur les performances des modèles en phase de calage et en validation. En effet, les performances au calage sont moins révélatrices des réelles capacités de simulation des modèles. Celles-ci sont mieux exprimées par la validation [31]. Pour évaluer la performance des modèles développés dans cette étude, le coefficient de corrélation, la racine carrée de l'erreur quadratique moyenne et la moyenne biaisée, ont été utilisés comme critères d'évaluation.

Le coefficient de corrélation (R) est utilisé pour mesurer la corrélation linéaire entre la variable réelle ou mesurée et la variable calculée. Sa formule est (équation 3):

$$R = \frac{\sum_i \left(Q_i - \overline{Q}\right) \times \left(Q'_i - \overline{Q'}\right)}{\sqrt{\sum_i \left(Q_i - \overline{Q}\right)^2 \times \sum_i \left(Q'_i - \overline{Q'}\right)^2}} \quad (3)$$

avec :

- Q_i : débit mesuré ;
- Q'_i : débit simulé ;
- $\overline{Q}$: moyenne des débits mesurés ;
- $\overline{Q'}$: moyenne des débits simulés.

La relation est dite parfaite si R = 1 ; très forte si 0,8 ≤R <1 ; forte si R se situe entre 0,5 et 0,8 ; d'intensité moyenne si R se situe entre 0,2 et 0,5 ; faible si R se situe entre 0 et 0,2 ; nulle si R = 0 [32].

La racine carrée de l'erreur quadratique moyenne (RMSE) est utilisée comme la mesure de la performance globale du modèle. Le modèle est bien optimisé si la valeur de RMSE est proche de zéro, ce qui tend vers une parfaite prévision. Sa formulation mathématique est donnée par la relation suivante (équation 4):

$$RMSE = \sqrt{\frac{\sum_{i=1}^{n} \left(Q_i - Q'_i\right)^2}{n}} \quad (4)$$

avec :

-Q_i : débit observé ;
-Q'_i: débit simulé ;
-n: taille de l'échantillon.

Le biais est un critère permettant de mettre en évidence l'écart entre deux grandeurs. Il doit être minimisé (l'optimum est la valeur nulle). Il donne alors l'erreur relative entre les valeurs observées et celles simulées lors des analyses. Lorsque la

moyenne biaisée « B » tend vers zéro, les résultats du modèle sont sans biais, c'est-a-dire que les deux valeurs sont proches et donc le modèle est performant. Ce paramètre est défini par la relation suivante (équation 5):

$$B = \frac{1}{n}\sum_{i=1}^{n}\left|Q_i - Q'_i\right| \quad (5)$$

avec :

- Q_i: débit observé ;

- Q'_i: débit simulé.

Outre l'évaluation numérique, des analyses graphiques comparant des débits observés aux débits simulés ont été réalisées afin d'apprécier la qualité de la modélisation effectuée. En pratique, si la simulation était parfaite, c'est-à-dire, si chacune des valeurs simulées par les modèles était égale à la valeur observée, le nuage de points constitué serait aligné et confondu à la droite d'équation y=x. Cependant, comme la modélisation n'est pas parfaite, l'évaluation qualitative de la performance des différents modèles a consisté à apprécier la dispersion du nuage de points autour de la première diagonale.

3.4.2 EVALUATION DE LA QUALITÉ DES MODÈLES DÉVELOPPÉS AU MOYEN DE LA ROBUSTESSE

L'une des techniques les plus utilisées pour évaluer la robustesse d'un modèle est la technique du double échantillon [29]. Cette technique permet de tester l'adaptabilité du modèle quelle que soit sa complexité. Le critère de robustesse (R') du modèle a été évalué par la différence du coefficient de corrélation en validation ($R_{validation}$) et en calage (R_{calage}). Le modèle est dit robuste si le critère de robustesse est inférieur ou égal à 10%. L'expression du critère de robustesse est (équation 6):

$$R' = 100 \times \left|R_{validation} - R_{calage}\right| \quad (6)$$

4 RESULTATS ET DISCUSSION

4.1 VARIABLES EXPLICATIVES PERTINENTES DE LA PRODUCTIVITÉ DES FORAGES D'EAU

L'analyse en composantes principales normées (ACPN) a permis de réduire la dimension de l'espace des variables et d'éliminer les variables explicatives non pertinentes. L'analyse des matrices de corrélation, des valeurs propres et variances propres, des coordonnées des variables (Tableaux 2, 3 et 4) et les représentations graphiques (Figures 3 et 4) dans l'espace des variables issues de l'ACPN ont permis de rechercher les principaux facteurs à l'origine de l'évolution des variables.

Les résultats de la matrice de corrélation (Tableau 2) mettent en évidence trois tendances de corrélation :

- fortes corrélations entre les variables hydrauliques particulièrement les couples de variables tels que Qf-T(0,73), Qf-Qs (0,7), T-Qs (0,67) et Qf-Qae_1 (0,55) ;
- fortes voire très fortes corrélations entre d'une part Pt et Pae_1(0,93) et d'autre part entre les couples Ep_alt-Pae_1 (0,86), Ep_alt-Pt (0,80) et Ep_alt-Ep_soc (-0,59) ;
- faibles corrélations entre les paramètres hydrauliques et physiques de façon générale, et particulièrement entre le débit de forage et les paramètres physiques de forage. Seul le niveau statique (Ns) est corrélé à des paramètres tels que la profondeur de la première arrivée d'eau significative (Pae_1) (0,68), la profondeur totale de forage (Pt) (0,66) et l'épaisseur d'altération (Ep_alt) (0,54).

Tableau 2: Matrice de corrélation entre paramètres physiques et hydrauliques.

	Qf	Qae_1	Ns	K	T	Qs	Ep_alt	Ep_Soc	Pt	Nae	Pae_1
Qf	1										
Qae_1	**0,55**	1									
Ns	-0,16	-0,04	1								
K	0,03	0,02	0,19	1							
T	**0,73**	0,31	-0,13	0,03	1						
Qs	**0,70**	0,43	-0,13	0,04	**0,67**	1					
Ep_alt	-0,07	0,21	**0,54**	0,10	-0,22	-0,16	1				
Ep_Soc	0,003	-0,27	-0,01	0,04	0,07	0,02	**-0,59**	1			
Pt	-0,08	0,06	**0,66**	0,16	-0,21	-0,18	**0,80**	0,02	1		
Nae	-0,06	-0,19	0,09	0,06	-10^{-3}	-0,02	0,04	0,15	0,16	1	
Pae_1	-0,03	0,17	**0,68**	0,13	-0,18	-0,16	**0,86**	-0,17	**0,93**	-0,02	1

L'analyse des résultats relatifs aux vecteurs et variances propres (Tableau 3) montre que les trois premiers facteurs F1, F2 et F3 expliquent à eux seuls 96,49% de l'information avec 46,6 % pour le facteur 1, 26,55% pour le facteur 2 et 23,35% pour le facteur 3. Au regard de ces pourcentages exprimés, notre analyse portera sur les plans factoriels F1-F2 et F1-F3.

Tableau 3 : Valeurs propres des paramètres hydrauliques et physiques.

Facteurs	Valeur propre	%Variance	Cumul valeur propre	Cumul variance (%)
Facteur 1	5,31	46,60	5,31	46,60
Facteur 2	3,03	26,55	8,34	73,15
Facteur 3	2,66	23,35	11	96,49

Les figures 4 et 5 montrent les résultats de l'analyse corrélatoire dans les plans factoriels F1-F2 et F1-F3. Le facteur F1 est défini par deux regroupements. Le premier regroupement, situé dans la partie positive est constitué par Ns, Pt, Pae_1 et Ep_alt. Le deuxième regroupement est composé de K et de Ep_Soc. Le facteur F2 est également défini par deux regroupements. En dehors du débit de forage qui est la variable à expliquer, le premier regroupement du facteur F2 contrôle trois autres variables qui sont Qs, T et Qae_1 situés dans la partie positive. Le second regroupement est défini seulement par Nae. Le facteur F3 montre quasiment le même regroupement que le facteur F2. Cependant, on constate que le nombre d'arrivées d'eau (Nae), situé dans la partie négative du facteur F2, est situé dans la partie positive pour le facteur F3. Ce résultat pourrait démontrer le faible poids de cette variable dans la définition du débit de forage d'eau. L'analyse de la matrice de corrélation montre que les différents regroupements traduisent des variables corrélées entre elles. Ce qui veut dire qu'elles apportent la même information (on parle alors de redondance).

En définitive les variables explicatives retenues comme étant les plus influentes sur la productivité des forages d'eau et estimables à partir de données géophysiques sont:

- facteur F1 : la profondeur de la première arrivée d'eau significative (Pae_1) et l'épaisseur de socle (Ep_Soc);
- facteur F2 : la transmissivité (T) et le nombre d'arrivées d'eau (Nae);
- facteur F3 : la transmissivité.

Pour la conception des modèles de régression linéaire multiple, deux structures de modèle ont été retenues:

- modèle 1: la profondeur de la première arrivée d'eau significative (Pae_1), l'épaisseur de socle (Ep_Soc), la transmissivité (T) et le nombre d'arrivées d'eau (Nae) ;
- modèle 2: la profondeur de la première arrivée d'eau significative (Pae_1) et l'épaisseur de socle (Ep_Soc) et la transmissivité (T).

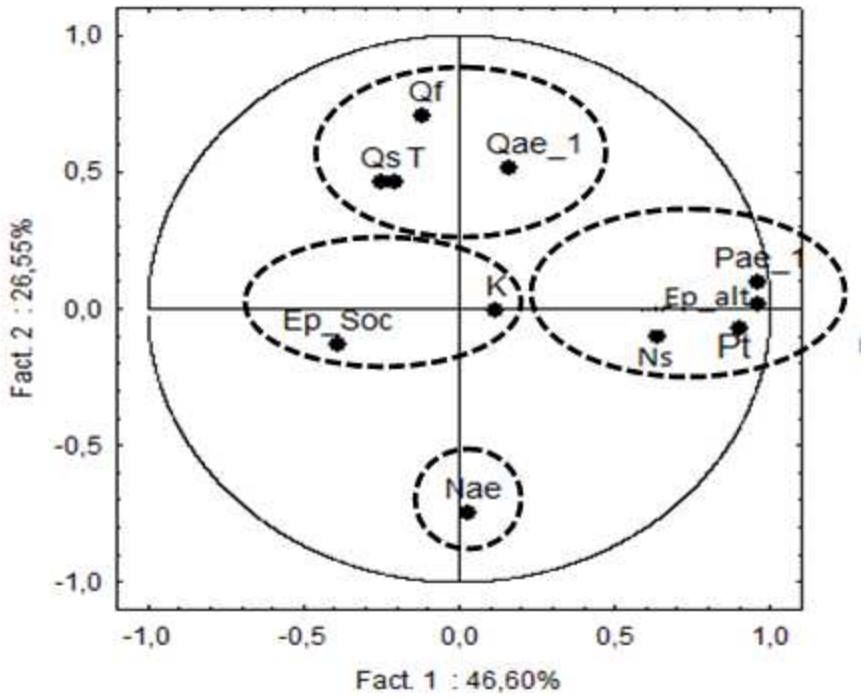


Fig. 4: Plan factoriel F1-F2 des variables.

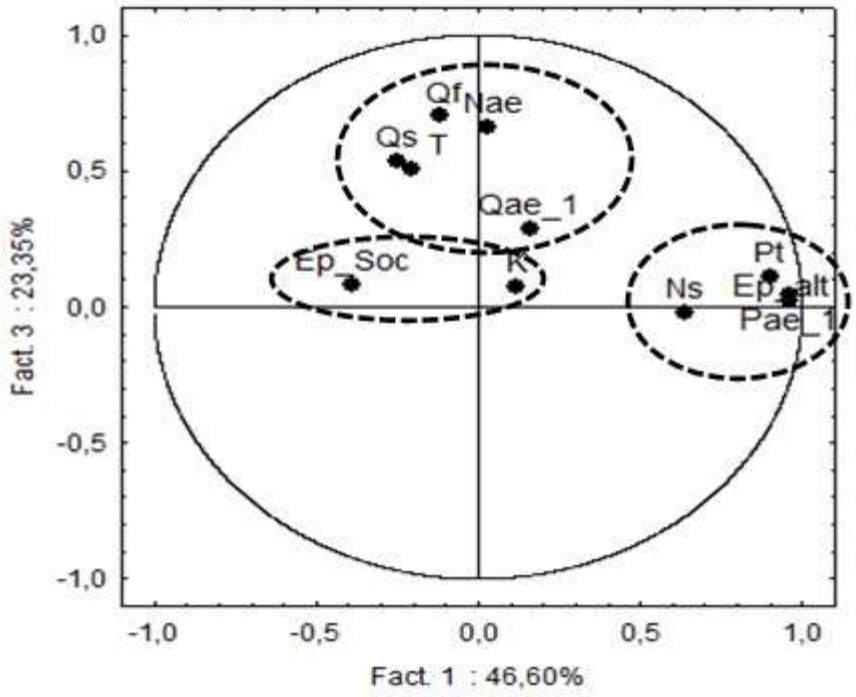


Fig. 5: Plan factoriel F1-F3 des variables.

4.2 RÉSULTATS DE LA MODÉLISATION STATISTIQUE DE LA PRODUCTIVITÉ DES FORAGES D'EAU

Les tableaux 4 et 5 donnent les coefficients des régressions linéaires et les erreurs-types de chaque coefficient. On constate que pour les deux modèles, l'erreur-type (ou valeur de probabilité selon le test de Student) relatives aux variables physiques (épaisseur forée dans le socle, nombre d'arrivées d'eau et la profondeur de la première arrivée d'eau significative)

est inférieure à 1%. Quant à celle de la transmissivité, elle est relativement élevée (4,155-4,183). L'erreur-type de la constante est dans l'ensemble inférieure à 1,5%. Les valeurs relativement élevées d'erreurs-types pour la transmissivité sont liées à la relative faiblesse des valeurs de celle-ci (10^{-7} à 10^{-3} m^2/s). Ces résultats traduisent des relations étroites entre le débit de forage (variable expliquée) et les variables explicatives en général et les variables physiques au regard du test de Student en particulier. Ceci signifie que chaque variable a une contribution significative sur le débit de forage d'eau en milieu de socle cristallin et cristallophyllien.

Tableau 4: Coefficients de régression et erreurs-types du modèle 1.

Variables	Coefficients	Erreur-Type
Constante	1,124	1,441
Transmissivité (T)	41 744,069	4155,368
Epaisseur forée dans de socle (Ep_Soc)	$1,286.10^{-2}$	$2,257.10^{-2}$
Nombre d'arrivée d'eau (Nae)	$-3,685.10^{-1}$	$2,415.10^{-1}$
Profondeur de la première arrivée d'eau (Pae_1)	$1,951.10^{-2}$	$1,565.10^{-2}$

Tableau 5: Coefficients de régression et erreurs-types du modèle 2

Variables	Coefficients	Erreur-Type
Constante	$9,807.10^{-2}$	1,284
Transmissivité (T)	41 607,937	4183,022
Epaisseur forée dans de socle (Ep_Soc)	$7,538.10^{-3}$	$2,245.10^{-2}$
Profondeur de la première arrivée d'eau (Pae_1)	$1,971.10^{-2}$	$1,576.10^{-2}$

Les équations de régression obtenues sont :

- modèle 1 :

$Q=41\ 744,069*T+1,286.10^{-2*}Ep\_Soc-3,684.10^{-1*}Nae+1,951.10^{-2}*Pae\_1+1,124$ (7)

- modèle 2 : $Q=41\ 607,937*T+7,538.10^{-3*}Ep\_Soc+1,971.10^{-2}*Pae\_1+0,098$ (8)

Le tableau 6 présente les performances des deux modèles de simulation des débits de forage d'eau en milieux de socle cristallin et cristallophyllien développés (modèle 1 et modèle 2).

Tableau 6: Performances des modèles développés.

	Performance en calage		**Performance en validation**	
	Modèle 1	Modèle 2	Modèle 1	Modèle 2
R	0,726	0,718	0,673	0,687
Biais	$7,092.10^{-4}$	$2,323.10^{-7}$	$2,51.10^{-1}$	$1,447.10^{-2}$
RMSE	2,544	2,575	2,862	2,792

L'analyse du tableau montre de forts coefficients de corrélation variant entre 72 et 73 % pour les deux modèles en phase de calage. Pour la validation, il est également observé de forts coefficients de corrélation oscillant entre 67 et 69% pour les deux modèles. Ces résultats montrent que le débit des forages observé et le débit des forage simulé sont corrélés. Le modèle 1 présente des valeurs de corrélation légèrement plus élevées quelle que soit la phase d'évaluation. Les plus fortes valeurs sont obtenues en phase de calage. Le biais obtenu varie de 10^{-7} à 10^{-4}, en phase de calage et de 10^{-2} à 10^{-1} en phase de validation. Les valeurs les plus faibles ont étés obtenues en calage. Le modèle 2 présente particulièrement les valeurs les plus faibles en calage comme en validation. Les différentes valeurs obtenues en calage comme en validation traduisent des résultats satisfaisants d'autant plus que les valeurs sont très proches de 0. Les valeurs de RMSE fluctuent entre 2,5 et 2,9 avec les valeurs les plus faibles en calage. La valeur la plus faible en calage est obtenue pour le modèle 1. Cependant, en validation, la valeur la plus faible a été obtenue pour le modèle 2. Les différentes valeurs au sein d'une même phase d'évaluation sont sensiblement proches. En définitive, les résultats obtenus tendent vers zéro, ce qui traduit une satisfaction générale. Les valeurs du critère de robustesse au regard du coefficient de corrélation des modèles 1 et 2 sont respectivement de 5,3% et 3,1% et restent dans l'ensemble inférieures à 10%.

Une analyse qualitative des résultats de calage (Fig. 6 et 7) et de validation (Fig. 8 et 9) a été effectuée. Les représentations graphiques des débits de forage simulés en fonction des débits de forage observés par les différents modèles montrent que les points sont bien repartis le long de la diagonale (y=x). Ces résultats graphiques confirment les résultats des critères numériques d'évaluation des différents modèles et démontrent la capacité des modèles à prévoir des débits à partir des paramètres hydrauliques et physiques des forages qui se rapprochent des débits observés.

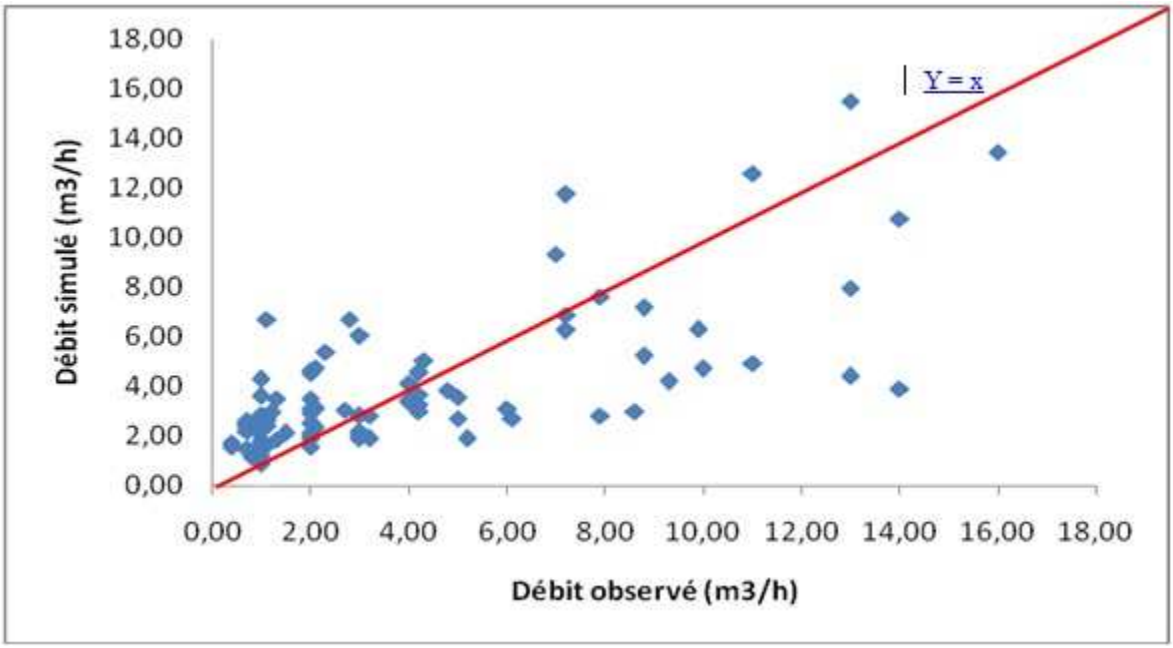


Fig. 6: Débits observés et escomptés (m^3/h) par le modèle 1 en calage.

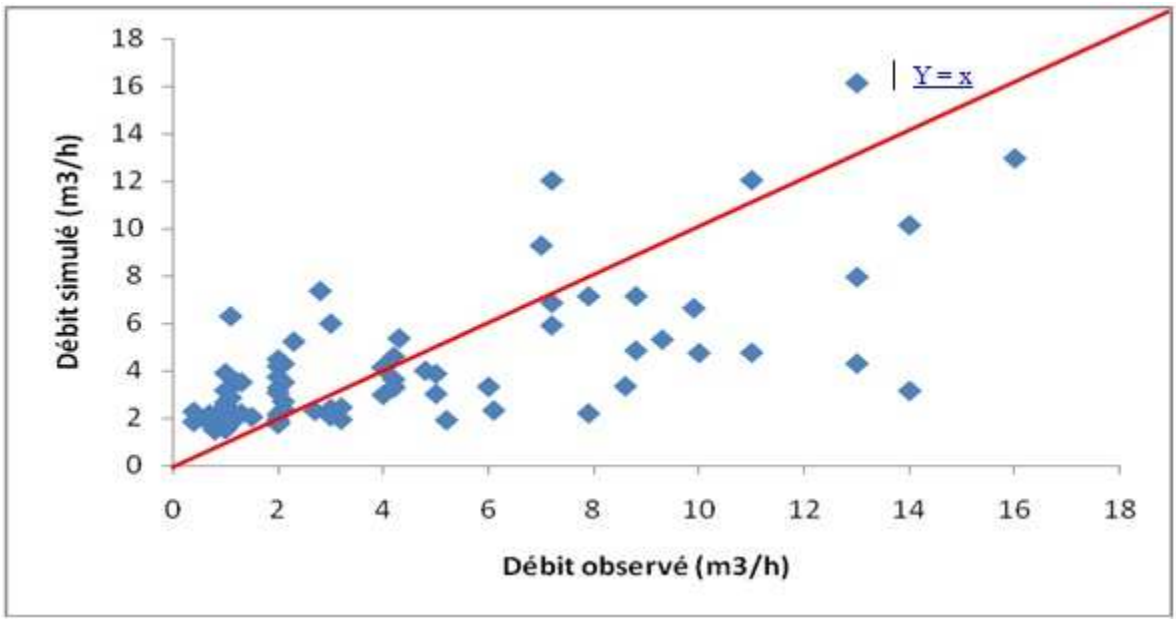


Fig. 7: Débits observés et escomptés (m^3/h) par le modèle 2 en calage.

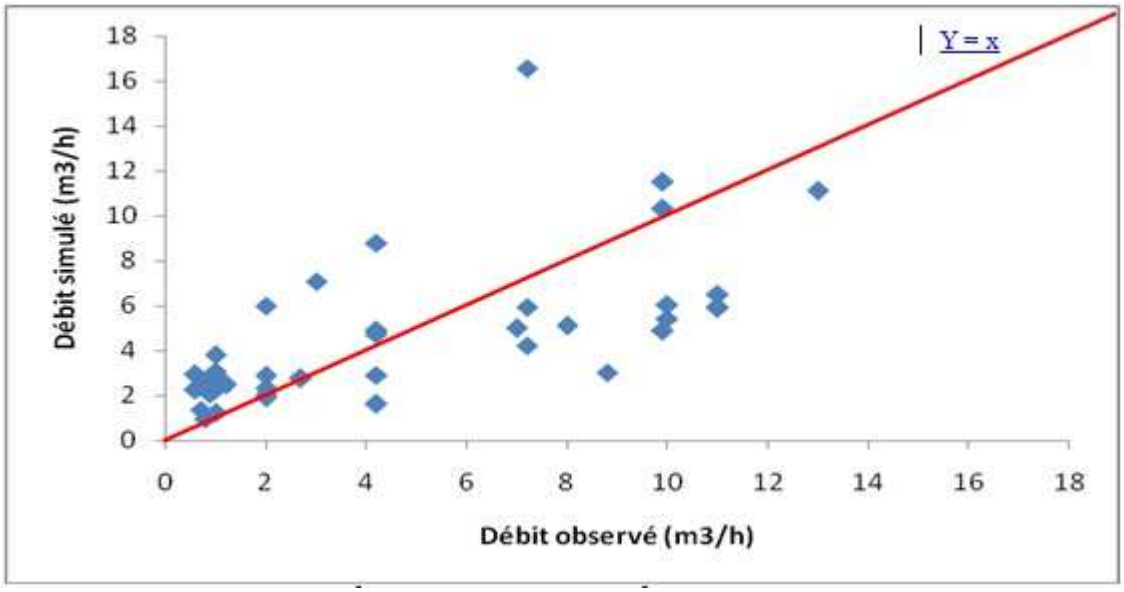


Fig. 8: Débits observés et escomptés (m^3/h) par le modèle 1en validation.

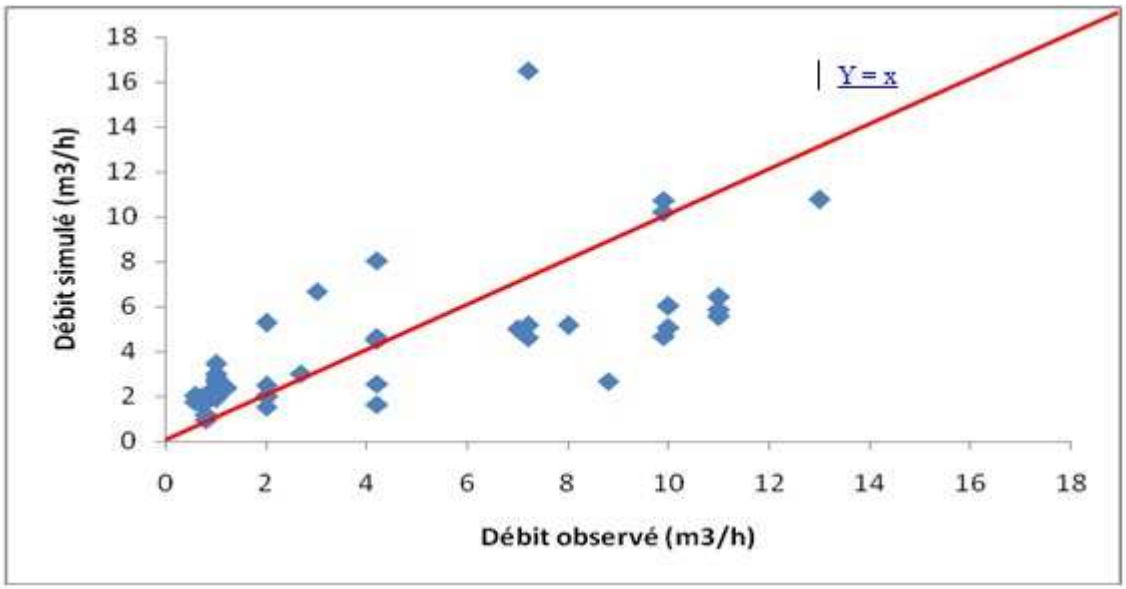


Fig. 9: Débits observés et escomptés (m^3/h) par le modèle 2 en validation.

4.3 DISCUSSION

Les variables explicatives pertinentes et estimables par les mesures géophysiques de surface retenues pour cette étude sont la transmissivité, l'épaisseur de socle, le nombre d'arrivées d'eau et la profondeur de la première arrivée d'eau. En effet, la profondeur de la première arrivée d'eau significative, l'épaisseur de socle et le nombre d'arrivées d'eau peuvent être prédéterminées par les sondages électriques [1, 2, 4, 5, 7]. La profondeur de la première arrivée d'eau significative peut être assimilée à la profondeur de la fracture la plus active du point de vue hydraulique. Le nombre d'arrivées d'eau peut être assimilé au nombre de fractures hydrauliquement actives. Quant à la transmissivité, elle peut être déterminée à partir des sondages électriques et des sondages par résonance magnétique protonique (RMP) [3-6]. Des auteurs [16-18] d'études menées en milieux de socle de Côte d'Ivoire et du Tchad , ont utilisé les mêmes paramètres physiques que ceux retenus dans le cadre de cette étude pour l'établissement des équations de productivité à savoir l'épaisseur de socle, le nombre d'arrivées d'eau et la profondeur de la première arrivée d'eau significative. La différence significative dans le choix des variables se situe dans la transmissivité. En effet, concernant les auteurs précités, le quatrième paramètre pertinent retenu a été la vitesse d'avancement dans le socle. Les paramètres hydrauliques et physiques ont été utilisés dans cette étude pour apprécier

l'apport des paramètres hydrauliques dans la modélisation de la productivité des forages en milieu de socle contrairement aux travaux antérieurs [16-18].

Les valeurs obtenues pour l'erreur-type pour les différentes variables explicatives sont généralement faibles (inférieures à 1%) surtout pour les variables physiques. Ces résultats montrent que chaque variable a une contribution significative sur la le débit de forage d'eau en milieu de socle cristallin et cristallophyllien. Les fortes valeurs d'erreur-type obtenues pour la transmissivité seraient dues à la forte variabilité des valeurs de transmissivité. En effet, le coefficient de variation est de 123%, ce qui traduit une série très hétérogène. Au regard des résultats des critères d'évaluation de la performance (coefficient de corrélation, biais, racine carrée de l'erreur quadratique moyenne) et de la robustesse ainsi que des représentations graphiques, on peut dire que les deux modèles sont performants et robustes. Au niveau de la performance, le modèle 1 a été meilleur en calage mais en validation, c'est le modèle 2 qui a démontré une plus meilleure capacité à prévoir le débit des forages. Quant à la robustesse, le modèle 2 a été plus robuste que le modèle 1. En passant du modèle 2, qui est constitué de trois variables explicatives (transmissivité, épaisseur forée dans le socle fissuré et première arrivée d'eau significative) au modèle 1 composé de quatre variables explicatives (transmissivité, épaisseur forée dans le socle, première arrivée d'eau significative et nombre d'arrivées d'eau), il y a une légère amélioration de la performance quelle que soit la phase, mais de manière globale les performances ne sont pas très satisfaisantes et le coefficient de corrélation (R) demeure toujours d'environ 0,7. On en déduit que l'ajout du nombre d'arrivées d'eau n'a pas apporté suffisamment d'informations significatives au modèle 1 afin de lui permettre de faire une prévision satisfaisante du débit des forages. En effet, le nombre d'arrivées d'eau n'influence pas significativement la productivité des forages d'eau en milieu de socle cristallin et cristallophyllien sachant qu'un grand nombre d'arrivées d'eau peut produire un débit inférieur à un faible nombre d'arrivées d'eau si celles-ci ont un débit plus important. L'ajout du nombre d'arrivées d'eau comme variable explicative au modèle 1 a engendré une forte baisse de la robustesse donc une augmentation du critère de robustesse (+2,2%). En effet, le modèle 2 produit des performances qui sont plus constantes en passant du calage à la validation comparativement au modèle 1. Le modèle 2 produisant presque les mêmes performances que le modèle 1 alors qu'il est constitué de trois variables explicatives comparé au modèle 1 qui en compte quatre, semble donc le plus parcimonieux. La validation est très essentielle dans l'évaluation d'un modèle et le choix d'un modèle est d'abord guidé par sa performance. Les résultats de notre étude suggèrent que le modèle 2 se présente comme le meilleur modèle pour la prévision du débit des forages d'eau en milieu de socle cristallin et cristallophyllien en général et particulièrement dans l'ex-région du N'zi-Comoé (Centre-Est de la Côte d'Ivoire).

5 CONCLUSION

L'objectif général de notre recherche était de développer et d'évaluer des modèles statistiques capables de prédire le débit des forages en milieux de socle cristallin et cristallophyllien à partir de paramètres hydrauliques et physiques estimables par les méthodes de prospection géophysique de surface. La zone test a été l'ex-région du N'zi-Comoé (Centre-Est de la Côte d'Ivoire). L'application de l'analyse en composantes principales normées (ACPN) aux variables hydrauliques des forages d'eau (débit du forage, débit spécifique, débit de la première arrivée d'eau, transmissivité, niveau statique, conductivité hydraulique et nombre d'arrivées d'eau) et physiques (épaisseur d'altérites, épaisseur de socle sain foré, profondeur de la première arrivée d'eau et profondeur totale du forage) a permis d'identifier les variables explicatives les plus pertinentes pour la conception du modèle de productivité en milieu de socle. Les résultats de l'ACPN ont montré que les variables les plus expressives sont la transmissivité, l'épaisseur de socle fissuré foré, la profondeur de la première arrivée d'eau significative et le nombre d'arrivées d'eau. L'organisation de ces différentes variables a permis de proposer deux modèles dont le premier comprend les quatre variables explicatives retenues alors que le deuxième est constitué de trois variables c'est-à-dire privé du nombre d'arrivées d'eau. Les valeurs généralement faibles de l'erreur-type (inférieures à 1%) surtout pour les variables physiques traduisent des relations étroites entre le débit de forage (variable expliquée) et les variables explicatives en général et particulièrement les variables physiques au regard du test de Student. Ceci signifie que chaque variable a une contribution significative sur le débit de forage d'eau en milieu de socle cristallin et cristallophyllien. Deux équations ont été établies explicitant la relation entre les variables explicatives et le débit de forage. L'avantage des modèles présentés dans cette étude réside surtout dans de leur relative simplicité et leur caractère explicite. La présente étude montre que par un choix approprié de paramètres, la régression linéaire multiple peut être très performante dans la prévision du débit des forages. Les deux modèles conçus donnent des résultats acceptables avec des performances satisfaisantes en calage comme en validation au regard des critères d'évaluation choisis que sont le coefficient de corrélation (environ 0,7), le biais sur la moyenne (10^{-7} à 10^{-2}) et la racine carrée de l'erreur quadratique moyenne (2,5 à 2,9). Ces différents modèles sont également robustes avec une valeur du critère de robustesse variant entre 3,2 et 5,3%. Il est intéressant de noter que, même si les deux modèles ont des performances similaires eu égard au coefficient de corrélation et

à l'erreur quadratique, le critère du biais et le critère de robustesse distinguent ces deux modèles. Plus précisément, le modèle 2 a les valeurs de biais les plus faibles en calage comme en validation et est plus robuste que le modèle 1. Ceci suggère que l'ajout du nombre d'arrivées d'eau n'a pas apporté une amélioration de la simulation du débit de forage en milieu de socle. Il ressort donc de cette étude que le modèle statistique ayant comme variables explicatives la transmissivité, l'épaisseur forée dans le socle fissuré et la profondeur de la première arrivée d'eau significative (modèle 2), pourrait constituer un excellent outil de prévision du débit de forages en milieu de socle cristallin et cristallophylllien.

REFERENCES

[1] **R. Guerin et Y. Benderitter, "**Shallow karst exploration using mt-vlf and dc resistivity methods". *Geophysical prospecting*, Vol.43, pp.635-653, 1995.

[2] **C. Meyer, «** Applications de la géophysique aux recherches d'eau souterraine », Technique et documentation, Lavoisier, 183 p., 2001.

[3] **J.M. Vouillamoz**, « La caractérisation des aquifères par une méthode non invasive: les sondages par résonance magnétique protonique ». Thèse de Doctorat de l'Université de Paris XI, 216p., 2003.

[4] **R. Guérin, "**Borehole and surface-based hydrogeophysics", Journal of Hydrogeology, Vol.13, pp.251–254, 2005.

[5] **V. Durand, B. Deffontaines, V. Leonardi, R. Guerin, R. Wyns, G. Marsily et J.L. Bonjour, «** A multidisciplinary approach to determine the structural geometry of hard-rock aquifers. Application to the plancoet migmatitic aquifer (ne Brittany, w France)", Bulletin de la Société Géologique Française, Vol.5, pp.227-236, 2006.

[6] **M. Sina et M. Razack, «** Estimation du champ de transmissivité d'un aquifère alluvial fortement hétérogène à partir de la résistance transversale. Application à la nappe du Haouz de Marrakech (Maroc) ». *Revue des sciences de l'eau / Journal of Water Science*, Vol.19, N° (3), pp.221-232, 2006.

[7] R. **Guerin, J.M. Baltassat, M. Boucher, K. Chalikakis, P.Y. Galibert, J.F. Girard, V. Plagnes et V.R. Remi, «** Geophysical characterisation of karstic networks – application to the ouysse system (poumeyssen, France)", Comptes rendus Geoscience, Vol.341, pp.810–817, 2009.

[8] **T. Lasm, K.F. Kouamé, M.S. Oga, J.R.P. Jourda, N. Soro et H.B. Kouadio, «** Etude de la productivité des réservoirs fracturés des zones de socle. Cas du noyau archéen de Man-Danané (Ouest de la Côte d'Ivoire) », *Revue Ivoirienne des Sciences et Technologie*, Vol.5, N°97, pp.1-15, 2004a.

[9] **J.P.R. Jourda, M.B. Saley, E.V. Djagoua, K.J. Kouamé, J. Biémi et M. Razack, «** Utilisation des données ETM+ de Landsat et d'un SIG pour l'évaluation du potentiel en eau souterraine dans le milieu fissuré précambrien de la région de Korhogo (Nord de la Côte d'Ivoire) : approche par analyse multicritère et test de validation », *Télédétection*, Vol.5, N°4, pp.339-357, 2005.

[10] **J.P.R. Jourda, E.V. Djagoua, K.F. Kouamé, M.B. Saley, C. Gronayes, J.J. Achy, J. Biémi et M. Razack, «** Identification et cartographie des unités lithologiques et des accidents structuraux majeurs du département de Korhogo (Nord de la Côte d'Ivoire) : apport de l'imagerie ETM+ de Landsat », *Télédétection*, Vol.6, N°2, pp.123-142, 2006a.

[11] **J.P.R. Jourda, M.B. Saley, E.V. Djagoua, K.J. Kouamé, J. Biémi et M. Razack, «** Utilisation des données ETM+ de Landsat et d'un SIG pour l'évaluation du potentiel en eau souterraine dans le milieu fissuré précambrien de la région de korhogo (Nord de la Côte d'Ivoire) : approche par analyse multicritère et test de validation », *Télédétection,* Vol.5, N°4, pp. 339-357, 2006b

[12] **T. Lasm, M. Youan-Ta, J.P.R. Jourda et K.F. Kouamé, «** Fracture Networks Analysis in Crystalline Basement: Case of Bondoukou Area (Northeast Côte d'Ivoire)", *European Journal of Scientific Research*, Vol.21, N°1, pp. 196-208, 2008.

[13] **M**. **YouanTa, T. Lasm, J.P. Jourda, K.F. Kouamé et M. Razack, "**Cartographie des accidents géologiques par imagerie satellitaire Landsat-7 ETM+ et analyse des réseaux de fractures du socle précambrien de la région de Bondoukou (Nord-Est de la Côte d'Ivoire) », *Télédétection*, Vol.8, N°2, pp.119-135, 2008.

[14] **M. Koita, H. Jourde, D. Ruelland, K. Koffi, S. Pistre et I. Savané, «** Cartographie des accidents régionaux et identification de leur rôle dans l'hydrodynamique souterraine en zone de socle. Cas de la région de Dimbokro-Bongouanou (Côte d'Ivoire). Journal des Sciences Hydrologiques, Vol.55, N°5, pp. 805-820, 2010.

[15] **V.M. Sorokoby, M.B. Saley., K.F. Kouamé, M.E.V. Djagoua, M. Bernier, K. Affian et J. Biémi, «** Utilisation des images Landsat ETM+ et du SIRS pour la cartographie linéamentaire et thématique de Soubré-Meagui (Sud-Ouest de la Côte d'Ivoire): contribution à la gestion des ressources en eau souterraine », *Télédétection*, Vol. 9, N°3-4, pp.209-223, 2010.

[16] **P. Gombert**, «Variabilité spatiale de la productivité aquifère du socle sahélien en hydraulique rurale ». *IAHS Publ.*, Vol. 241, pp.113-122, 1997.

[17] **P. Gombert**, « Stratégie de prospection hydrogéologique du socle de la bordure orientale tchadienne par optimisation du nombre et de la profondeur des sondages de reconnaissance ». *Journal of Water Science*, Vol. 12, N°3, pp. 597-608, 1999.

[18] **K.E. Kouadio, N. Soro et I. Savané**, « Stratégie d'optimisation de la profondeur des forages en contexte de socle : Application à la région du Denguélé, Nord-Ouest de la Côte d'Ivoire ». *Revue des sciences de l'eau*, Vol. 23, N°1, pp. 1-15, 2010.

[19] **Y.B. Daouda, «** Lithostratigraphie et pétrographie des formations birimiennes de Toumodi-Fêtêkro (Côte d'Ivoire). Implication pour l'évolution crustale du paléoprotérozoique du craton ouestafricain ». Thèse de Doctorat de l'Université d'Orléans, France, 190 p., 1998.

[20] **Y.A. N'go, T. Lasm, M. Koita et I. Savané, «** Extraction par télédétection des réseaux de fractures majeures du socle précambrien de la région de Dimbokro (Centre-Est de la Côte d'Ivoire) », *Télédétection*, Vol. 9, N°1, pp. 33-42, 2010.

[21] **N.H. Kadio, M.B. Saley, B.E. N'dri, A. Ouattara et J. Biémi, «** Contribution à l'interprétation des linéaments par l'exploitation des Pseudo Images, de l'hydrographie en région tropicale humide: Cas du N'zi-Comoé (Centre de la Côte d'Ivoire) », *European Journal of Scientific Research*, Vol. 24, N°1, pp. 74-93, 2008.

[22] **A.M. Kouassi, K.E. Ahoussi, K.A. Yao, W.E.J.A. Ourega, K.S.B. Yao et J. Biémi, «** Analyse de la productivité des aquifères fissurés de la région du N'zi-Comoé (Centre-Est de la Côte d'Ivoire) », *Larhyss Journal*, N°10, pp. 57-74, 2012a.

[23] **A.M. Kouassi, J.C. Okaingni, K.E. Kouakou et J. Biémi,** « Evaluation des propriétés hydrauliques des aquifères de socle cristallin et cristallophyllien : cas de la région du N'zi-Comoé (Centre-Est de la Côte d'Ivoire) ». *International Journal of Innovation and Applied Studies*, Vol.2, N°2, pp.92-103, 2013.

[24] **K.E. Ahoussi**, « Evaluation quantitative et qualitative des ressources en eau dans le Sud de la Côte d'Ivoire. Application de l'hydrochimie et des isotopes de l'environnement à l'étude des aquifères continus et discontinus de la région d'Abidjan-Agboville ». Thèse de Doctorat de l'Université de Cocody-Abidjan, Côte d'Ivoire, 270p.
K.E. Ahoussi, N. Soro, A.M. Kouassi, G. Soro, B.Y. Koffi et S.P. Zadé, "Application des méthodes d'analyses statistiques multivariées à l'étude de l'origine des métaux lourds (Cu^{2+}, Mn^{2+}, Zn^{2+} et Pb^{2+}) dans les eaux des nappes phréatiques de la ville d'Abidjan ». *International Journal of Biological and Chemical Sciences,* 4 (5), 1753-1765, 2010.

[25] **M. Belanger, N. El-Jabi, D. Caissié, F. Ashkar et J.M. Ribi**, « Estimation de la température de l'eau en rivière en utilisant les réseaux de neurones et la régression linéaire multiple ». *Revue des Sciences de l'Eau*, Vol.18, N°3, pp.403-421, 2005.

[26] **L. Benyahya, D. Caissie, L.A.K. Mertes, S.J. O'Daniel, W.W. Woessner and S.A. Thomas, «**A review of statistical water temperature models". *Canadian Water Resources Journal / Revue canadienne des ressources hydriques,* Vol.32, N°3, pp.179-193, 2007.

[27] **A. Daigle, A. St-hilaire, D. Peters and D. Baird**, "Multivariate modeling of water temperature in the Okanagan watershed.". *Canadian Water Resources Journal-Revue canadienne des resources hydriques*, Vol.35, N°3, pp.237-258, 2010.

[28] **B. Hingray, C. Picouet et A. Musy**, « Hydrologie: une Science pour l'Ingénieur ». Edition Presse Polytechniques et Universitaires, Romandes 2ème édition, 600 p, 2012.

[29] **A.M. Kouassi, K.F. Kouamé, Y.B. Koffi, K.A. Kouamé, S. Oularé et J. Biémi,** « Modélisation des débits mensuels par un modèle conceptuel : application à la caractérisation de la relation pluie-débit dans le bassin versant du N'Zi-Bandama (Côte d'Ivoire) ». *Journal Africain de Communication Scientifique et Technologie*, Vol.11, pp.1377-1391, 2011.

[30] **A.M. Kouassi, B.T.M. N'guessan, K.F. Kouamé, K.A. Kouamé, J.C. Okaingni J.C. et J. Biémi, «**Application de la méthode des simulations croisées à l'analyse de tendances dans les relations pluie-débit à partir du modèle GR2M: cas du bassin versant du N'Zi-Bandama (Côte d'Ivoire) ». *Comptes rendus géoscience*, Vol. 344, N°5, pp.288-296, 2012b.

[31] **O. Nascimento**, « Appréciation à l'aide d'un modèle empirique des effets d'actions anthropiques sur la relation pluie-débit à l'échelle d'un bassin versant ». Thèse de Doctorat, Ecole Nationale des Ponts et Chaussées de Paris, France, 390p, 1995.

[32] **Y.B. Koffi, T. Lasm, P.A. Ayral, A. Johannet, A.M. Kouassi, E. Assidjo et J. Biémi**, «Optimisation des modèles Perceptrons Multicouches avec les algorithmes de premier et de deuxième ordre. Application à la modélisation de la relation pluie-débit du Bandama Blanc, Nord de la Côte d'Ivoire ». *European Journal of Scientific Research,* Vol. 17, N°3, pp.313-328, 2007.

International Journal of Innovation and Scientific Research
ISSN 2351-8014 Vol. 10 No. 1 Oct. 2014, pp. 171-178

http://www.ijisr.issr-journals.org/

PHYSICOCHEMICAL ANALYSIS OF WATER RESOURCES IN SELECTED PART OF OJI RIVER, ENUGU STATE SOUTH EASTERN NIGERIA

Moses O. Eyankware and Philip N. Obasi

Department of Geology, Faculty of Physical Science, Ebonyi State University,
Abakaliki, Ebonyi State, Nigeria

ABSTRACT: Oji River and its environs is located few kilometres from Enugu, the capital city of Enugu state. Geographically, the study area is bounded by latitudes $6^{\circ}14'$N-$6^{\circ}17'$N and longitudes $7^{\circ}17'$E-$7^{\circ}19'$E. The study area is underlain by the Ajali Sandstone and Nsukka Formation. The area has abundant water resources. A total of ten (10) water samples were collected at various locations for hydrochemical analysis. The result shows that the water resources for (WS 2, 4-10) are safe for domestic, industrial and agricultural uses as the chemical constituents are below (WHO,2011) permissible limit. Except for WS 1-Oji wonderful river where nitrite (NO^{2+}) and Fluoride (F) value were observed to be higher than (WHO, 2011) permissible limit (8.2 and 2.5mg/l) respectively. This indicate that nitrite and fluoride treatment is required for WS 1-Oji wonderful river while for WS3-Ogba spring were copper value (11.0mg/l) were observed to also be higher than (WHO, 2011) permissible and as such requires copper treatment.

KEYWORDS: Groundwater, Surface water, Physical parameters, Chemical parameter, domestic purpose.

1 INTRODUCTION

The study area is located in Enugu State, south eastern Nigeria, the Villages in the area include; Ojinator, Ugwuoba, Achi, Egbagu, Upkata and Agbalengi. Since water is necessary for the daily activities of plants, animals and humans. Moreso, increase in population has led to increase in demand for portable water, inhabitants of the area depend solely on surface and groundwater for domestic, agriculture and other uses. The presence of objectionable tastes, odour, colour as well as harmful substances in such water no matter how abundant it is, renders it unsuitable for domestic, industrial and agricultural uses [11]. The physical and chemical characteristics of water are important parameters as they may directly or indirectly affect its quality. Suitability of groundwater for domestic use is determined by its geochemistry. Geochemical data also gives important clues to the geologic history of rocks and indications of groundwater recharge, movement and storage [17]. Water quality depends on number of factors, such as general geology, degree of chemical weathering of prevailing lithology, quality of recharge water and inputs from sources other than water-rock interaction [1], [13], [4], [5].[9] noted that agricultural inputs and wastes, domestic and industrial wastes commonly find their way into groundwater as leachates through the soil. All these affect the quality of water resources in the area. Most houses and industries channel their waste directly to the river channels.

Hence, the need to access the physical and chemical constituents of water resources from available surface water and groundwater sources in Oji River and environs. This work seeks to compare result of hydrochemical analysis with the World Health Organization [16] standard for drinking water. It will also proffer recommendations on the best option on management/utilization of water resources in the area.

Corresponding Author: Moses O. Eyankware

2 PHYSIOGRAPHY, CLIMATE AND VEGETATION

The study area is characterized by gently sloping topography, the nature and slope of the area makes it vulnerable to erosion. The total annual rainfall ranges from 1600m to more than 2000m, the inversion in the tropical air mass causes convectional rainfall. The area falls within the tropical rainforest belt of Nigeria with temperature ranges from 30^0c to 32^0c as shown in Figure 1. It is characterized by two seasons, the dry and rainy season. The climate is favourable for farming. The dry season is usually from (November-March), it is marked by an average rainfall of about 60mm. The highest annual rainfall in south eastern Nigeria is received around the eastern highlands due to the convectional and orographic nature of the rains received [7]. According to Monanu [7], variations in the amount, seasonal distribution and annual rainfall variability affect peasant farming within communities adversely. The rainfall pattern which is controlled by the movement of the Inter-tropical Convergence Zone (ITCZ) is characterised by a long wet season from April to July, with a short dry season in August, followed by a short wet season from September to October [7] .

The vegetation is characterised by grassland though some plant species of low land rainforest such as (*Elacies geineenus*) oil palm tree is found, the area is composed of short and tall grasses and shrubs that are found on the highland and for the forest area in lowland along the stream channels. The change in vegetation is due to lithological variation with the study areas.

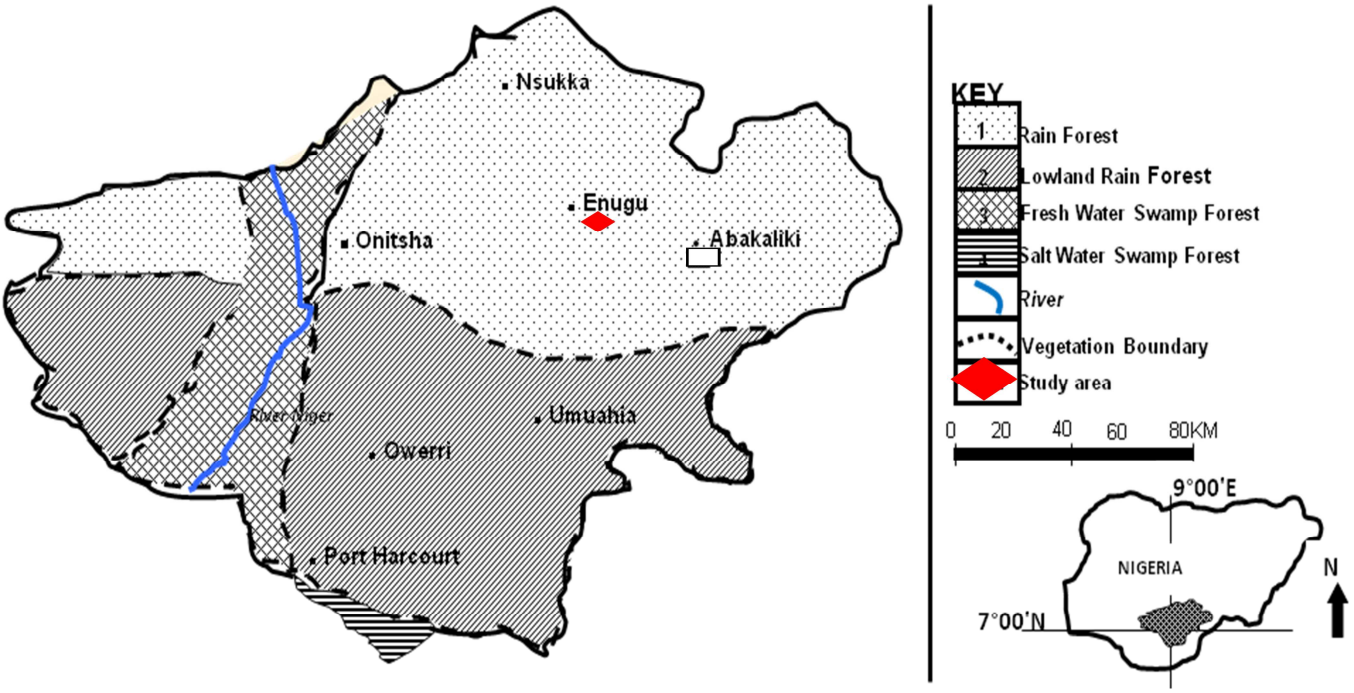


Figure 1: Map Showing Climate and Vegetative Zones of Southeastern Nigeria (Modified after) [6].

3 GEOLOGY OF THE STUDY AREA

The study area lies across two geological formation; Ajali Formation and Nsukka Formation. The Nsukka Formation (Upper Maastrichtian) covers 25% of the study area. It lies conformably on top of the Ajali Sandstone (Maastrichtian), covers a total of 65% of the study area. The Ajali formation has a thickness of about 45-50meters and consists of thin band of white mudstone and shale occurring at interval and increasing in number toward the base. The Nsukka Formation was first describe by [14] as the 'upper coal measure' it consist of intense ferroginisation of well bedded blue clays, carbonaceous shale and thin band of limestone resulted in ironstone which exist in formation. [8] used sedimentological evidence to suggest that the Nsukka Formation represented a phase of fluvio-deltaic sedimentation that began close to the end of the maastrichtian and continued during the Paleocene.

4 HYDROGEOLOGY OF THE STUDY AREA

The study area is with springs, streams and rivers. This includes the popular Oji wonderful river, Dodo River, Ezu River and Ozom River while the streams are Nwangele and Izele stream.

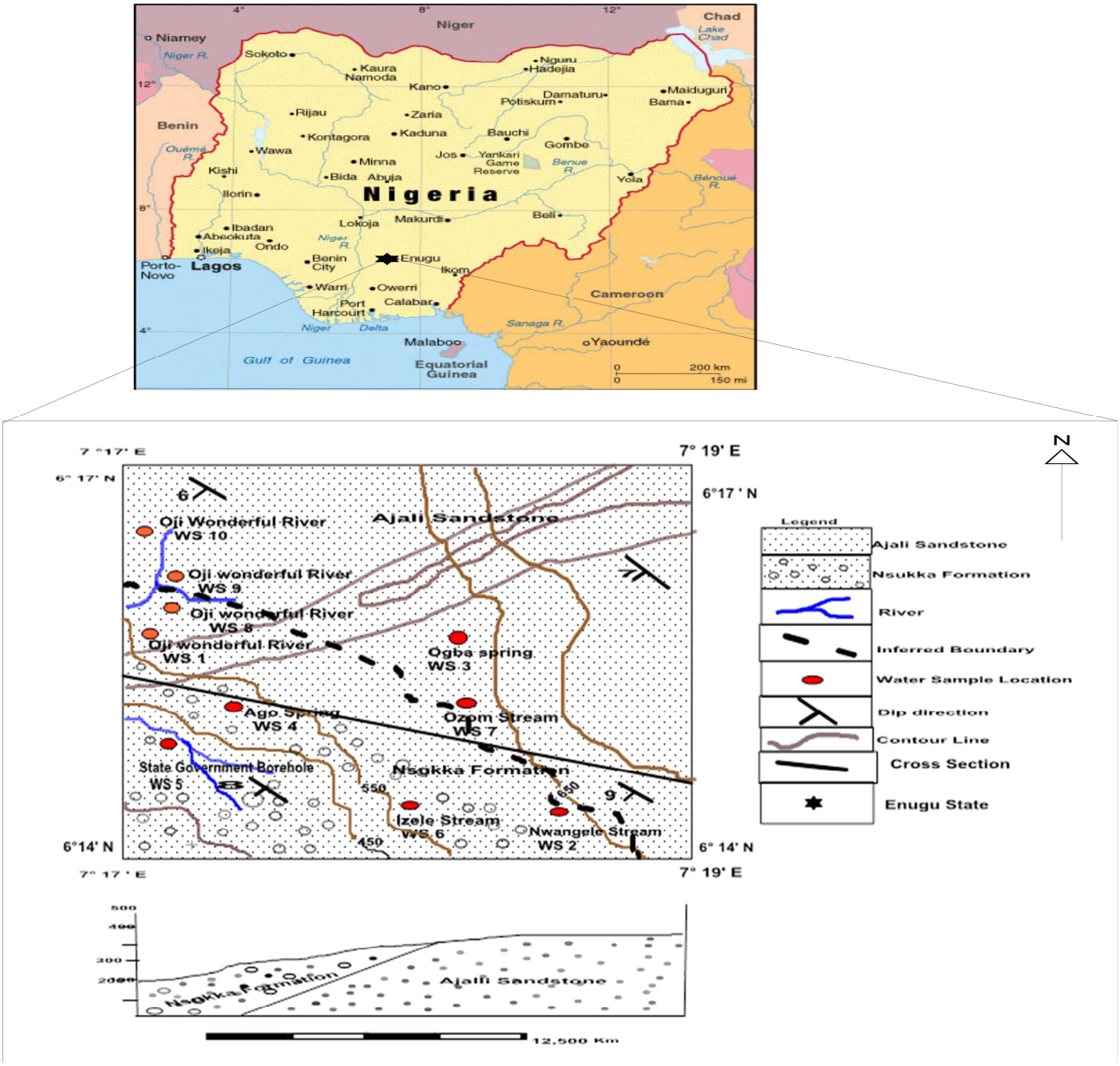


Figure 2: Geological Map and Water Samples Collection Sites.

5 METHODOLOGY

Ten water samples were collected from different rivers traversing different communities in the study area as shown in a Figure 2. In-situ measurements of temperature (°C), electrical conductivity (EC), and total dissolved solids (TDS) were carried out in the field while samples were collected in clean new white plastic bottles (1.5 L) which were first rinsed with part of the water samples to avoid contamination. While Conductivity Meter Bridge was used for turbidity measurement and pH meter used to determine the acidity of the water samples. Total dissolved solids were determined by evaporation; weighing 100 ml

of water sample and then subtracting the weight of the residue from the weight of water before evaporation. The EC was measured using a WPACMD 400 m which can measure conductivity over the range of 10-2 to10-6 µ Siemens/cm2 with an accuracy of 0.1 µ S/cm2. The coordinates (longitude, latitude and elevation/altitude) of each sample location in the study area was taken using the GARMIN GPSmap76CSx. These samples were labelled WS I- 10 (Table 1). All the water samples were preserved in a refrigerator to exclude microbial activity and unwanted chemical reaction. The determinations of other physicochemical properties of the water samples were performed within 2 days of sampling. HACH DR 2800 Spectrophotometer was used in the determination of different hydro geochemical properties such as Na^{+}, K^{+}, HCO_3^{-}, Cl^{-}, NO^{2-}, SO^{4-}, Fe^{+}, Mn^{2+}, NO_3^{-},SO_4^{2-}, Nacl, Mg^{2+} CO_3^{2-}, Mn, Ca^{2+}, PO_4^{2-}, Cu^{2+}. Analytical water test tablets prescribed for HACH DR Spectrophotometer 2800 using procedures 2outlined in the HACH DR 2800 Spectrophotometer manual were used for the examination of the water quality. Other analyses such as the determination of Mg and Ca concentrations were done by complexometric titration method.

6 RESULTS AND DISCUSSION

From the physicochemical analysis carried out for carbonate, total hardness, salinity (Nacl), silica (SiO_2), total alkalinity, total dissolved solid (TDS) their values ranges from (9.6-41.5mg/l, 0.0-21.6, 0.0-11.3, 0.0-28.0, 0.0-1.5, 22.4-28.2mg/l) respectively, for carbonate, total hardness, salinity and total dissolved solid their values falls below the [16] permissible water quality limit. While silica (Sio_2) and total alkalinity has no WHO guideline, they occur in drinking-water at concentrations well below those at which toxic effect. [18]

For the parameters like pH, turbidity and conductivity their values ranges from (6.0-6.9, 1.3-2.0, 0.5-2.9NTU, 34.7-60.2µs), respectively their value falls below the [16] permissible water quality limit. For the cations calcium (Ca^{+}), magnesium (Mg), sodium (Na) and potassium (K) their value ranges from (4.2-12.3, 1.2-3.5, 0 - 0.3 and 0.9-2.1mg/l) respectively. Their values falls below the [16] permissible water quality limit as shown in Figure 3. While that of anions nitrite (NO_2), Nitrate (NO^3), phosphate (PO_2). Sulphate (SO_2^{3-}), bicarbonate (HCO_3) and chlorine (Cl) their values ranges from (0.0-8.2, 0.0-26.0, 0.0-0.1, 2.1-12.2, 1.4-17.6, 30.8-66.7 and 1.4 – 17.6 mg/l) respectively. As for nitrate, sulphate, bicarbonate and phosphate their values fall within below the [16] permissible water quality limit as shown in Figure. 4. Except for nitrite (NO^{2-}) which its value (8.2mg/l) was observed to be above the [16], permissible water quality limit at WS1 Oji wonderful river. Nitrite infiltrates into water bodies from fertilizers and manure [8]. Nitrite is source for concern in infants under six months of age as it causes methemoglobinema. In general, the most important source of human exposure to nitrate and nitrite is through vegetables (nitrite and nitrate) and through meat in the diet. Nitrite is used as a preservative in many cured meats, [15]. And fluoride value (2.5mg/l) is above the [16] guideline value at WS1 Oji wonderful river which is as a result of natural system "weathering and rain water"[2], these implies that WS1 require treatment. Fluoride dissolved into groundwater as it moves through pore spaces between rocks. It also infiltrate into groundwater through discharge from fertilizer or aluminium factories as shown in Figure 4.

For trace element iron (Fe), manganese (Mn) and copper (Cu) their values ranges from (0.0-0.1, 0.0-0.0 and 0.0-11.0mg/l) respectively as shown in Fig.5. Their values fall below the [16], permissible limit. Except copper(Cu) its value (11.0mg/l) for WS3 0gba spring the value of copper is above the of [16], guideline value .The sources of copper in both surface and groundwater is from industrial waste and domestic waste and mining activities within the study area. Copper is essential trace element but toxic to plants and algae at moderate levels. Copper can cause stomach and intestinal distress, liver and kidney damage. In high doses, it results in bad taste and significant staining in cloths fixtures.

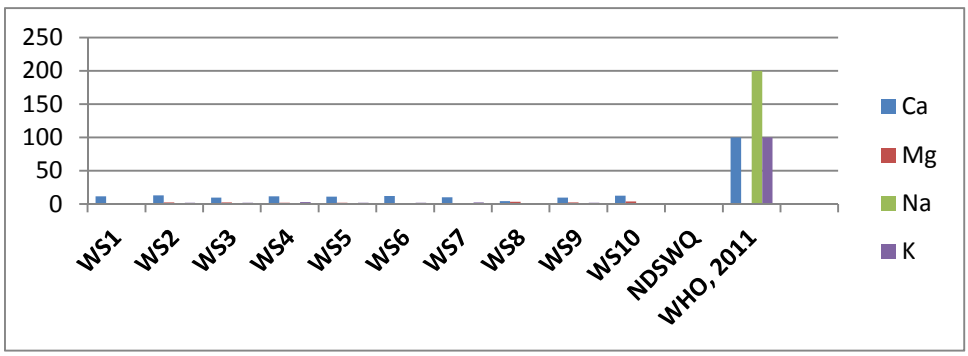


Figure 3. Major Cations in the analyzed samples expressed as a bar chart.

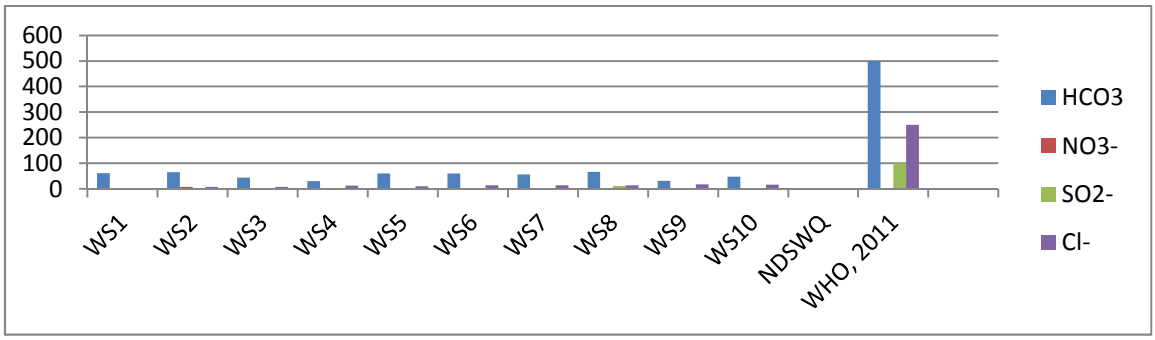


Figure. 4. Major Anions in the analyzed samples expressed as a bar chart

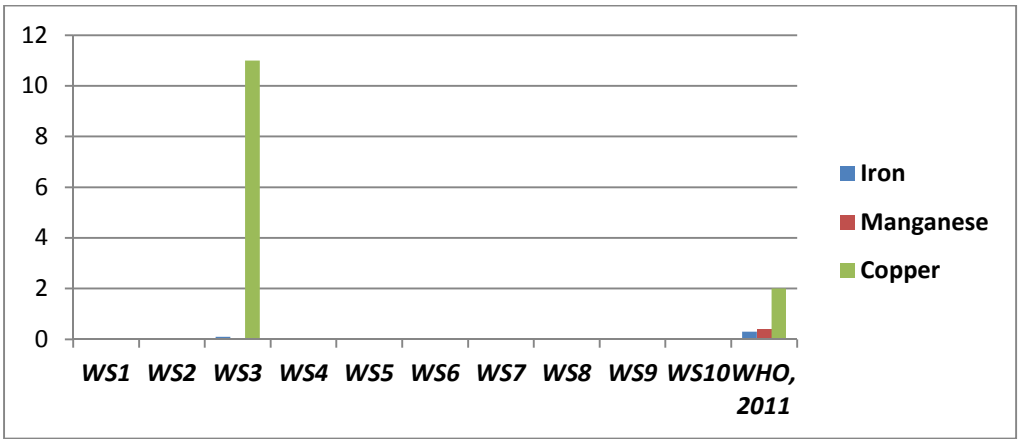


Figure.5. Trace Elements expressed in barchart

Table 1. Result of physiochemical analysis of water sample of Oji River compared with [16] standard

Constitutes	W.H.O Standard 2011	WS1 Oji wounderfulRiver	WS2 Nwangele Stream	WS3 OgbaSpring	WS4 Ago Spring	WS5 State Government Borehole	WS6 Izele Stream	WS7 Ozom Stream	WS8 Oji wounderful River	WS9 Oji wounderful River	WS10 Oji Wounderful River
P^H	6.5-8.5	6	6.4	6.4	6.5	6.5	6.3	6.9	6.0	6.2	6.0
Temp ^oC	24	25	24	27	24	28	24	29	27	23	24
Apperance		Cloudy	Cloudy	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear
Colour (units AP.CO Std)	15	2.0	1.6	1.8	4.6	1.9	1.6	1.7	1.5	1.3	1.3
Turbidity (NTU)	5	2.0	0.9	0.9	0.8	0.9	0.8	0.5	1.5	2.3	2.9
ConductivityμS	1000	56.0	43.8	50.2	43.8	46.5	52.5	49.1	52.4	60.2	34.7
Calcium mg/l ca^{2+}	75	11.3	12.6	9.6	11.2	10.8	11.7	10.1	4.2	9.6	12.3
Magnesium mg/Lmg^+	250	1.2	2.0	2.0	1.6	1.5	1.3	1.3	3.2	2.4	3.5
Sodium mg/l Na^+	200	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0
Potassium mg/l Na^+	200	1.3	1.6	1.9	2.6	1.9	1.7	2.1	1.4	1.9	0.9
Sulphate mg/l So^{2-}	250	2.4	2.4	2.4	2.1	2.2	2.7	2.4	12.2	2.1	2.5
Chloride mg/l Cl	250	1.4	8.6	8.5	12.5	10.8	14.3	13.7	14.6	17.6	16.6
Bicarbonate mg/L HCO_3	500	62.0	65.0	44.0	30.8	60.0	60.0	56.4	66.7	32.4	48.3
Carbonate mg/ l CO_3^2	500	12.0	16.0	16.0	9.6	20.0	33.2	41.5	17.2	22.6	19.3
Nitrate mg/l NO_2^-	50	26.0	0.0	0.0	0.0	0.4	1.8	0.9	0.6	0.	0.0
Nitrite mg/l NO^{3-}	3	**8.2**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	2.6
Phosphate mg/l PO_4^{2-}	10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
Fluoride mg/l	1.5	**2.5**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.3
Free Chlorine mg/l Cl	5	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4
Iron mg/l	0.3	0.00	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Manganese mg/L Mn^{2+}	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Copper mg/ L Cu^{2+}	2	0.0	0.0	**11.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Hardness mg/l $CaCo^3$	500	0.0	14.6	11.6	12.8	12.3	19.5	21.6	21.6	24.3	19.2
Salinity mg/ l Nacl	600	11.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	1.6
Total Dissolved Solid Mg/ l	500	28.0	26.9	25.1	24.2	23.3	28.3	31.6	28.2	22.4	31.5
Total alkalinity mg/l		1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.3

7 CONCLUSION

From the physiochemical analysis carried out for both the surface and groundwater are in compliance with [16] guideline value for locations (WS 2, 4-10). Except for WS1 (Oji wonderful river) where fluoride and nitrite content tend to be higher than the permissible limit of [16] water standard. While for (WS3-Ogba spring) copper has the value of (11.0mg/l) which shows that the higher than the permissible limit of [16] water quality standard. This result implies that fluorine and nitrite treatment is needed for WS1 (Oji wonderful river), while for (WS3-Ogba spring) require copper treatment as shown in Figure 6.

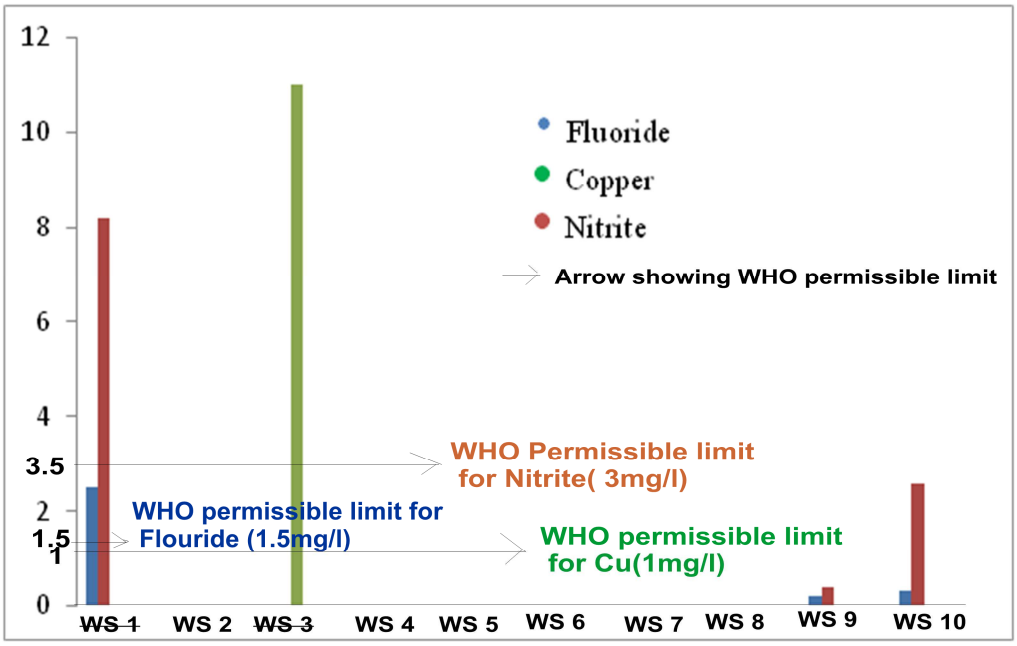


Figure.6 Showing Flouride (F), Copper(Cu) and Nitrite(NO^2) values above the permissible limit of [16] for each of the locations WS(1-10).

ACKNOWLEDGMENT

I wish to acknowledge Richard Akpolo of Geoprobe Enugu and my lovely mother Mrs. Queen Eyankware for her financial effort towards making this publication possible

REFERENCES

[1] Domenico, P.A. (1972): Concepts and models in groundwater hydrology. McGraw-Hill, New York.
[2] Egbunike, M.E (2007): Hydrogeochemical Analysis of Water Samples in Nandoand Environs of the Anambra Basin of South Eastern Nigeria.Pac.J. Sci. Technol. 8(1): pp 32-35.
[3] Freeze, R.A., and Cherry, J. A, (1979): Groundwater. pentice-Hall, Englewood Cliffs, New Jersey. pp.250-263.
[4] Hussein, M.T. (2004): Hydrochemical evaluation of groundwater in the Blue Nile Basin, eastern Sudan, using conventional and multivariate techniques. Hydrogeol. J. 12:pp 144-158.
[5] Igbozuruike, M.U. (1975). Climatology and Vegetation types. Eastern states EthiopePublishing House, Benin City.
[6] Monanu, P. C. (1975). Rainfall. In : Nigeria in maps: Eastern States, Ofomata, G.E.K. (Ed).EthiopePublishing House, Benin City, Nigeria, pp. 25-26.
[7] Obi, G.C. (2001). The Geology of the Lower Benur Trough University of Nigeria Nsukka.
[8] Obasi, P. N. and Akudinobi, B. E. B; (2013). Hydrochemical Evaluation of Water Resources ofthe Ohaozara Areas of Ebonyi State, Southeastern Nigeria. Journal of Natural SciencesResearch. 3 (3) 75 – 80pp
[9] Ofomata, G. E. K. (1975a). Soil Erosion. In : Nigeria in maps: Eastern States,Ofomata, G.E.K. (Ed). Ethiope Publishing House, Benin City, Nigeria, pp. 41-42.
[10] Okeke, O.C, Igboanua A.H (2003). Characteristics and quality assessment of surface waterand groundwater resources of Awka Town, SE Nigeria. W. Res. J. 14:71-77.
[11] Richards, L.A., (1954). Diagenesis and improvement of saline and alkali soils. Agric.Handbooks 60, U.S. Dept. Agric. Washington, D.C. 160p.
[12] Shah, T., Molden, D., Sakthivadivel, R. and Seckler, D. (2000). The global ground water situation:overview of opportunity and challenges. International Water Management Institute.
[13] Tattam, C.W. 1960: A review of Nigerian stratigraphy. Annual Report of the Geological Surveyof Nigeria, Kaduna. 46 pp 65-67.
[14] WHO (World Health Organization). (2008). Guideline for drinking water qualityRecommendations, 3rd Edition. Vol 1 Genus, Switzerland. Pp 417-419.

[15] WHO (World Health Organization). (2011). Guideline for drinking water quality Recommendations, 4th Edition. Vol 1. Pp 219-230.
[16] Walton, W.C. 1970. Groundwater resources evaluation. McGraw Hill Book Co., New York. Pp. 417
[17] Water sanitation Health Drinking Water Quality
[online] available. (www.who.int/water_sanitation_health/dwq/guidelines/en).

International Journal of Innovation and Scientific Research
ISSN 2351-8014 Vol. 10 No. 1 Oct. 2014, pp. 179-190

http://www.ijisr.issr-journals.org/

Design and Implementation of Intelligent Human Stress Monitoring System

Mariya Khan[1], Zoha Rizvi[2], Muhammad Zakir Shaikh[2], Warda Kazmi[2], and Anum Shaikh[2]

[1]Institute of Biomedical Technology, Liaquat University of Medical & Health Sciences Jamshoro, Sindh, Pakistan

[2]Mehran University of Engineering and Technology, Jamshoro, Sindh, Pakistan

ABSTRACT: Stress is increasingly pervasive and a fundamental reason for causing 60% of all human ailments and other diseases. Due to the irregular growing pace of life style, stress has become one of the major reasons causing health issues. Stress is experienced by every person almost every single day which is automatically related to the interconnection between the environment and the person itself. This stress may be a danger sign for their lives. So, it is necessary that people should be aware about the consequences of being over stressed, before it leads to some serious health issues. Therefore, we are designing a continuous Intelligent Human Stress Monitoring System(IHSMS) which will be responsible for monitoring the users'/patients' stress levels and providing the continuous feedback about their stress level' and pieces of information related to it.

It will be helpful to the people about their behavior patterns to quite activities which trigger high stress level and anxieties. Our Intelligent Human Stress Monitoring System is based on a wireless body area networks of Intelligent sensors (W.I.S.E) that transmits vital parameters ideal to record stress levels and changes in the stress level' and then transmits aggregated data via internet to hospital and medical health care facilities where they are continuously being observed. In addition to this, our Intelligent Human Stress Monitoring (IHSMS) system provides online signal processing through LabVIEW. In short, our Intelligent Human Stress Monitoring System (IHSMS) will be very beneficial to health care sectors.

KEYWORDS: Wireless BAN, W.I.S.E, GSR (skin galvanic response), Telemedicine, labVIEW, IHSMS.

1 INTRODUCTION

The term "Stress" is generally defined in biological system as a condition that seriously disturbs the physiological/psychological homeostasis of an organism. Stress is so harmful that it can/may leads to long-term diseases. Stress increases the risk of heart diseases by 40%, heart attack by 25%, and stroke by 50%. In Netherland 1 out of 7 disable gets his condition because of stress at work (TNO survey 2006). Some doctors says, collectively stress is a possible cause for all types of diseases. A little stress is necessary for us but too much stress brings negative impact. Most of the people do not know how to deal with the stressful situations in their lives.

Corresponding Author: Mariya Khan

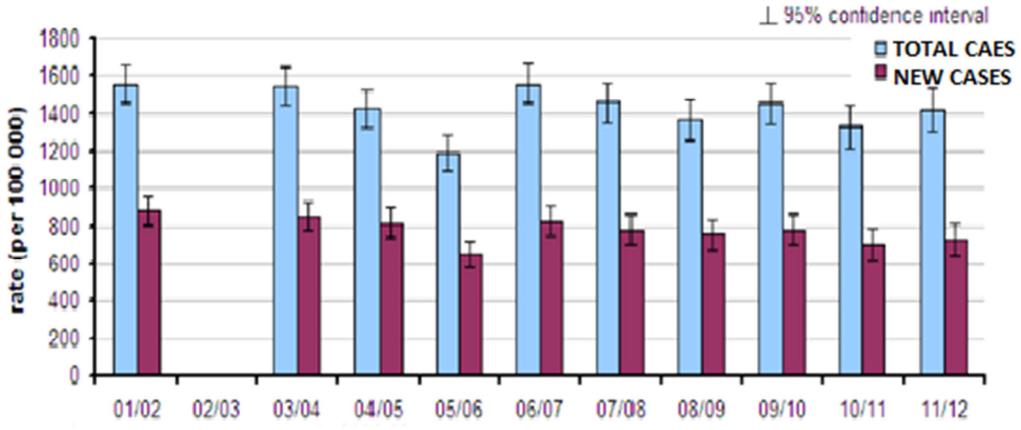


Figure1. is showing prevalence and incidence rate of work related stress. Depression or anxiety.

In 2011/12 there was an estimated incidence of 86000 male and 135000 female cases of work-related stress based on Labour Force survey. This compares to an estimates prevalence of 175000 cases of work related stress amongst males and 253000 cases of work related stress amongst females. [41] [42]

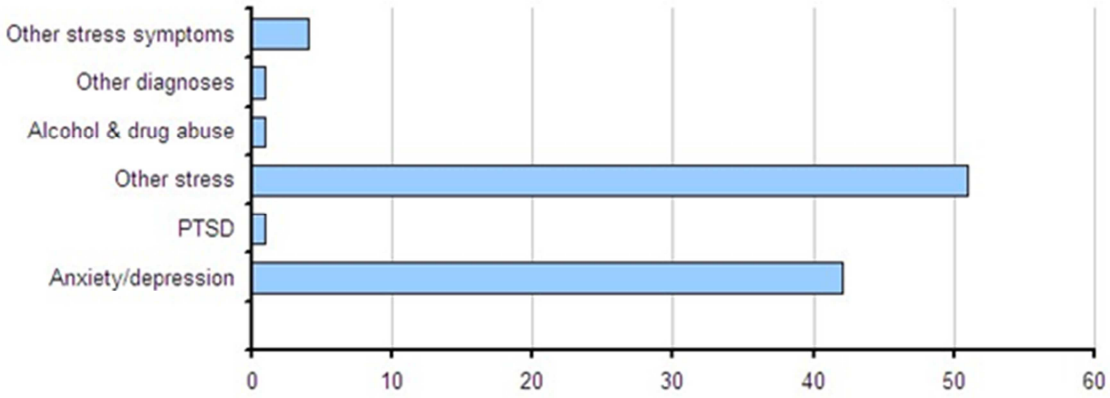


Figure. 2. is showing Breakdown of mental ill health by Diagonsis 2010-2012.

Therefore, we are designing a system that can monitor a person's stress on daily basis; it helps a person to find that from which situations they get stressed out and what the things they get stress from are. Than it will be easier to find solutions and to get relief from stressful situations and conditions, which is necessary to achieve healthier life style.

2 PREVIOUS WORKDONE

On the market, there are smart phones apps available where people can hold a finger to the camera, which will then detect slight changes in color related to blood flow. With these apps, users can purchase other apps that direct the user

towards stress reduction techniques. However,they do not continuously record stress level.Our goal is to create and combine a continuous stress monitoring device and stress management device into one system. We are using sensor intelligence with the wireless network technology in our system, which will provide reliable and accurate stress monitoring. Our continuous stress monitoring device will be responsible for monitoring the user's stress level, so that the user will be able to concentrate on his/her tasks throughout the day and be assured that stress levels are accounted for.

3 WORKING METHODOLGY

Our Human stress monitoring system combines recent technologies of advance sensors and wireless communication techniques and telemedicine systems. It comprises following parts.

- Sensing/monitoring parameters
- EEG
- ECG and Breathing
- GSR(skin galvanic response)
- Movement sensors(accelerometers)
- W.I.S.E
- PDA(personal digital assistant) device
- Monitoring servers(computers)

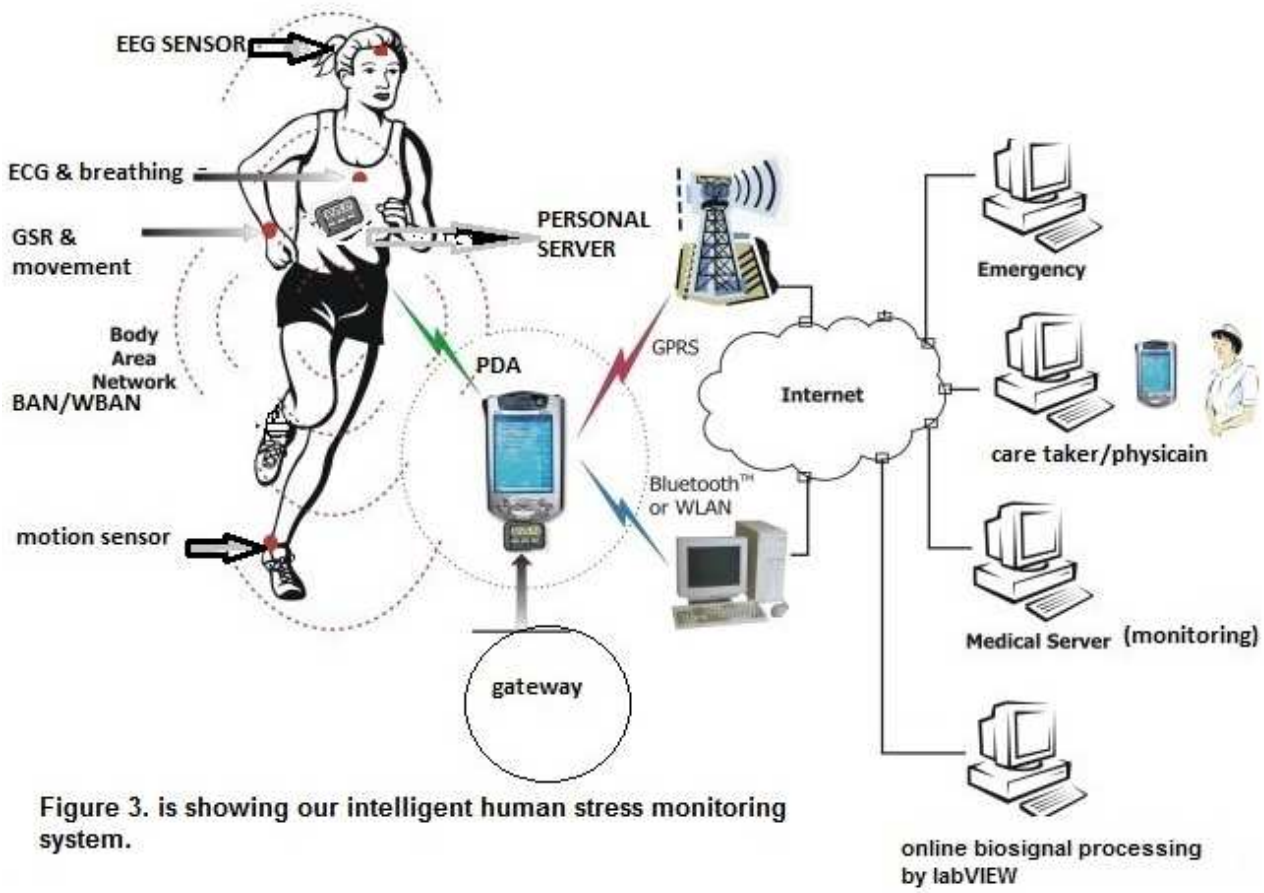


Figure 3. is showing our intelligent human stress monitoring system.

4 DETAILS OF THE SYSTEM

4.1 SECTION 1 (WIRELESS BAN PART)

We are designing a human stress monitoring system based on a wireless body area network (WBAN) of intelligent sensors, which transmits vital parameters (EEG, ECG, temperature etc.) without limiting the activities of the wearer. We have also integrated a BAN (body area network) of wireless intelligent sensors (W.I.S.E) as a development environment for research in the field of mobile health monitoring applications. W.I.S.E is microcontroller- based intelligent physiological sensors that is responsible for data acquisition and low-level real time signal processing tasks. Our BAN is organized as a client server network with a single personal server (PS) and multiple W.I.S.E clients. It's a part of a telemedical system hierarchical signal processing.Individual W.I.S.E sensors are controlled by, and communicate with, the PS using a custom wireless protocol. In addition to its responsibilities as a communication server, the PS also provides synergy of information through data aggregation and higher level signal processing. [8] [9]

4.2 SECTION 2 (TELEMETRY PART)

Now the aggregated measured data is transmitting to the PDA device (gateway). Connection between the PDA and the internet is implemented using Bluetooth IEEE802.11, IR, or a USB cradle. Now the gathered data can be forwarded in real time to the hospital, clinic or medical station through a LAN (local area network), WAN (wide area network). Now the telemedical workstation is responsible for long-term analysis of physiological signals, data presentation, and archiving .Our human stress monitoring system allow an individual to closely monitor changes in his or her stress levels and provide feedback to help maintain an optimal health status by avoiding high stresses. [8] [9]

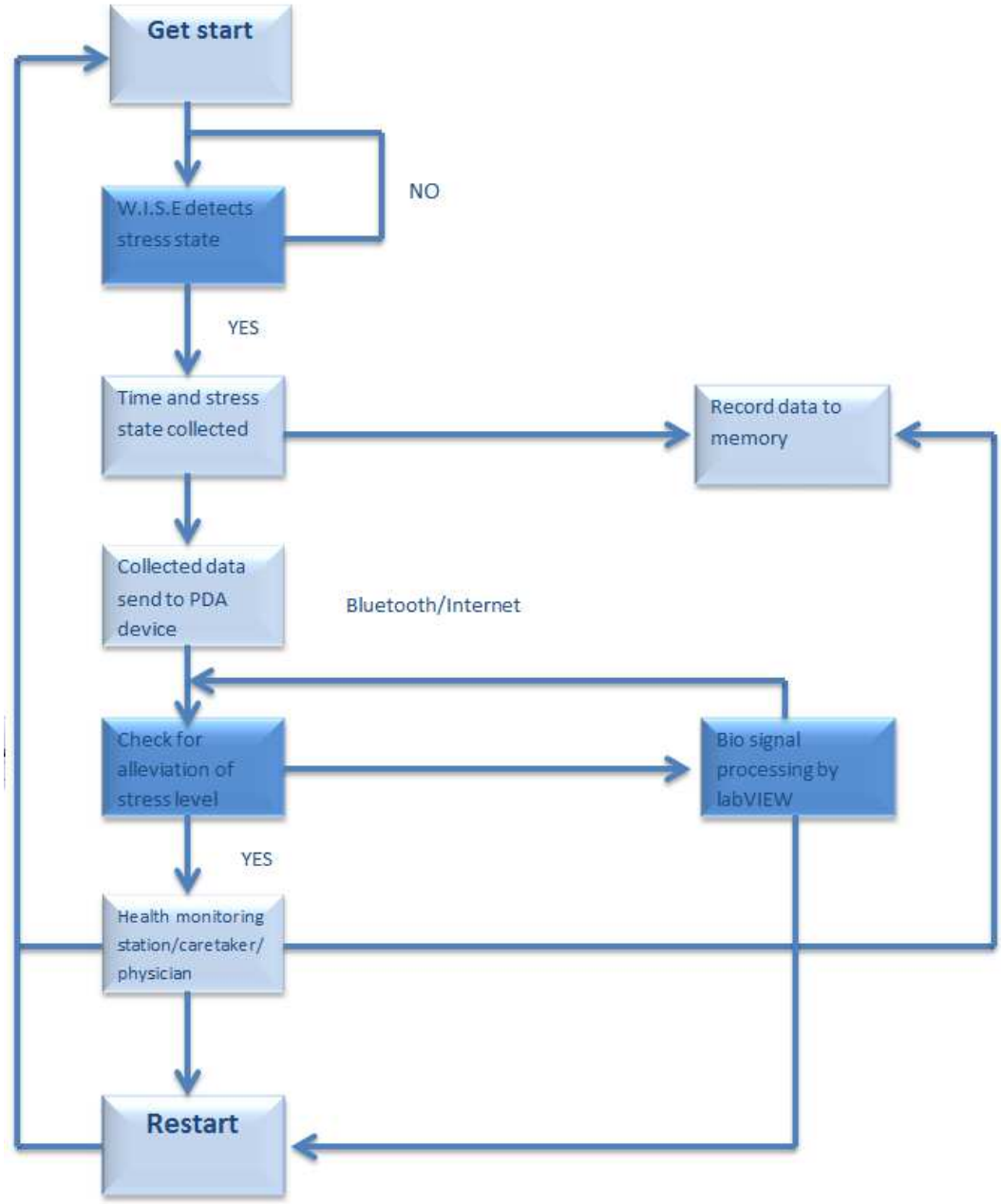
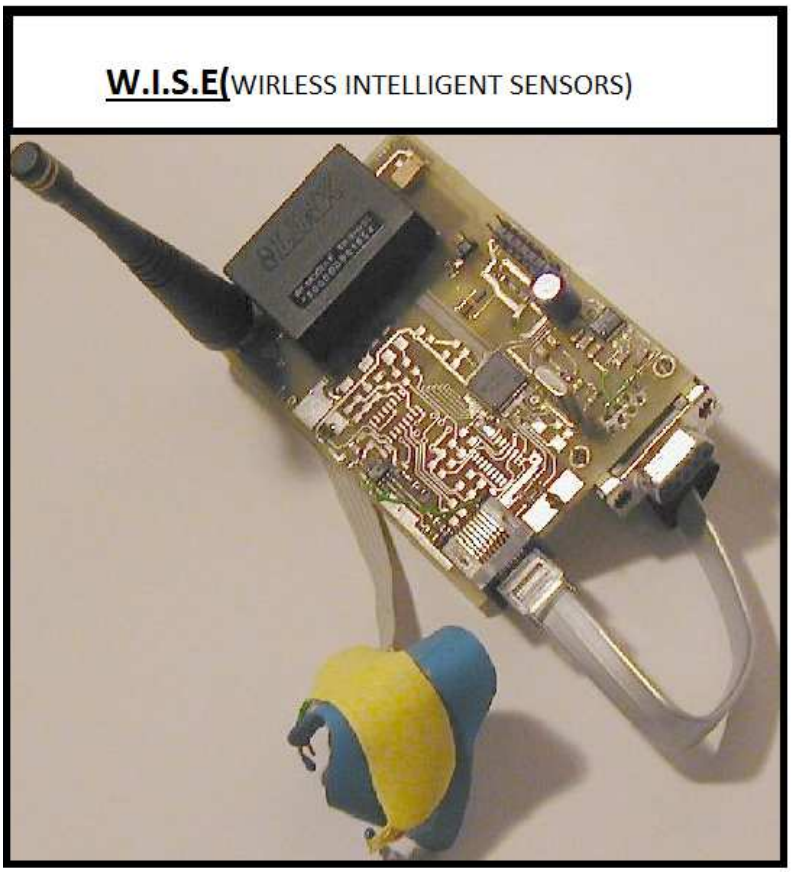


Figure.4 is showing a flowchart of Intelligent Human Stress Monitoring System's working mechanism.

5 W.I.S.E

The core of our wireless intelligent sensor (W.I.S.E) consists of Texas Instruments' microcontrollerMPS430F149 that is responsible for A/D data acquisition and processing, analog signal conditioning, the LINX wireless transceiver module TC-916-SC operating at 916 MHz. The controller features 16-bit RISC architecture, ultra-low power consumption (400 µ in active mode, less than 1µ in standby mode), 60KB flash memory, 2KB RAM, and a small 64-pin Quad Flat Pack (QFP) package. Our current prototype uses either custom-developed biomedical amplifiers on board or an off-the-shelf two-channel bio-amplifier TETMD A110-1/2 from Teledyne for signal conditioning. It is a battery powered, compact, ultra-low power, analog signal processing amplifier and filter. The signals from the bioamplifier are converted to digital signals using internal 8-channel, 12-bit analog to digital converter on microcontroller. Additional analog channels are used to monitor battery voltage, wireless link quality, and other external analog inputs. Therefore, W.I.S.E is capable of reporting the battery status andgenerating low-battery warnings to the higher system levels. [11][14] [18]



6 ADDITIONAL FEATURES: LABVIEW SIGNAL PROCESSING

One of the features of the LabVIEW application which is meant for online visualizing the measured biosignals and saving them locally is to give the observer, during the stress test, the possibility of setting markers. In this way the different data sets corresponding to the different phases of the stress test can be identified during the offline post processing. [7]

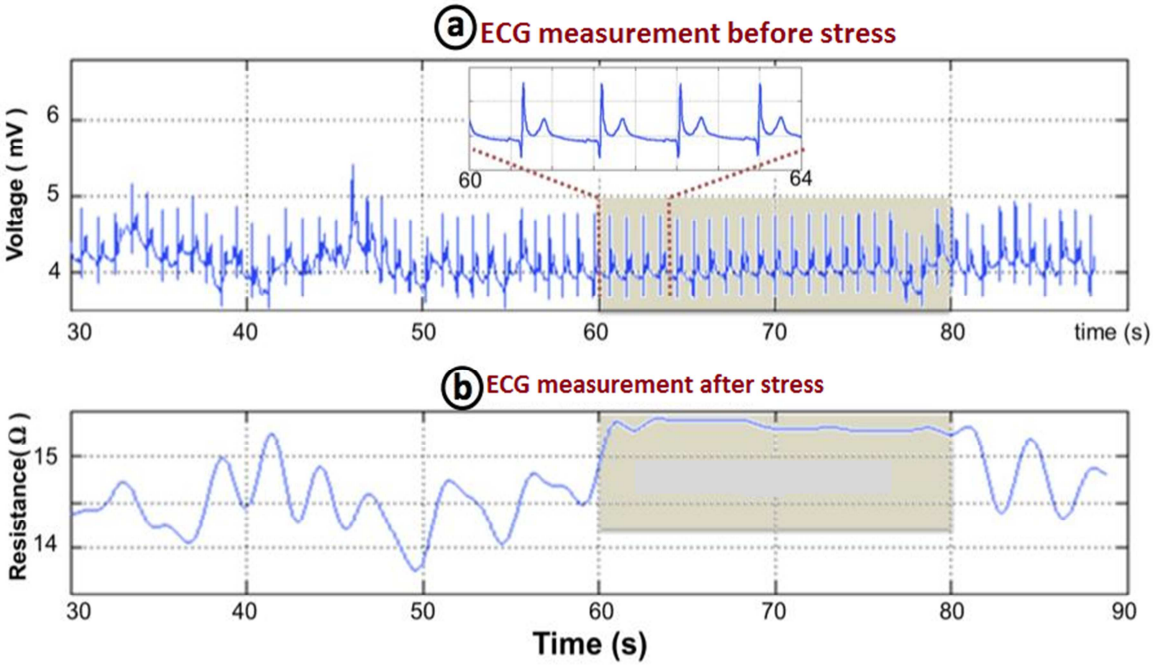


Figure 5. is showing the ECG measurement results before and after stress, results are taken from Intelligent human stress monitoring system.

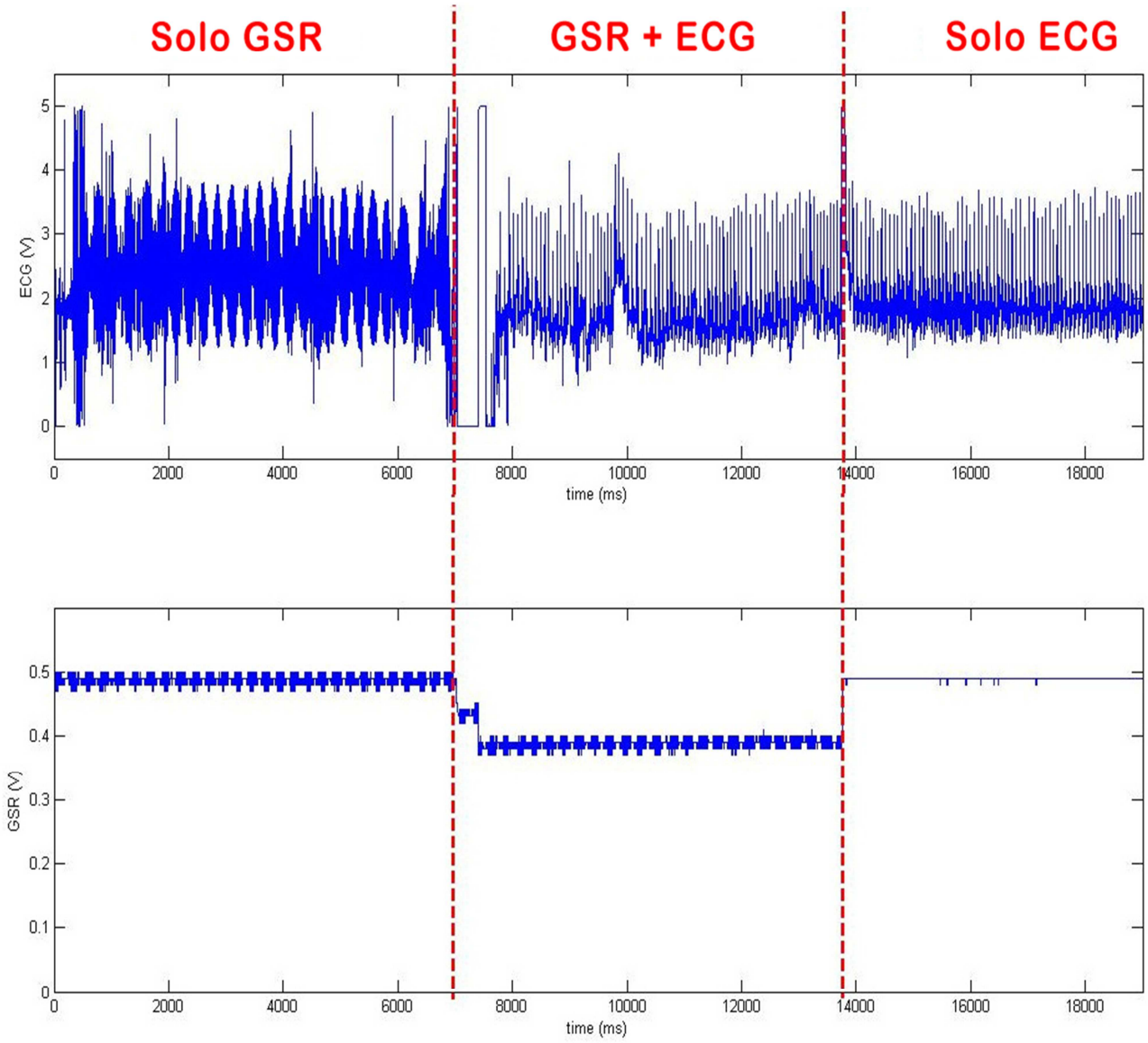


Figure6. is showing the results of ECG and GSR measurements, results are taken from Intelligent huamn stress monitoring system.

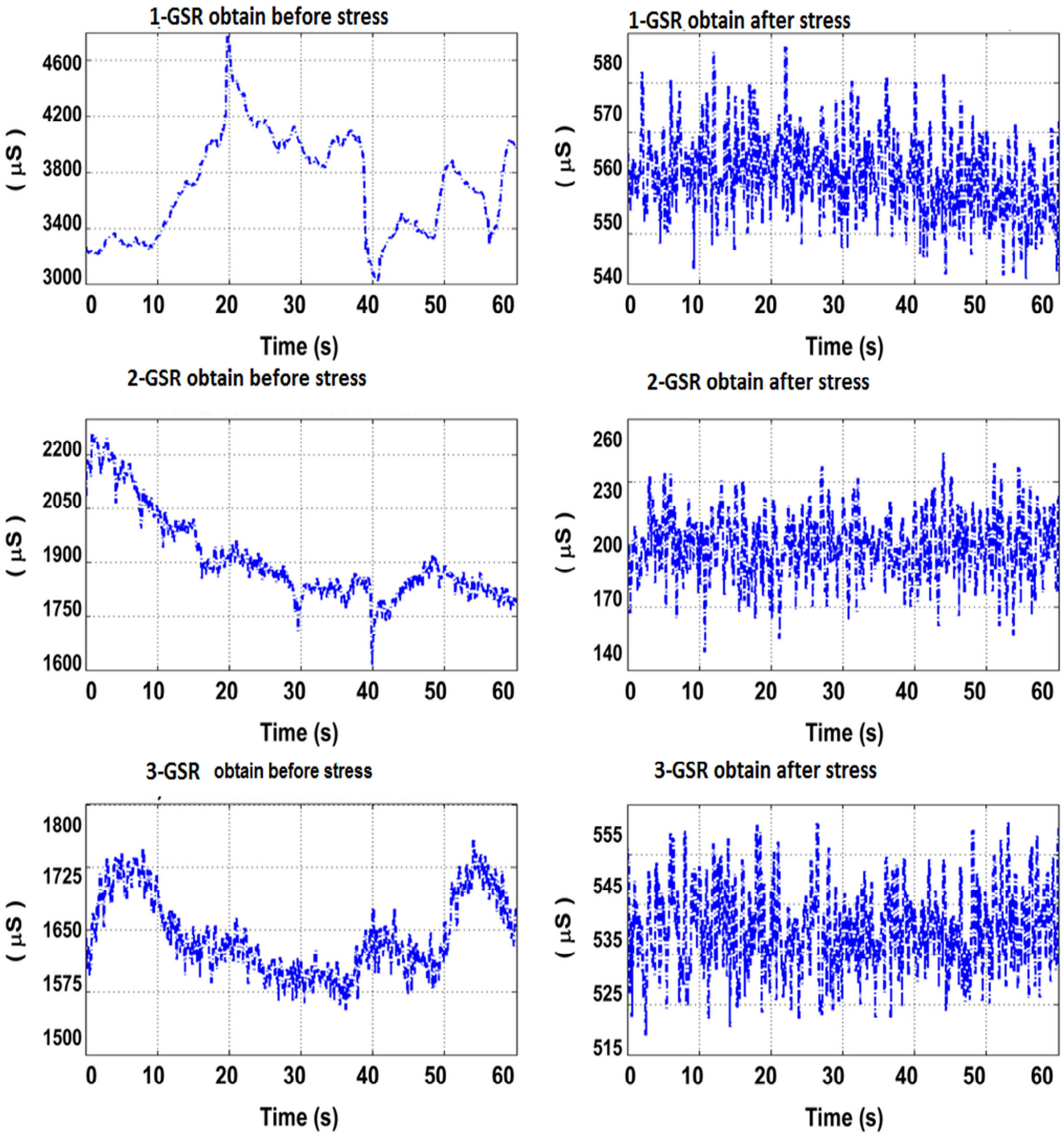


Figure 7. is showing the results of GSR measurements,results are taken from Intelligent human stress monitoring system

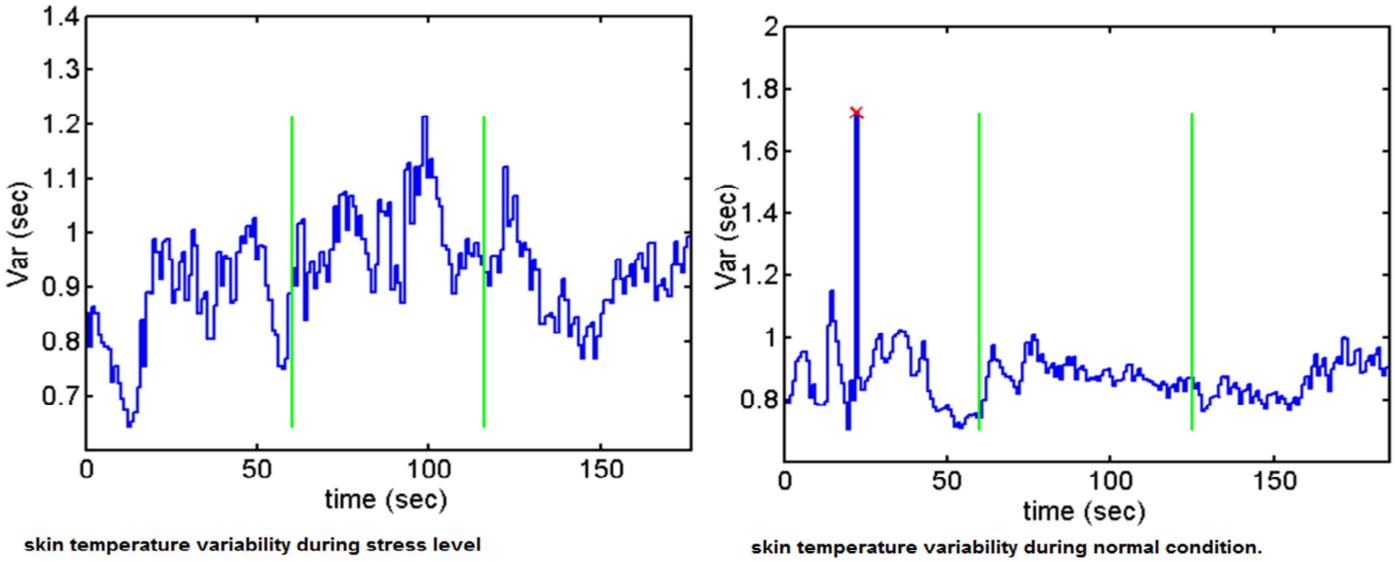


Figure 8 is showing skin temperature variability during stress level and in normal condition.

7 APPLICATIONS

There are many applications of Intelligent Human Stress Monitoring system (IHSMS). If a person already having chronic diseases (high blood pressure, arrhythmia, etc.) or if he/she cannot manage stress so, it leads to long term illness and more complications. Therefore, before curing stress or other illnesses, we have to monitor measure and manage stress which is ultimately the main application of Intelligent Human Stress Monitoring System. Moreover, it will be beneficial to soldiers, firefighters, police officers, and athletes, meeting participants and many others so that they can easily manage their stress and anxiety and can perform their actions in a more productive way.

8 CONCLUSION

It is noteworthy that intelligent human stress monitoring system is crucial for detection of stress. Our intelligent human stress monitoring system promises to revolutionize health care by allowing inexpensive, non-invasive, continuous and ambulatory health monitoring with almost real-time updates of stress level .so that patients can benefit from continuous long-term monitoring as a part of a diagnostic procedure. Therefore, they can achieve optimal maintenance of a chronic condition. Furthermore, in this way our intelligent human stress monitoring system is providing a solution that can help to achieve healthier life style.

REFERENCES

[1] Fernando Seoane , Inmaculada Mohino-Herranz, Javier Ferreira, Lorena Alvarez, Ruben Buendia, David Ayllón , Cosme Llerena and Roberto Gil-Pita "Wearable Biomedical Measurement Systems for Assessment of Mental Stress of Combatants in Real Time" sensors 2014, 2014. pp. 7121-7141.

[2] Kocielnik, R.Tech. Univ. Eindhoven, Eindhoven, Netherlands Sidorova, N.; Maggi, F.M. ; Ouwerkerk, M. ; Westerink, J.H.D.M "Smart technologies for long-term stress monitoring at work" ,Computer-Based Medical Systems (CBMS), 2013 IEEE 26th International Symposium ,20-22 June 2013,pp.53,58.

[3] Stella Christopoulou''A smart citizen healthcare assistant framework" Health and Technology, 09/2013; 3(3), pp. 249-265.

[4] Sabato Manfredi "Performance Evaluation of Healthcare Monitoring System over Heterogeneous Wireless Networks", E-Health Telecommunication Systems and Networks, 1, 2012, pp.27-36. (http://www.SciRP.org/journal/etsn).

[5] Team#30Yong Ho Kwon Udara Cabraal Hong Lee TA: Igor Federov "Stress Detection and Management System" ECE 445: Senior Design (Design Re. view) 10/07/2012.

[6] Giovanni Cagalaban, Wooyoung Soh and Seoksoo Kim, “Devising an Optimal Scheme for Wireless Sensors for Patient Report Tracking and Monitoring in Ubiquitous Healthcare”, “International Journal of Software Engineering and Its Applications”, Vol. 5 No. 4, October, 2011. pp .63-75.

[7] Stefan Hey Adnene Gharbi Birte von Haaren Katrin Walter Nils König Simone Löffler “Continuous noninvasive Pulse Transit Time Measurement for Psycho-physiological Stress Monitoring”, e-Health, Telemedicine, and Social Medicine, 2009. eTELEMED '09 International Conference on1-7 Feb. 2009, pp.113 – 116.

[8] “Synchronized physiological monitoring using a distributed wireless intelligent sensor system”, Engineering in Medicine and Biology Society, Vol.2, 2003, pgs.1368 - 1371.

[9] Emil jovanov, amanda o’donnell lords, dejan raskovic, paul g. Cox, reza adhami, and frank andrasik “Stress Monitoring Using a Distributed Wireless Intelligent Sensor System” , IEEE ENGINEERING IN MEDICINE AND BIOLOGY MAGAZINE, MAY/JUNE 2003, Vol. 22, No. 3, pp.49-55.

[10] D.P. Agrawal and Q. Zeng,”Introduction to Wireless and Mobile Systems”. Pacific Grove, CA: Brooks/Cole, 2003.

[11] J. Price, “An implementation of wireless network of intelligent sensors WISE,”M.S. thesis, Electrical and Computer Engineering Department, Univ. of Alabama Huntsville, Huntsville, AL, 2002.

[12] E. Jovanov, D. Raskovic, and R. Hormigo, “Thermistor-based breathing sensor for circadian rhythm evaluation,” inProc. 38th Annu. Rocky Mountain Bio engineering Symp., RMBS 2001,Copper Mountain, CO, Apr. 2001, pp. 493-497 .

[13] E. Jovanov, J. Price, D. Raskovic, K. Kavi, T. Martin, and R. Adhami, “Wireless personal area networks in telemedical environment,” inProc. 3rd Int. Conf. Inf.Technol. Biomed. (ITAB-ITIS2000), Arlington, VA, Nov. 2000, pp. 22-27.

[14] E. Jovanov, D. Raskovic, J. Price, A. Moore, J. Chapman, and A.Krishnamurthy, “Patient monitoring using personal area networks of wireless intelligent sensors,” inProc. 38th Annu. Rocky Mountain Bioengineering Symp, RMBS 2001, Copper Mountain, CO, Apr. 2001, pp. 373-378.

[15] D. Raskovic, E. Jovanov, and K. Kavi, “Hierarchical digital signal processing,” in Proc. 2001 IEEE Int. Symp. Intelligent Signal Processing and Communication Systems, ISPACS 2001, Nashville, TN, Nov. 20-23, 2001, pp. 18-21.

[16] Rosalind w. Picard and Charles Q Du “Monitoring stress and heart health with a phone and wearable computer”, OFFSPRING, VOL, 1 NO1, 2002.

[17] Aleksandar Milenković, Chris Otto, Emil Jovanov, “Wireless sensor networks for personal health monitoring: Issues and an implementation” Computer Communications, Volume 29, Issues 13–14, 21 August 2006. Pages 2521-2533.

[18] Emil Jovanov, Dejan Raskovic, John Price John Chapman, Anthony Moore, Abhishek Krishnamurthy, “Patient monitoring using personal area networks of wireless intelligent sensors,” in Proc. 38th Annu. Rocky Mountain Bioengineering Symp., RMBS 2001, Copper Mountain, CO, Apr. 2001, pp. 373-37.

[19] J. Agre, and L. Clare, “An Integrated Architecture for Cooperative Sensing Networks,” IEEE Computer, May 2000, pp. 106-108.

[20] D. Starcevic, E. Jovanov, V. Radivojevic, Z. Obrenovic, and A. Samardzic, “Virtual medical devices for telemedical applications”, in P. Spasic, I. Milosavljevic, M. Jancic-Zguricas, Eds.,Telemedicine, Academy of Medical Sciences of Serbian Medical Association, Belgrade, Yugoslavia, 2000 pp. 218-244.

[21] T. Martin, E. Jovanov, and D. Raskovic, “Issues in Wearable Computing for Medical Monitoring Applications: A Case Study of a Wearable ECG Monitoring Device,” International Symposium on Wearable Computers ISWC 2000, Atlanta, October 2000.

[22] G. Asada, M. Dong, T.S. Lin, F. Newberg, G. Pottie, and W.J. Kaiser, “Wireless integrated network sensors: Low power systems on a chip,” inProc. 1998 European Solid State Circuits Conf., The Hague, The Netherlands, Sept. 1998, pp. 9-16.

[23] J. Bai, et al., “A Portable ECG and Blood Pressure Telemonitoring System”, IEEE Engineering in Medicine and Biology, July/August 1999, pp. 63-70.

[24] S. Barro, et al., “Intelligent Telemonitoring of Critical Care Patients”, IEEE Engineering in Medicine and Biology, July/August 1999, pp. 80-88.

[25] W. Morse, "Medical electronics," IEEE Spectrum, vol: 34, issue: 1, Jan. 1997, pp. 99 –102.

[26] T. Akin and K. Najafi, “A Telemetrically Powered and Controlled Implantable Neural Recording Circuit with CMOS Interface Circuitry,” in Proceedings of IEEE 7th Mediterranean Electrotechnical Conf., Antalya, Turkey, April 1994, pp. 545-548.

[27] E. Jovanov, J. Price, D. Raskovic, K. Kavi, T. Martin, and R. Adhami, "Wireless Personal Area Networks in Telemedical Environment," in Proc. of 2000 IEEE EMBS Intern. Conf. on Inform.Technol. Appl. in Biomedicine, Key Bridge Marriott Hotel, Arlington, Virginia, Nov. 8-10.

[28] M. Gorlick, "Electric Suspenders: A Fabric Power Bus and Data Network for Wearable Digital Devices," Proc. of the Third Intern. Symp.on Wearable Computers, San Francisco, CA, October, 1999, pp. 114-121.

[29] DARPA Sensor Information Technology, Available at http://dtsn.darpa.mil/ixo/sensit.asp, Jan. 2003.

[30] NIST Smart Spaces, Available at http://www.nist.gov/Smartspace/SmartSpaces, Jan. 2003.

[31] Analog Devices, Available at http://www.analog.com/industry/iMEMS/index.html, Jan. 2003

[32] http://www.nist.gov/Smartspace/SmartSpaces.
[33] http://www.janet.ucla.edu/WINS/Sensor Information Technology,
Available at, http://www.darpa.mil/ito/research/sensit/index.html.
[34] Agilent, http://www.agilent.com.
[35] Protocol Systems, http://www.protocol.com.
[36] Cleveland Medical Devices, http://www.clevemed.com.
[37] Wearable Polysomnograph, Advanced Medical Electronics Corporation,
http://www.amecorp.com/Wearable_Polysomnograph.html.
[38] TMS320C54X DSP: CPU and Peripherals, Reference Set, Volume 1 (SPRU131C), Texas Instruments, 1996,
http://www.ti.com.
[39] Smart Technologies for Long-Term Stress Monitoring at Work at www.sics.se/ah.
[40] Stress and Psychological Disorders in Great Britain 2013
Available at http://www.hse.gov.uk/statistics/causdis/stress/stress.pdf.
[41] http://www.stresshumain.ca/documents/pdf/Mesures%20physiologiques/CESH_howMesureStress-MB.pdf.
[42] http://books.google.com.pk/books Pervasive Healthcare Computing: EMR/EHR, Wireless and Health Monitoring By Upkar Varshney
[43] http://books.google.com.pk/books MEDIC: An End-to-end Biomedical System Based on Active Sensor Fusion.
[44] http://books.google.com.pk/books Tele health care Computing and Engineering: Principles and Design by Fei Hu.
[45] http://books.google.com.pk/books Handbook on Theoretical and Algorithmic Aspects of Sensor, Ad Hoc Wireless.
[46] http://books.google.com.pk/books Tibetan Medicinal Plants.
[47] http://books.google.com.pk/books E-Health: Combining Health Telematics, Telemedicine, Bio medical engineering.
[48] http://books.google.com.pk/books Biomedical Information Technology
[49] http://www.researchgate.net/publication/237011348_A_smart_citizen_healthcare_assistant_framework.
[50] www.stress.org/stress-is-killing-you/.com

International Journal of Innovation and Scientific Research
ISSN 2351-8014 Vol. 10 No. 1 Oct. 2014, pp. 191-194

http://www.ijisr.issr-journals.org/

Schoolgirl pregnancies as a most critical and rapidly growing challenge in Tanzania

Sabbath M. Uromi

Assistant Lecturer,
Tanzania Public Service College,
P.O. Box 329,
Tabora, Tanzania

ABSTRACT: Girls have high aspirations for their education, despite concerns with poverty, gender-based violence, the consequences of early pregnancy and marriage, and lack of school facilities. Every year more than 8000 girls drop out from the school due to pregnancy. Though many countries agreed to increase opportunities for all children to have access to education in Millennium Development Goals, girls Student's pregnancy is among the rapidly growing social challenges that hinder the realization girl child to education (MoEVT 2008 and BEST 2010). Tanzania is one of the nations which highly experienced adolescents' pregnancy rate in the world affecting their full potential in life. More vulnerable to meet challenges of poverty, Community who are against children pregnancy are the ones who involved in love affairs with students and impregnated them, recent research done by TAMWA groups that leading to involved in love affair with students and impregnated them are government staffs, bus conductors', businessman, tax drivers, and well off people (TAMWA 2010). Recently research done in Iringa municipal shows those 30 students of nine secondary schools and 4 students of three primary schools are impregnated during 2012. Thirteen million children are born to women under the age of 20 years worldwide and more than 90% in developing countries (Wikimedia Foundation, 2010).
The Sub-Saharan Africa (SSA) region is characterized by high school dropout rates in the world. Teenage pregnancy prevalence is 143 per 1000 girls and resultantly, women are losing battle of equal access to secondary education (James et al, 2000). Therefore there is need to help girls to get their basic needs particularly education so they can participate full to the development of the community that surrounds the (Community Development Gender and Children 2000).

KEYWORDS: early pregnancy, mothering students, re-admission policy, gender unbalance in education.

INTRODUCTION

Pregnancy is a physiological process, presenting with history of missed period, fatigue, breast enlargement and tenderness, abdominal distension, nausea and vomiting together with light-headedness. Abdominal ultrasound, urinary or serum levels of HCG are confirmatory tests for pregnancy. When these happen at age of 19 years or below they are called adolescent or teenage pregnancies (UNDP report, 2003).

For instance recent research done in Tanzania revels some causes of Girls student pregnancy as follows: Low socioeconomic status was found to be an important cause for adolescent pregnancies as 57.1% of respondents suggested. Other factors responsible were luxury and deprivation of education to girls (43.5% and 16.5% respectively). Source of reproductive health education was contrary to most previous studies as 82.6% reported to get it from parents and health centre's, while schools and peer groups contributed only 29.1% and 7.2% respectively (MUHAS-2008/2009). Although the Constitution of Tanzania grants every child the right to education, yet a girl's access to education is denied when she becomes pregnant or gives birth. This study explored the experiences of pregnant and mothering students in secondary schools and the community awareness, attitudes and perceptions toward pregnancy policy in Tanzania. Farida Maluli (2014).

CAUSES OF EARLY PREGNANCIES FOR GIRLS STUDENTS IN TANZANIA

All the same, readmission of pregnant students and teenage mothers is still a major problem in many schools (Nyambura, 2000). Despite the government authorization, it is not always a straight forward issue as some school heads do not want to give teenage mothers space in their schools (Tjombonde 2003). They continue to believe that, giving a chance of education to teenage mothers will encourage more girls to become pregnant. As a result, pregnant and mothering students are still expelled from schools and some are struggling to continue with studies under difficult situations. Worse still, there is limited information on students' experiences of mothering in this situation of the lack of explicit policy. Thus this study sought to gain insights into the pregnant and mothering secondary students' experiences in Tanzania to fill the apparent gap.

According to WHO report (1998) which showed that about two-thirds of sub-Saharan

African women gave birth before 20 years of age due to cultural norms which encourage early marriage and proving fertility at young age. Also a study by Robert Berkow et.al. in 1999 showed that adolescent pregnancy is a multifaceted problem as it involves social, political, cultural, educational and economical factors as follows:

Socio-cultural beliefs and practices: Early marriage and pregnancy prevent girls from finishing school. Girls who get pregnant are expelled and the pregnancy is considered to be the girl s fault.

Gender biased socialization in school. While assertive behavior is promoted among boys, passive behavior is encouraged among girls. Girls are called on to perform domestic duties for teachers at school, such as fetching water, reinforcing gender stereotypes and taking time away from learning. WHO (1998).

Above all, Girls identify poverty, lack of school facilities, and distance to school as major obstacles to schooling in places where they can easily see other girls who do not experience such obstacles. Also too much leisure, illiteracy and low level of education is another cause of unwanted pregnancy for school girls. Nyambura, M. (2000).

Economic factors: Despite the abolition of school fees, parents are often unable to meet other school costs. This poses a big challenge on the retention of those enrolled. Some parents migrate to distant farms or other districts during the rainy seasons and their children are prone to expulsion from school if they are absent for three consecutive months. Girls normally work to supplement household income while lack of formal employment opportunities discourages children from completing the primary cycle. Elimu Yetu Coalition (2003).

In addition, Low socioeconomic status is the most contributing factor for adolescent pregnancies as well as Financial problems especially Unemployment and poverty among girls, lack of information about sexual matters, exposure. They tend to be silent on these obstacles in places where poverty levels are higher and there are greater distances to walk to school. In addition, there is considerable silence on gender-based violence (TEGINT report 2008 and 2010).

Furthermore, Government funding for schooling is insufficient. Many schools where gender parity in attendance, progression and attainment is not a problem are supplementing government funding with very high levies from parents and communities. Cohen, L., & Manion, L. (1994).

Health and HIV/AIDS: The high number of school pregnancies is an indicator of unprotected sexual activity and the high vulnerability of girls to HIV infection (rates of infection are six times higher for girls than boys). Moreover, girls who are normally caregivers become especially burdened when HIV/AIDS strikes the family, preventing them from regular school attendance UNESCO (1995).

For instance Dr Kheri Tungaraza, of Sinza hospital in Dar es Salaam, says teenage pregnancies could be fatal because the girls' bodies are not well-developed and susceptible to complications at delivery. What is worrying is that most of these pregnant girls give birth at home under the care of traditional birth attendants who cannot provide specialized healthcare. As a result, they are at risk of suffering fistula, ruptured uterus and unsafe abortion. "I have encountered several cases where the baby was too big to be delivered normally. Sometimes, the uterus raptures and the baby go up to the 'abdomen' and this call for an emergency operation, only to find that the baby is already dead," he says. Robin Hood Foundation. (1996).

STRATEGIES TO ELIMINATE GILRS STUDENTS' PREGNANCY

The main strategies of eliminating Girls students' pregnancy are based on:

i) Conducting seminars, workshop, trainings and outreaches. These activities will be organized and conducted for students, community, parents and teachers so as to see how we can deal with the

ii) Formation of Students Ant Pregnancies clubs. There must be organization of clubs for students which will be responsible for discussing and organizing debates for campaigns of ant pregnancies. These clubs can mobilize students to participate in various social and economic activities. Cohen, L., & Manion, L. (1994).
iii) Conducting debates, dialogue and conferences. The government and Nongovernmental organizations must be responsible for organizing and preparing theses activities for the purpose of creating awareness against student pregnancies, enhancing popular participation of society at all toward the problem. These will create platform for society to meet with policy makers and share various concerns. James W. et el (2000)
iv) Undertaking HIV/AIDS and sexual diseases prevention and family planning programmes for the communities so as to enhance responsible families that are reasonable and affordable with great emphasis on reducing the vulnerable children's and creating awareness on STD'S in learning environments and communities at all.
v) The adolescents who become sexually active need access to reliable contraceptive methods. Adolescent who are at risk and those with pregnancy and parenting need psychological support and proper information and motivation not to conceive again during adolescence
vi) Capacity building for primary school management committees and community structures including traditional leaders groups, delivering training on education rights, gender, HIV/AIDS, budget tracking, and school governance to enhance parents, managers and community members' commitment to girls' education;
vii) Promoting legal and policy frameworks for girls' education, engaging with local government officials on teacher qualifications, deployment and support, especially for female teachers in rural areas, and working with the national education organizations on policy issues;
viii) Partner institutional capacity building, working with in kiswahili language Maarifa ni Ufunguo, meaning; knowledge is the key to become a leading authority on education and gender. Mette R. (2003).

ROLES OF THE GOVERNMENT AND COMMUNITY AT LARGE

The Government and Community must be accountable to secure young girl from unwanted pregnancy because the government is the authority who control and regulate all the development activities of the nation as a whole and Community are the people who are very close with the students as their parents and guard of the children. Since they are the owner of the children and stay close with the children they have to participate in the fight of unwanted pregnancy as the community can have the well educated society. Hence government and community must do the following:

i) Reduce poverty and accelerate socio-economic development.
ii) Promoting gender and equality in access of education.
iii) Enhance girls to have their own development, wellbeing and happiness.
iv) Empower women/ girls in making decision about their lives.
v) Reducing vulnerable children's.
vi) Reducing the spread of Sexual Transmitted Diseases in learning environments and surrounding environments.

CONCLUSION

From this study it has been clear that parents/ guardians and health posts are important sources of reproductive health education to adolescents and hence useful for preventing adolescent pregnancies, therefore it is high time for education stakeholders, including the government, to work on measures to revive and sustain societies' high moral standing.

RECOMMENDATIONS

I therefore recommend the following actions to be taken by Government and all members of the society in Tanzania:

i) Parents and guardians should be encouraged to educate their children about reproductive health because they can do it better as this study has shown.
ii) Increased chances for girls to acquire formal education will lower the problem adolescent pregnancies.
iii) Knowledge on reproductive biology if taught in schools from elementary level will help greatly in combating the problem of early pregnancies.
iv) Policy and strategy development for prevention of HIV infection among girls for mitigating the impact of HIV/AIDS on the education system.
v) The government must ensure girls retention and improved performance in school through implementing Child Friendly School initiatives to create a safe and supportive learning environment for both girls.

REFERENCES

[1] WHO (1998), Education levels and cultural norms influence pregnancy in Adolescents.
[2] Muhondwa (1999) Adolescent sexuality and HIV/AIDS in Mtwara and Makete district.
[3] Tanzania Country Highlight (2003) www.unicef.org/girlseducation/index.html
[4] UNDP, Human Development Report (2003) Education system.
[5] Farida Maluli (2014) Research on Humanities and Social Sciences www.iiste.org ISSN 2222-1719 (Paper) ISSN 2222-2863 (Online) Vol.4, No.1, 2014
[6] Mette R. (2003). Growing up Pregnant: Events of Kingship in Everyday Life; Muheza Tanga Tanzania.
[7] Ministry of Education and Culture Policy. G(1995) Ministry of education and culture. Education and training.
[8] Ministry of Education and Vocational Training (2009) Children in Africa. The new Education and Training Policy in Tanzania Gvt Press Dsm.
[9] Namibia. Ministry of Basic Education, Sport and Culture. (2001a). National policy on teenage pregnancy in Namibia. Namibia Windhoek.
[10] Ministry of Education and Vocational Training (2009) Children in Africa. The new Education and Training Policy in Tanzania Government Press Dar es Salaam.
[11] Robin Hood Foundation. (1996). Kids having kids: A special report on the cost of adolescent childbearing. New York: The Foundation.
[12] James W. et el (2000) Value Education and Democracy Report of Working Group on Value in Education (South Africa)
[13] Journal of Adult Education Issue Na 17 (2009) Institute of Adult Education Tanzania
[14] Nyambura, M. (2000). Regional Ministerial consultation on closing the gender gap in education: Curbing drop out. Uganda: Kenyata University.
[15] Roye, C. F. & Balk, S. J. (1996) Evaluation of an intergenerational progamme for pregnant and parenting adolescents. Martenal-Child Nursing Journal, 24(10, 32-40)
[16] UNESCO (1995). Children in Namibia: Reaching towards the right of every child. Unicef-Namibia, Windhoek.
[17] WHO (1998). Education Level and Cultural Norms Influencing pregnancy in Adolescents. Wikimedia Foundation, Inc (2010).
[18] Nyakubenga P. (2009) Factors Associated with Adolescent pregnancies: Amy secondary School Students. Tanga.
[19] Harrison, C. (1990). Some body's baby. NewYork: Signet.
[20] Elimu Yetu Coalition (2003). Gender and education: The challenges of educating girls in Kenya.
[21] Cohen, L., & Manion, L. (1994). Research methods in education (4th ed.). London: Rout ledge
[22] Maluli, F. (2011). Mothering and Schooling? Students' Experiences in Relation to dropping out of School or Continuing with Secondary Education. Unpublished MA Dissertation. University of Dodoma, Tanzania.

International Journal of Innovation and Scientific Research
ISSN 2351-8014 Vol. 10 No. 1 Oct. 2014, pp. 195-217

http://www.ijisr.issr-journals.org/

TIC, innovation et impacts sur l'analyse concurrentielle: Leader Firme du Bassin Minier Tunisien

[ICT, innovation and impact on the competitive analysis: Tunisian Leader Basin Mining Firm]

Mohsen Brahmi[1], Sonia Zouari[2], and Bensalem Karim[3]

[1]IAE, Business Administration Institute, Campus Scientific Southern, FEMS University, Tunisia

[2]High Institute of Business Administration HBAI.S, Tunisia

[3]Economic Innovation, Versailles Saint-Quentin-en-Yvelines University, CERG Ile of France (SF), France

ABSTRACT: The objective of this paper is to reveal the reality of the use of the New Technologies ICT on the competitive analysis, in the context of the Tunisian Firms, through the study of one of the most important on a national scale which is the Tunisian public CPGT Firm. This research study, besides, allowed revealing the role and the real impact of the ICT on the competitive structure of this Firm within this more relentless world environment. We took as approach of empirical investigation the technique of the survey (investigation) by questionnaire with the staff and the conversations (interviews) with the responsible leaders on the strategic orientation of the firm in the medium and long term, on the technological and informative infrastructure as well as at the level of the competitive strategy of the firm.

KEYWORDS: ICT, Tunisian public Firm, Competitive strategy, Infrastructure technology.
JEL: H54, L32, L86, M15, M21, P17

RESUME: L'objectif de ce papier est de déceler la réalité de l'utilisation des Nouvelles Technologies TIC sur l'analyse concurrentielle, dans le contexte des entreprises Tunisiennes, à travers l'étude de l'une des plus importantes à l'échelle nationale qui est la Firme publique Tunisienne CPGT. Cette étude de recherche permettra, par ailleurs, de dégager le rôle et l'impact réel des TIC sur la structure concurrentielle de cette Firme au sein de cet environnement mondial plus acharné. On a tenu compte comme approche d'investigation empirique la technique de l'enquête par questionnaire auprès du personnel et des entretiens avec les dirigeants responsables sur l'orientation stratégique de la Firme à moyen et long terme, sur l'infrastructure technologique et informationnelle ainsi qu'au niveau de la stratégie concurrentielle de la Firme.

MOTS-CLEFS : TIC, Firme publique Tunisienne, stratégie concurrentielle, infrastructure technologique.
JEL: H54, L32, L86, M15, M21, P17.

Corresponding Author: Mohsen Brahmi

1 INTRODUCTION

La dernière décennie a vu la convergence de diverses technologies, les TIC[1] sont la représentation à travers de différents outils qui sont aujourd'hui indispensables dans nombreuses activités de l'entreprise. La convergence des technologies en télécommunication et en informatique a donné lieu à de nombreux outils qui sont devenus indispensables pour les dirigeants d'entreprises. Ainsi, la technologie[2] Reix R. (2000) se définie comme « une technique à la conception et à la réalisation d'un produit. Les technologies de l'information correspondent donc à des techniques permettant de fabriquer[3] de l'information».

Une vue d'ensemble, depuis la fin des années quatre-vingt-dix et dés le début de la première décennie[4] du XXIème siècle, du tissu économique Tunisien prouve avec claire voyance que l'autorité Tunisienne a commencé à prendre conscience de l'utilité réelle et de l'importance remarquable des TIC tant pour l'amélioration des processus internes que pour le renforcement de la compétitivité externe de l'entreprise, quelque soit sa taille, et de l'économie Tunisienne, en générale. En effet, les TIC contribuent bel et bien à jouer un rôle majeur dans la redéfinition des frontières et des rapports qui régissent la structure concurrentielle des Firmes exportatrices Tunisiennes, principalement.

Ces Technologies d'informations[5] (Vacher B., 2002, Perm D., 1993, Stoiarick K., 1999,) ont contournés, ces dernières années, des vastes nouveaux terrains de recherches empiriques[6] (Hempell T., 2004, Leeuwen G., Hempell T., et Wiel., 2002,) de l'usage vers leurs impacts réels sur la performance de l'entreprise. Certains auteurs les ont considéré comme une source capitale (Benoit, 1997, all) pour toute entreprise désireuse de rester compétitive face au contexte concurrentiel dure où elle opère leur activité économique. Soucieux de signaliser à nos jours que ces TIC étant des outils flexibles accroissant considérablement le traitement et l'analyse de l'information en sauvegardant sur des supports numériques comme banque des données sécurisées (Boulay, 2004), ont contribué pleinement à la réussite de la stratégie mise en œuvre, évidemment, par l'entreprise Tunisienne tout au long de son cycle[7] de vie.

Par ailleurs, la compétitivité et la productivité des entreprises exportatrices Desbien[8] J., (1998) sont de plus en plus dépendantes de l'efficacité[9] (Payette A. 1989), de la pertinence[10] (Marmuse C., 1997) et de l'utilisation rationnelle et propice des TIC[11] (Mallet poujol, 1998, Villarmois O., 1998, Jacob R, 1999 et al.). Il apparait, évidemment, comme une nécessité de mieux cerner l'environnement informatique des entreprises, leurs adoptions et usages du réseau mondial de communication qui constitue une source primordiale de transmission d'informations et d'accès rapide via ce réseau.

Toutefois, dans la scène mondiale, cette concurrence mondiale qui devient de plus en plus dure est un fondé inévitable dont toutes les Firmes exportatrices sont soumises, aucune ne peut en échapper ni l'éliminer. Ainsi, la recherche d'une meilleure rentabilité devient le souci majeur de toute Firme pour se prémunir contre la menace de ses principaux concurrents. Selon Porter, cette rentabilité est déterminée par l'attractivité du secteur et par la compréhension élaborée des

---

[1] *Nouvelles Technologies d'Information et de Communication, ICT*

[2] *Reix.R, « Systèmes d'information et management des organisations », 3e édition, édition Vuibert, 2000, 426 p, p.66*

[3] *Fabriquer correspond ici à saisir, traiter, stocker, communiquer*

[4] *Après Genève (Swiss), en 2005 la Tunisie à organisée la 2ème Sommet mondiale TIC.*

[5] *Vacher R., 2002, « Dans quelle mesure les Tic jouent elles un rôle stratégique pour les PME », revue Internationale des PME, Vol 15, N° 364, p 37-61.*
Perm D., 1993, « l'impact de nouvelles technologies », Editions d'organisation, 1993, Paris, p.52.
Stoiarick K., 1999, « IT spending and Firm productivity : Additional evidence frome the manufactoring Sector », OCDE, Spg 1999.

[6] *Hempell T.,2004, « Productivity effects of ICT in the German service sector» OCDE, Sep, 2004. Leeuwen G., Hempell T., et Wiel., 2002, « ICT, innovation and business performance in services : Evidence for Germany and the Netherlands», OCDE, ju 2002.*
Greenan N., Mairesse J., & Topiol, A., 2001, « Information technologie and research an development impacts on productivity and skills : looking for correlations on Franch Firm level Data » OCDE, 2001.

[7] *Pour les entreprises exportatrices publiques le cas de la CPGT, le cycle de vie se décompose en trois phases (l'exploitation, production et finalement la commercialisation par voie de l'exportation)*

[8] *Desbien J., 1998, « comment augmenter la productivité dans le secteur public », Revue Internationale de Gestion, Vol 36, 1998, p. 62*

[9] *Payette A., 1989, efficacité des gestionnaires et des organisations, les editions d'organisations, paris, p7.*

[10] *Marmuse C. 1997, « Performance », Encyclopédie, Editions d'organisation, 1997, Paris, p.21.*

[11] *Mallet Poujol, 1998, Nouvelles technologies de l'information et libertés individuelles », Doc Francaise, juillet 1998.*
Villarmois O., 1998, « Le concept de performance et sa mesure », Acte des XIVe Journées des IAE, Nante, Vol 2, p.199-216.
Jacob R., 1999, « Anatomie d'une rencontre de 3e type : gestion stratégique de l'interrelation entre les personnes, les NTIC & l'organisation », Colloque management technologique, Groupe ESC Grenoble, 14-17 Déc. 1999. France

règles de la concurrence qui affectent cet attrait[12]. Les Firmes cherchent désormais à utiliser tous les moyens possibles, principalement les Nouvelles Technologies, dans le but ultime de modifier ces règles en leurs faveurs.

Pour Michael E.Porter et Victor E.Millar (1985), les technologies de l'information et de communication peuvent affecter l'environnement concurrentiel d'une entreprise dans trois sens aussi important l'un que l'autre[13]:

Ils affectent la structure industrielle et, ce faisant, change les règles de la concurrence.

Ils créent un avantage concurrentiel en donnant à des compagnies de nouvelles manières de surpasser leurs rivaux. En conséquent, ils engendrent de nouveaux types d'affaires.

Or, le progrès technologique est l'une des grandes forces motrices de la concurrence et il joue un rôle très important dans les changements structurels des secteurs[14] (Gera S., et Gu W., 2004). Comprendre les liens entre technologie et concurrence n'est toujours pas évident puisque le progrès technologique tire son importance des effets qu'il exerce sur l'avantage concurrentiel et n'a pas de véritable valeur en soie[15]. Les NTIC incarnent de façon concrète l'importance du progrès technologique dans la recherche d'un avantage concurrentiel et la technologie des systèmes d'information[16] est présente partout : contrôle, logistique, programmation, coordination,… etc. (Bussler L., et Davis E., 2002)

L'énorme progrès qu'ont connu ces technologies durant cette dernière décennie leurs a permis d'occuper une place très importante, et parfois primordiale, dans plusieurs entreprises[17]. Et ils se manifestent aujourd'hui comme un outil stratégique et concurrentiel indiscutable[18] (Jacques Mairesse & Gilbert Cette & Yussuf Kocoglu, 2000 et 2005). C'est ce qu'on va essayer de montrer dans ce papier. A cet effet et pour détecter la véritable relation qui existe entre les TIC et l'analyse concurrentielle pour le contexte des entreprises exportatrices Tunisien, on a choisi à travers l'étude du cas de la Grande Firme citoyenne Publique Tunisienne, CPGT[19.]

Celle-ci Fondée en 1897, la Compagnie des Phosphates de Gafsa Tunisienne, CPGT, est une entreprise plus que centenaire, qui est l'opérateur public des phosphates en Tunisie. Son expansion sera sans précédent par l'ouverture des mines souterraines qui se prolonge vers les autres régions du Bassin Minier de Gafsa Tunisien, BMGT.

En effet, l'extraction du produit phosphater a débuté dans le Bassin Minier Sud-ouest Tunisien (BMT) il y a plus de 110 ans. Bien que la Tunisie est le deuxième pays à prés le Maroc, au niveau mondial, qui a commencé à valoriser, depuis une cinquantaine d'années au sein du Groupe Chimique Tunisien à Sfax qui est liée directement pour la diversification du produit en vrac exploité par l'entreprise mère CPGT, par une part remarquable prés de 80% de ce produit naturel en engrais phosphatés (Acide phosphorique, DAP, TSP.., etc.) de qualité très concurrentielle au Marché[20] Mondial des Engrais Phosphatés, MMEP.

---

[12] Porter M.E, 1997, « L'avantage concurrentiel », 1ere édition, édition DUNOD, 1997, 647 p, p.14

[13] Porter.M.E et Millar.V.E, 1985, « How information gives you competitive advantage », Harvard Business Review, N°4, Juillet-Aout 1985, 12 p, p.150

[14] Gera S., et Gu W., 2004, « Effets des innovations organisationnelles et des technologies de l'information sur le rendement des Entreprises », Analyse microéconomique, Stata Canada, 2004.

[15] Ibid., p.20.

[16] Bussler L., et Davis E.,2002, « Information system : The quiet revolution in human resource management », Journal of Computer Information System, Vol124, 2002, p.17-18.

[17] Consul Study, 2000, « ICT impacts on te industry Firms cometitivity », OCDE,2000.

[18] Jacques Mairesse & Gilbert Cette & Yussuf Kocoglu, 2000. « Les technologies de l'information et de la communication en France : diffusion et contribution à la croissance », Économie et Statistique, Programme National Persée, vol. 339(1), p.117-146.

Cette, Gilbert & Mairesse, Jacques & Kocoglu, Yusuf, 2005. "Effets de la diffusion des technologies de l'information sur la croissance potentielle et observée," L'Actualité Economique, Société Canadienne de Science Economique, vol. 81(1), pages 203-230, Mars-Juin.

[19] Compagnie des Phosphates de Gafsa Tunisienne, Société publique minière du sud-ouest Tunisien, a été fondée en fin d 19ème siècle, 1897, poursuivie par un ensemble des transformations acquisition-fusion pour maintenir son propre statut juridique tout en procurant une diffusion de notoriété à l'échelle international, évidemment, les premières places occupant actuellement au marché des engrais minerais phosphatés.

[20] Fort de remarquer, pour la période (2008-2011), le triplement '3x plus' des cours des Engrais minerais Phosphatés au Marché Mondial MMEP, qui résulte évidement à la forte demande mondiale croissante des pays émergeants et ceux asiatiques, principalement, pour l'enrichissement et la fertilisation de l'agriculture mondiale, celle-ci encontre partie ces prix s'envolent typiquement.

De ce fait, la C.P.G.T était considéré depuis longtemps et jusqu'à présent comme l'unique vecteur d'employabilité et le plus principal pôle industriel localisé, depuis plus qu'un siècle d'activité, dans le Bassin Minier de Gafsa au Sud-ouest de Tunisie, où fait vivre plus de 480.000 habitations des familles du Bassin minier de Gafsa. Cette plus grande citoyenne Firme occupe[21] le cinquième rang mondial au niveau de la production, bien que la troisième place parmi les gros pays exportateurs du produit phosphaté.

Toutefois, ce positionnement de cette grande Firme Tunisienne minière CPGT à l'échelle mondiale, est dû grâce : à sa stratégie d'investissement en nouvelles technologies TIC qui procurent un impact réel sur la stratégie concurrentielle de toute Firme exportatrices Tunisienne, en générale. Aussi, grâce à ses propres réserves potentielles estimées à 1300 millions de tonnes avec une qualité rare très apprécié par ces propres clients Européens et Asiatiques dans le marché mondial des engrais phosphatés. Ainsi, que par sa production annuelle de 8.5 millions de tonnes de phosphate marchand en 2010 et qui est prévue de 9.5 millions de tonnes de ce produit minier pour les années suivantes (malgré les perturbations économiques mondiales s'ajoutant les derniers événements sociaux de la révolution Tunisienne de 2011) selon les prévisions[22] de moyen et long terme du centre de recherche et valorisation de la CPGT à la délégation Métlaoui.

Toutefois, face à cette concurrence mondiale intense et des nouveaux entrants prévus pour ce secteur, les TIC peuvent jouer donc un rôle majeur pour renforcer plus ce secteur Minier Tunisien dans la redéfinition des frontières et des rapports qui régissent la structure concurrentielle et principalement la haute concurrence des pays producteurs de ce produit minier à l'échelle mondiale. Ces Nouvelles Technologies contribuent pleinement à la réussite de la stratégie mise en œuvre par la Firme CPGT.

Nous avons choisi de structurer ce papier de recherche en trois sections à savoir :

La première section de ce papier est consacrée à présenter les étapes de la réalisation de notre recherche empirique ainsi que les résultats de cette recherche exposés sous forme des tableaux et de graphiques. La deuxième section sera consacrée à l'interprétation de ces résultats, ce qui nous permettra de dégager et de formuler nos recommandations.

2 METHODOLOGIE DE LA RECHERCHE EMPIRIQUE

2.1 METHODOLOGIE DE LA RECHERCHE : DE LA PROBLEMATIQUE A L'ANALYSE DES DONNEES

La recherche empirique nous permettra de valider les hypothèses théoriques sur le terrain de la recherche, nous sommes partis de l'hypothèse que l'intégration des TIC dans l'analyse concurrentielle nécessite une meilleure maîtrise des relations entre ces technologies et les différents acteurs de la structure concurrentielle.

La validation de cette hypothèse passe par la vérification de ces sous-hypothèses :

H.1-1 : les TIC sont devenues incontournables pour le bon fonctionnement de la Firme.
H.1-2 : Le rôle des TIC peut évoluer d'un rôle de soutien, à un rôle stratégique et à vocation concurrentielle, ces nouvelles technologies peuvent aussi bien remplir des fonctions opérationnelles que de gestion.
H.2-1 : La structure concurrentielle d'une Firme ne se limite pas aux seuls concurrents du secteur mais peut être étendue vers d'autres acteurs.
H.2-2 : Plusieurs stratégies peuvent être utilisées pour faire face aux acteurs de la structure concurrentielle.
H.3-1 : Les TIC contribuent à la la redéfinition des rapports de force entre la Firme et sa structure concurrentielle.
H.3-2 : Les TIC sont un moyen efficace, avec leur pouvoir de diffusion, peuvent influencer les actions futures des acteurs concurrentiels et promouvoir une stratégie efficace au sein de la Firme.

[22] Le Centre de Recherche et valorisation à Métlaoui (CRVM) constitue l'un des principaux nerfs de cette Grande Entreprise Minière Tunisienne. Son mission essentielle est de prévoir le rythme de production annuel, tout en appliquant des modèles de prévision de moyens et long terme (en générale sur des périodes de 10 ans et plus). Ce centre stimule bien la recherche et aussi l'exploitation d'autres zones géologiques minières du Bassin Minier Gafsa Tunisien pour maintenir, d'une part, et accroitre le volume de production du produit phosphaté, d'autre part, par le biais des nouveaux moyens Technologiques NTIC d'exploitation utilisés et considérés les plus modernes utilisés par le gros producteurs mondiaux comme le Maroc (1[ier] producteur mondial).

Parmi les techniques de recherche empirique on peut citer :

2.1.1 ENQUÊTE PAR INTERVIEW

Elle suppose une relation entre deux personne Blanchet A., et Gotman A[23]., (1992) l'interviewé et l'intervieweur[24]. L'intervieweur Duchesne S., et Haegel F[25]., (2008) à pour but d'extraire une information supposée détenue par l'interviewé en mettant en œuvre une démarche stratégique permettant d'orienter la communication vers les objectifs prévus. Cette technique diffère de l'entrevue qui évoque plus un échange réciproque d'information ainsi que de l'interrogatoire qui suppose l'existence d'une pression quelconque qui influe les réponses de l'interlocuteur.

L'interview Savoie-Zajc L[26]., (2010) requiert au préalable une bonne connaissance du sujet traité garantissant ainsi le non-dérapage par rapport aux thèmes clefs et la limitation de l'insincérité et de la déformation.

L'intervieweur peut aussi recourir à une situation expérimentale pour stimuler l'interlocuteur et l'orienter vers le sujet voulus tout en reconfigurant ses questions de façon à ce qu'elles soient plus flexibles et moins directives. Cette méthode permet de déceler les réactions subjectives de la personne interviewée et de mettre l'accent sur ses sentiments, opinions et attitudes. Dans tous les cas, l'intervieweur doit recueillir les informations telles qu'elles sont exprimées et ne doit en aucun cas influencer les résultats de l'interview.

2.1.2 L'ENQUÊTE PAR QUESTIONNAIRE

C'est une variante de l'interview dont la principale différence est l'existence d'un outil principal d'enquête Blanchet A., et Gotman A[27]., (2007) qui est le questionnaire et qui limite sensiblement la marge de liberté des deux acteurs. Les questions peuvent être de type fermé : référendum (oui, non) multi-propositions (choix entre plusieurs réponses possibles)[28]. Ces questions présentent l'avantage d'être facile à exploiter et à analyser statistiquement alors qu'on leur reproche un aspect rigide et une certaine orientation des réponses du sujet qui peut être prise pour une sorte d'influence.

Les questions à réponses libres, quant à eux, laissent une liberté d'expression au sujet et ne limitent pas le choix de l'interlocuteur dans un nombre restreint de réponses. Ces questions permettent d'atteindre une profondeur et une richesse qui ne peuvent pas être atteints par les questions fermées et évitent la menace d'influencer les réponses des sujets en leur permettant d'exprimer leurs véritables opinions.

Toutefois, les questions ouvertes sont difficiles à exploiter et la conversion des réponses en représentation numérique s'avère délicate. Aussi faudra-t-il filtrer et compresser les réponses dans un sens plus simplifié et mieux structuré pour se prêter à une analyse quantitative. Face à ces lacunes, le chercheur peut recourir à une combinaison de plusieurs types de questions : les fermés quand les réponses sont totalement prévisibles, les ouverts pour apporter la richesse et rehausser la valeur de la recherche.

2.2 CHOIX DE LA MÉTHODOLOGIE

Pour notre recherche, nous avons opté pour l'enquête par questionnaire et ce pour des raisons multiples. La toute première est que cette méthode se distingue par sa facilité d'exploitation et d'analyse. Deuxièmement, on a cherché à faire ressortir la perception des cadres et les dirigeants de cette Compagnie Minière Tunisienne (auprès de 217 personnes interrogées dans cette enquête, seul 107 personnes qui nous ont répondu[29]rigoureusement) concernant la position

---

[23] *Blanchet A., et Gotman A., 1992, 'l'enquête et ses méthodes : l'entretien. Paris, Nathan.*

[24] *Zghal. R, « Méthodologie de recherche en sciences sociales », édition Contribution à la littérature d'entreprise, 1992, 120 p, p.63*

[25] *Duchesne S., et Haegel F., 2008, L'entretien collectif : l'enquête et ses méthodes (2e éd.). Paris, Armand Colin.*

26 Savoie-zajc L., 2010, 'L'entrevue semi-dirigée. Dans B Gauthier (Ed.), recherche sociale. De la problématique à la collection de données. p 337-361. Québec, Presses

27 Blanchet A., et Gotman A., 2007, 'l'enquête et ses méthodes : l'entretien. (2e éd.) Paris, Armand Colin.

28 Ibid, p.73

[29] *Tants des défis en sont imposées face à notre enquête: qui s'expliquent par les diverses difficultés que nous vivons en Tunisie depuis les trois dernières années de la crise de 2008 et les problèmes persistants encore après la révolution Tunisienne 2010/2011, contribuant à bloquer le siège de cette citoyenne Firme publique Tunisienne, qui constitue le seul pôle Industriel de Sud-ouest, pour des durées non*

concurrentielle de leur société et la contribution des Technologies d'Information et de Communication au renforcement de cette position. Des contradictions et des convergences peuvent alors être décelées par l'étude qui permet de révéler des problèmes et des dysfonctionnements.

On a fourni nos questionnaires en papier et en support numérique par E-mail à tous les sujets questionnés. Par ailleurs, on a essayé d'être quasi-présent au moment où le sujet répondait au questionnaire pour garantir la bonne compréhension des différentes questions et pour s'assurer du respect de l'ordre dans lequel ils sont présentés, sans l'influencé dans le choix des réponses tout en le laissant libre pour garantir les critères de transparence des données et de la fiabilité de l'enquête. Pour le cas contraire, le questionnaire était transmis, main à main, aux sujets concernés après une brève présentation du but de la recherche. Les réponses nous sont parvenues, de part et d'autre, par voix courrier et support papier.

Une fois les réponses aux questionnaires collectées, on a procédé à une analyse à la fois qualitative et quantitative. Cette dernière nous a permis de traiter les réponses collectées par des tests mathématiques et statistiques nécessaires pour faire ressortir des moyennes et des pourcentages. Afin de vérifier que l'information obtenue par l'élaboration du questionnaire est fiable, on a utilisé des techniques de traitements des données (le tri-simple ou le tri-croisé) de l'analyse du contenu. En effet, dans le cadre de notre analyse on a choisi d'utiliser la technique tri-simple qui constitue la première démarche du traitement des données quantitatives d'enquête, avec l'aide de l'outil statistique SPSS 14.0. Elle repose sur le fait que la fréquence de répétions d'éléments de réponses traduit le centre d'intérêt et les préoccupations réelles des acteurs (Thiétart.R.A[30]., 1999). Mais ces résultats, bien qu'importants, ne doivent pas avoir une valeur absolue au moment de l'interprétation, c'est pourquoi une analyse qualitative s'impose pour saisir les relations entre les réponses et leurs significations profondes et pour soulever des phénomènes significatifs[31].

On s'est aussi basé sur notre observation sur le terrain durant la durée de recherche et sur des informations livrées par le personnel de la société pour apporter certaines clarifications et pour essayer d'expliquer les résultats obtenus par le questionnaire.

Dans notre recherche empirique, nous avons distribué les questionnaires sur notre échantillon (Cadres et directeurs de différentes directions) dans le but de détecter leurs perceptions du rôle stratégique des Technologies d'information et de communication et avoir une idée sur l'efficacité dans l'ensemble de leur système d'information. Le choix des cadres et des directeurs sujets de l'enquête était très délicat parce qu'il fallait qu'ils soient aptes à répondre à des questions qui touchent plusieurs domaines de l'activité de l'entreprise. C'est pourquoi on s'est concentré plus sur la direction informatique ainsi que la direction financière et celle Managériale et Commerciale, du fait de leurs contacts avec les différentes fonctions de la Firme.

2.3 ELABORATION DU QUESTIONNAIRE

En essayant de formuler des questions. Celles-ci devront nous aider à vérifier les hypothèses énoncées au début de ce travail. Ces questions sont majoritairement du type multi-choix et on a aussi utilisé des questions ouvertes pour éclaircir certains points. Le questionnaire est donc divisé en trois parties selon une logique qui permet la vérification des hypothèses :

La première partie devrait nous permettre d'évaluer la maturité Technologique et Informationnelle de la Firme CPGT et nous éclaircir sur le rôle pour lequel des Technologies d'Information ont été introduite dans la Firme enquêtée. La deuxième apporte une représentation de la position de la Firme face à son environnement concurrentiel. La dernière dévoile le rôle des Technologies d'Information existantes dans la réalisation de la stratégie de la Firme et dans l'attribution d'une position favorable au sein de la structure concurrentielle.

déterminées par les manifestants de cette région. Pourtant, on a mené un grand effort pour élaborer cette enquête avec un échantillon de 107 personnes dont 7 répondants sont écartés vu la non confirmation des questionnaires reçus et les manques des réponses. Toutefois, nous passerons nos vifs remerciements tous les personnels et Dirigeants de leurs ententes et leurs compréhensions malgré les grands obstacles incontournables de l'état de lieux de la société et de l'environnement en général, jusqu'à nos jours.

[30] *Thiétar.R.A,(1999), Méthode de recherche en management, Dunod Paris 1999.*

[31] *Ibid, p.93*

3 ANALYSE ET INTERPRETATION DES RESULTATS DE LA RECHERCHE EMPIRIQUE

Dans cette section, on a choisi de présenter en premier lieu les résultats traités. Alors que l'interprétation empirique et les diverses constatations seront l'objet de la deuxième sous section.

3.1 ANALYSE DE LA RECHERCHE EMPIRIQUE

Dans cette partie, nous allons procéder au dépouillement des informations et des réponses données par notre échantillon dans le cadre du questionnaire.

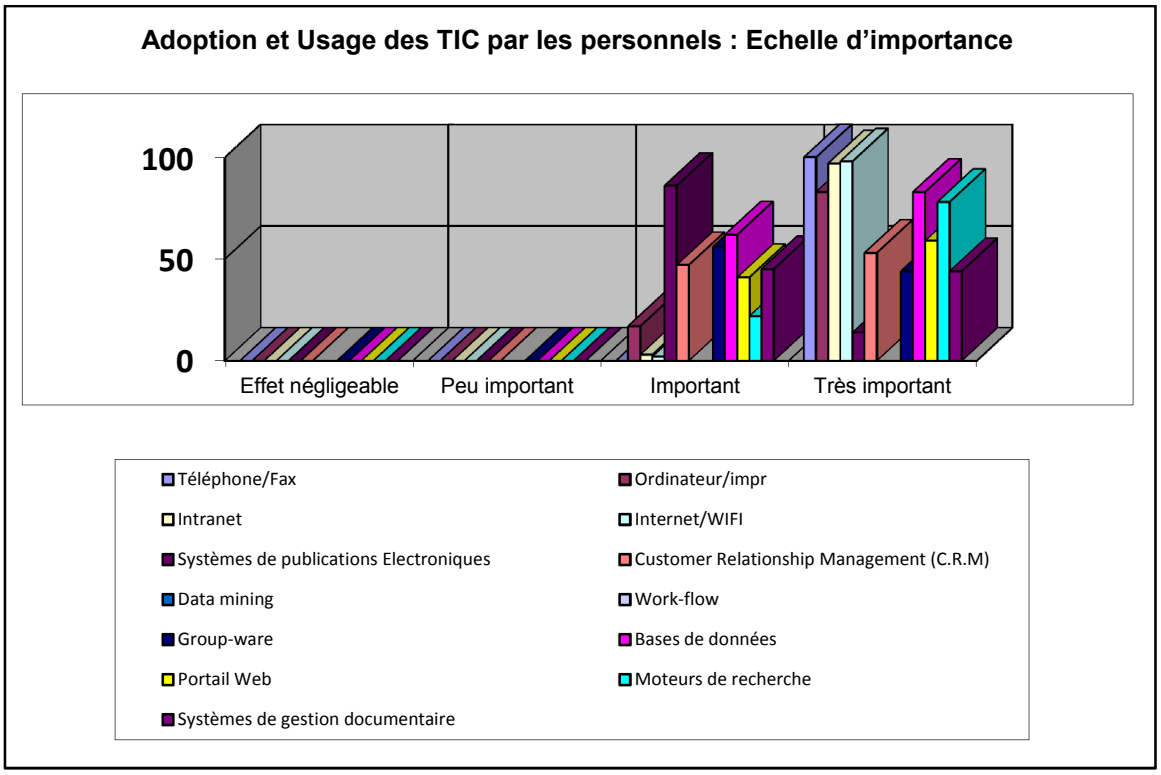
3.1.1 LES TECHNOLOGIES D'INFORMATION ET DE COMMUNICATION : USAGE, IMPORTANCE ET IMPACT DE LA QUALITE D'INFORMATION SUR LES FONCTIONS DE LA FIRME

Q.2 : le téléphone fixe tient la première place des Technologies de Communication le plus utilisé dans l'entreprise (100%), il est suivi par (Ordinateur/imprimerie , Intranet, Internet/WIFI, Systèmes de publications Electroniques, C.R.M, Data Mining, Work-flow, Group-ware, Bases de données , Systèmes de gestion documentaire, Moteurs de recherche , Portail Web) comme on les décrit dans le tableau1 suivant.

Tableau 1. Usage et répartition des TIC les plus adoptées par la Firme

Fréquence et Usage des TIC (%)	Effet négligeable	Peu important	Important	Très important
Téléphone/Fax	-	-	-	100
Ordinateur/impr	-	-	17	83
Intranet	-	-	3	97
Internet/WIFI	-	-	2	98
Systèmes de publications Electroniques	-	-	86	14
Customer Relationship Management (C.R.M)	-	-	47	53
Data mining	-	-	56	44
Work-flow	-	-	62	38
Group-ware	-	-	41	59
Bases de données	-	-	22	78
Portail Web	-	11	45	44
Moteurs de recherche	-	7	11	82
Systèmes de gestion documentaire	-	21	41	38

Note 1: All tables (1-20) and graphics are taken, by first author, under Spss Statisctic 20.0 version.



Q.3 : La majorité pense que les Technologies d'Information et de Communication bien intégrées dans le fonctionnement de la Firme, alors qu'ils sont divisés entre une intégration importante et plus importante.

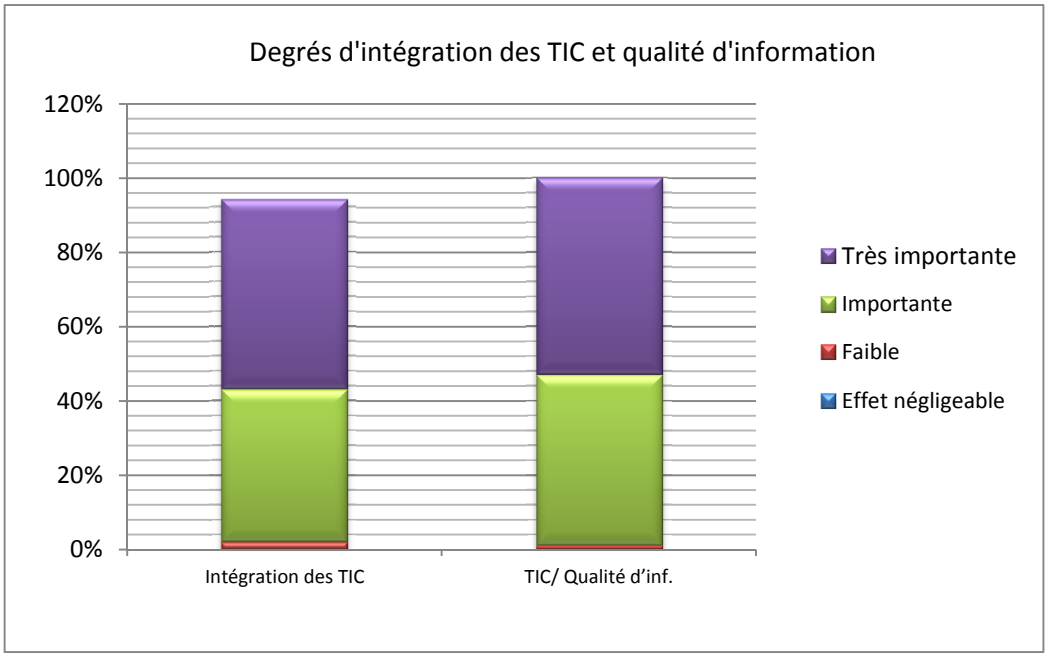
Tableau 2. Degrés d'intégration des TIC dans la fonction de la société

Degrés d'intégration des TI	Frequency	Percent	Valid Percent	Cumulative Percent
Inexistante	-	-	-	-
Peu importante	1	1	1	1
Importante	46	46	46	47
Très importante	53	53	53	100,0
Total	100	100,0	100,0	-

Q.4 : Seul une minorité très faible de cet échantillon (2%) pense que les Technologies d'Information sont peu importantes pour influencer positivement la qualité de l'information. Au contraire, la majorité qui sont réparties entre importante et très importante cette influence sur la qualité d'information pour la Firme.

Tableau 3. Rôle des TIC dans l'amélioration de la qualité de l'information

Effet des TIC/ Qualité d'inf.	Frequency	Percent	Valid Percent	Cumulative Percent
Effet négligeable	-	-	-	-
Peu important	2	2	2	2
Important	41	41	41	43
Très importante	57	57	57	100
Total	100	100,0	100,0	-



Q.5 : Une évaluation de la qualité de l'information regroupée par type et de l'importance de chaque type d'information. (Tableaux. 4-7 et illustration graphique)

Tableau 4. Qualité de l'information selon son importance relative à la prise des Décision

Qualité de l'information	Importance relative		Total
	Utile	Très utile	
faible	3	3	3
Importante	24	24	24
Très importante	73	73	73
Total	100	100	-

Tableau 5. Performance de l'information sur la qualité de l'information interne

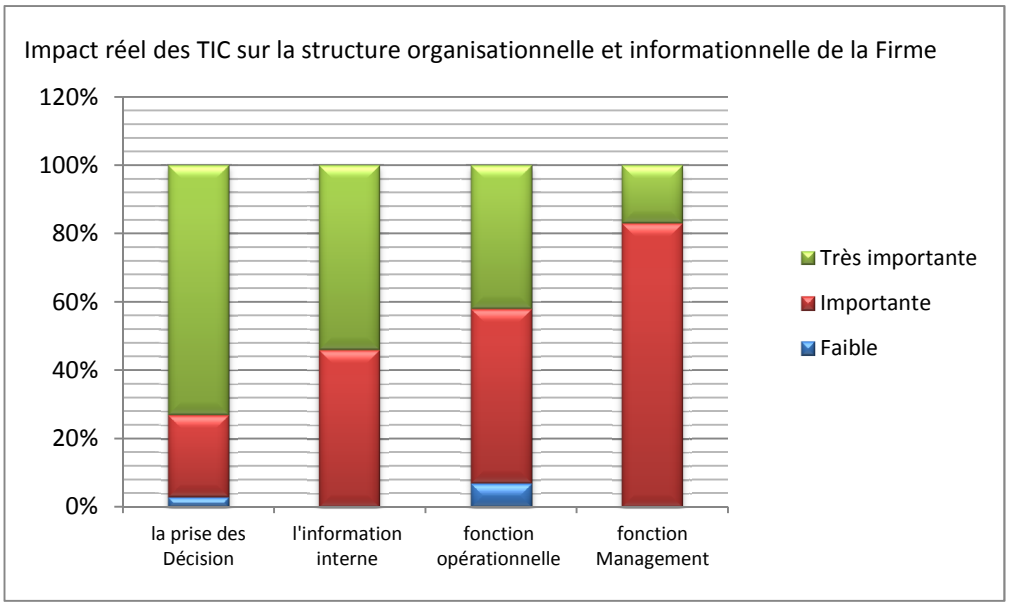
Qualité de l'information interne	Performance de l'information	Total
	forte	
faible	-	-
Importante	46	46
Très importante	54	54
Total	100	100

Tableau 6. Qualité de l'information et degré d'importance sur la fonction opérationnelle

Qualité de l'information opérationnelle	importance de l'information			Total
	faible	moyenne	forte	
faible	2	3	2	7
Importante	4	14	51	51
Très importante	-	42	42	42
Total	6	59	100	-

Tableau 7. Qualité de l'information et degré d'importance sur la fonction Management

Apport réel sur la qualité de l'information de la f. Mangement	importance de l'information	Total
	forte	
Faible	-	-
Importante	83	83
Très importante	17	17
Total	100	100



Q.6 : On remarque un accord total (100%) sur le rôle occupé par le système d'Information de la Firme qui est un rôle de soutien et aide à prise de décision.

Tableau 6. Rôle du système d'information

Rôle du Système d'inf.	Frequency	Percent	Valid Percent	Cumulative Percent
Soutien/Prise Décision	100	100,0	100,0	100,0

Q.7 : On remarque encore un accord total (100%) sur la perception de la nature du système d'information en place qui est un système d'information opérationnel.

Tableau 7. Nature du système d'information

Nature du Système d'inf.	Frequency	Percent	Valid Percent	Cumulative Percent
Opérationnel	100	100,0	100,0	100,0

Q.8 : Un taux de 100% de réponses a confirmé, qu'en matière de nouvelles technologies d'information et de communication, la CPGT est considérée au même niveau technologique par rapport à ce qui existe dans le marché mondial et chez les concurrents en cette matière.

3.1.2 LA STRUCTURE CONCURRENTIELLE

Q.9 : la majorité pense que la CPGT développe une relation coopérative (90%) avec ses clients, alors que le reste pense que la société occupe une position défavorable.

Tableau 8. Position de l'entreprise face à ses clients

Echelle d'importance	Frequency	Percent	Valid Percent	Cumulative Percent
Très faible	3	3	3	3
Faible	7	7	7	10
Coopérative	90	90	90	100,0
Total	100	100,0	100,0	-

Q.10 : 100% des réponses stipulent que la CPGT exerce un pouvoir de négociation plus fort face à ses fournisseurs.

Tableau 9. Position de l'entreprise face à ses fournisseurs

Echelle d'importance	Frequency	Percent	Valid Percent	Cumulative Percent
Très faible	2	2	2	2
Faible	5	5	5	7
Importante	97	97	97	100
Total	100	100	100	100

Q.11 : La moitié pense que la CPGT occupe une position forte face à ses concurrents, alors que l'autre moitié qualifie cette relation de coopérative.

Tableau 10. Position de l'entreprise face à ses concurrents

Echelle d'importance	Frequency	Percent	Valid Percent	Cumulative Percent
Faible	4	4	4	4
Partenariat et coopérative	41	41	41	45
forte	55	55	55	100,0
Total	100	100,0	100,0	

Q.12 : Les réponses à cette question sont très variées, bien que la majorité nie l'existence d'une menace des produits de substitution, le reste a confirmé l'existence de cette menace mais ils sont en désaccord sur son intensité.

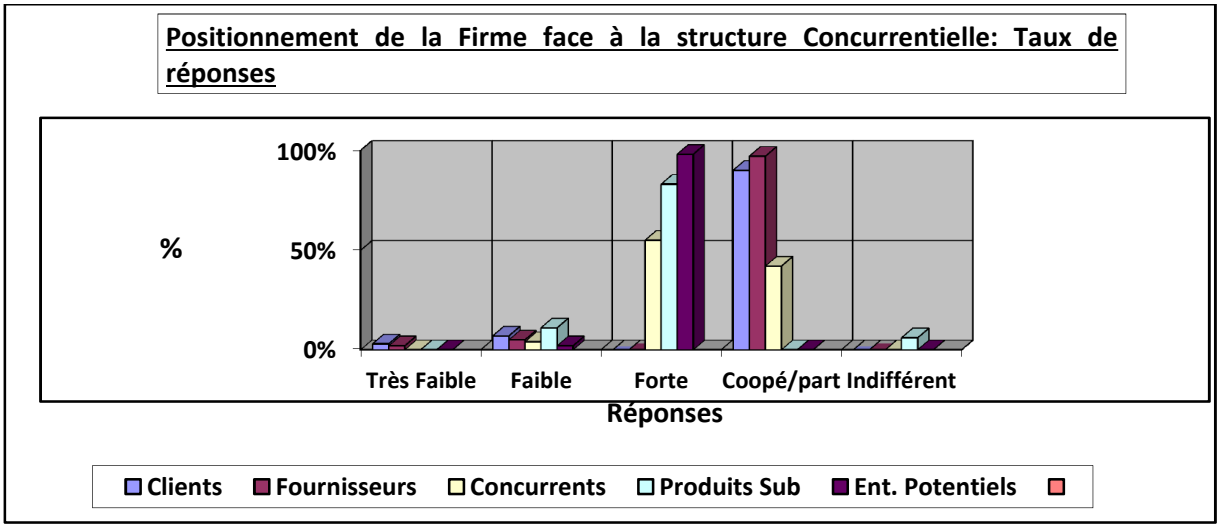
Tableau 11. Position de l'entreprise face aux Produits de substitution

Degré d'importance	Frequency	Percent	Valid Percent	Cumulative Percent
Très faible/ inexistant	3	3	3	3
Faible	16	16	16	19
Important	81	81	81	100
Total	100	100	100	-

Q.13 : 100% confirment l'existence permanente d'une menace de l'arrivé de nouveaux entrants dans le secteur mais insistent sur la position confortable de la CPGT face à ces nouveaux entrants.

Tableau 12. Position de l'entreprise face aux entrants potentiels

Echelle d'importance	Frequency	Percent	Valid Percent	Cumulative Percent
faible	2	2	2	2
forte	98	98	98	100,0



Q.14 : La quasi-totalité des personnes interrogées affirme que la stratégie de minimisation des coûts, comme celle mise en œuvre par l'entreprise, est la plus adoptée pour faire face à son environnement concurrentiel.

Tableau 13. Stratégie adoptée par la société

Degré d'importance	Frequency	Percent	Valid Percent	Cumulative Percent
Important : - **la Mini des Coûts 81%** **- la Différenciation pour du produit 12%** **- la Concentration 8%**	76	76.0	76.0	76.0
Faible (indifférent)	7	7.0	7.0	83.0
Inexistant	17	17.0	17.0	100,0
Total	100	100,0	100,0	-

3.1.3 LES TIC ET LA STRUCTURE CONCURRENTIELLE

Q.15 : Une minorité 25% pense que les Technologies d'Information n'ont qu'un faible impact sur la l'amélioration de la position de l'entreprise face à ses clients, alors que le reste (75%) pense qu'elles ont un vrai impact.

Tableau14. Apport des TIC dans la relation avec les clients

Echelle d'importance	Frequency	Percent	Valid Percent	Cumulative Percent
inexistant	6	6	6	6
Faible	19	19	19	25
Important	75	75	75	100,0
Total	100	100,0	100,0	-

Q.16 : La majorité pense que les technologies d'information ont un impact important sur le renforcement de la position de la société face à ses fournisseurs.

Tableau 15. Apport des TIC dans la relation avec les fournisseurs

Echelle d'importance	Frequency	Percent	Valid Percent	Cumulative Percent
Très Faible	9	9	9.0	9.0
Faible	12	12	12	21
Important	79	79	79	100
Total	100	100,0	100,0	-

Q.17 : La quasi-totalité juge que bien le rôle sérieux aux technologies de l'information dans la place favorable qu'occupe la CPGT par rapport à ses concurrents.

Tableau 16. Apport des TIC dans la relation avec les concurrents

Degré d'importance	Frequency	Percent	Valid Percent	Cumulative Percent
Inexistant	-	-	-	-
Faible	13	13	13	13
Important	87	87	87	100,0
Total	100	100	100	-

Q.18 : Face aux produits de substitution, le rôle principal des Technologies d'information est celui de la veille. Ainsi, les réponses sont partagées entre un faible rôle accordé aux TIC et un rôle important.

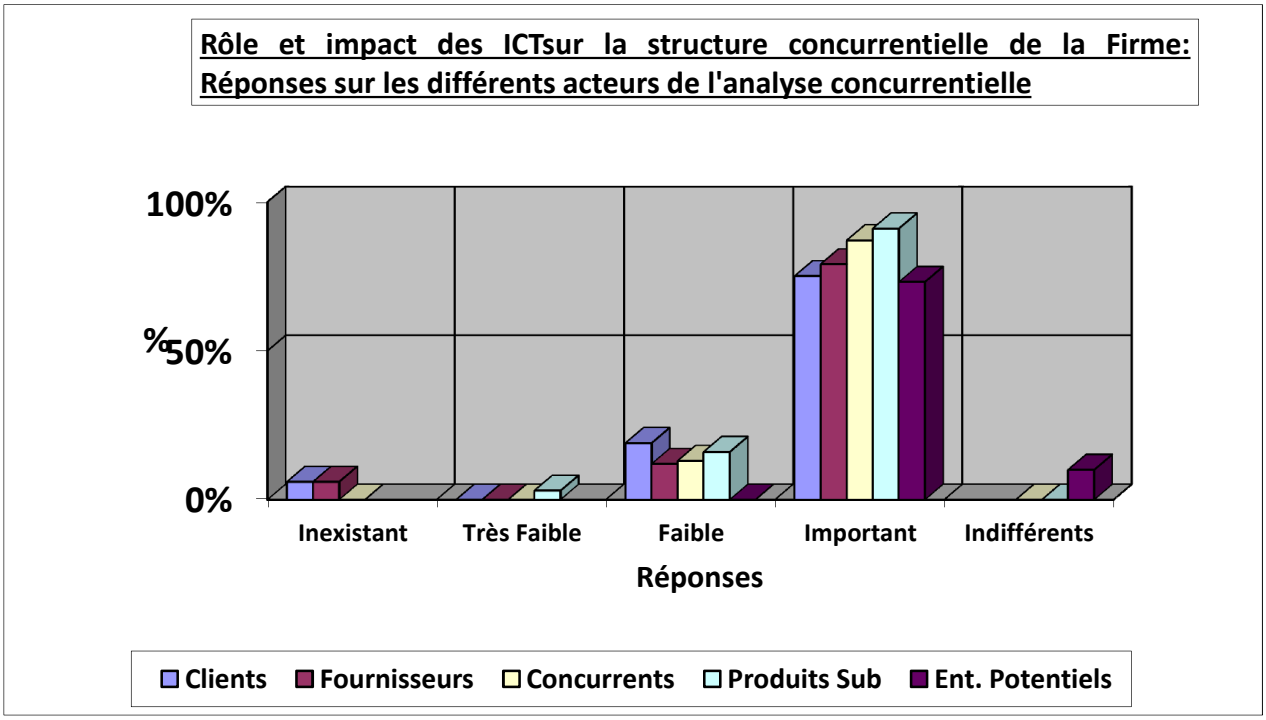
Tableau 17. Apport des TI face aux aux produits de substitution

Degré d'importance	Frequency	Percent	Valid Percent	Cumulative Percent
Très faible/ inexistant	3	3	3	3
Faible	16	16	16	19
Important	81	81	81	100
total	100	100	100	-

Q.19 : Les sujets sont partagés entre la contribution des Technologies d'information dans la favorisation d'une position convenable face aux entrants potentiels.

Tableau 18. Apport des TIC face aux entrants potentiels

Degré d'importance	Frequency	Percent	Valid Percent	Cumulative Percent
Important	73	73	73	73
intéressant	17	17	17	90
indifférent	10	10	10	100
Total	100	100,0	100,0	-



Q.20 : seul une minorité de 7% qui pense que les technologies d'information n'ont qu'un faible rôle dans la réalisation de la stratégie de l'entreprise à savoir la minimisation des coûts.

Tableau 19. Apport des TIC dans la réalisation de la stratégie de la société

Degré d'importance	Frequency	Percent	Valid Percent	Cumulative Percent
Important : - **la Mini des Coûts 81%** **- la Différenciation pour du produit 12%** **- la Concentration 8%**	76	76.0	76.0	76.0
Faible (indifférent)	7	7.0	7.0	83.0
Inexistant	17	17.0	17.0	100,0
Total	100	100,0	100,0	-

Q.21 : 100% pensent que la communication joue un rôle important dans le renforcement de la position de la société dans sa structure concurrentielle

Q.22 : 2% ont nié l'existence de moyens de communication pour un contexte stratégique, alors que les autres pensent que les seuls moyens existants sont l'Intranet, les réunions et les périodiques.

Tableau 20. Utilisation des moyens de communication nature des moyens de communication Cross tabulation

Utilisation des moyens de communication			Nature des moyens de communication utilisés				Total
			Intranet	Réunions	Périodiques	Missing System	
	oui	% of Total	98%	94%	62%	-	-
	non	% of Total	2%	6%	27%	11%	-
Total		% of Total	100%	100%	100%	11%	100,0%

Note: All tables (1-20) and graphics are taken, by first author, under Spss Statisctic 20.0 version.

3.2 INTERPRÉTATION DE LA RECHERCHE

3.2.1 INTERPRÉTATION CONCERNANT LES TIC

D'après les réponses précités fournies par les cadres interviewés tout au long de cette enquête dans cette grande Firme publique Minière Tunisienne CPGT, il apparait que les Technologies d'Information les plus utilisées au sein de cette Firme publique sont (à part ceux dites de la première génération technologique traditionnellement connues sous diverses formes pour toute entreprise comme : le Fax, le phone fixe, les PC personnels avec imprimantes, etc.) principalement l'intranet conçue comme plateforme interne facilitant la circulation de l'information et la communication entre les dirigeants et le cadres de cette Firme, l'internet est le deuxième outils de communication à haut débit le plus utilisé accessible à tous les personnels sans exception et aussi on parle ces dernières années d'un projet de plateforme extranet connu comme une nouvelle conception qui sera prochainement concrétisée essentiellement à facilité le lient avec les clientèles et les fournisseurs spécifiques de cette Firme, pour minimiser en quelque sorte les coûts des commandes régulières et le délais de livraison et sauvegarder les bases de données utiles.

La majorité des sujets enquêtés 89% ont prouvé que cette Firme Minière Tunisienne CPGT dispose d'une infrastructure informatique importante et qu'elle n'hésite chaque fois où il y a nécessité de moderniser ces outils bureautiques et aussi les équipements d'engins lourds d'extractions et de production. Toutefois, l'utilisation de ces diverses plateformes informatiques (Internet, intranet et l'extranet) pour le renforcement de la qualité de traitement de contrôle et de gestion de l'information, s'accompagne des formations régulières en TICs selon les besoins réels des cadres pour se familiariser à l'usage efficace et pertinent de ces nouvelles générations des technologies d'information et de communication, 92% des cadres interviewés ont jugés bien utiles ces cercles de formation en TICs soient par des formateurs internes ou externes de cette Firme.

Pour avoir plus de clarification et pour s'en enrichir par autres points de vue dans cette étude concernant l'effort et la stratégie d'investissement en TICs de cette Firme publique Tunisienne, on a rencontré certains dirigeants responsables des programmes de formation et ceux responsables des TICs, qui nous ont affirmé par leurs propres paroles :« […] malgré la situation actuelle qu'on connait tous de l'économie Tunisienne, la notoriété mondiale de notre Firme publique jugée saine selon les derniers rapports de Notations Fitich[32][…]En comparant notre Firme citoyenne Tunisienne dans son secteur d'activité par rapport à celles sur le territoire Tunisien ou celles étrangères, nul ne peut nier que la direction générale n'hésite plus lorsqu'il s'agit d'investir dans des Technologies de Communication et d'Information puisqu'elles sont considérées comme outils très utiles et sources de gains de compétitivité, malgré ces coûts élevés[…] nous s'appuyons à nos compétences humaines par nos ingénieurs pour créer des nouveaux Softs et de les développer pour que nous puissions ensemble se familiariser, de ce fait, on minimisera considérablement les couts d'acquisition des Softs[…] ».

Pour argumenter le discours des dirigeants de cette Firme, 79% des cadres s'aligne bien avec la stratégie de la direction générale, ont ajouté : «[…] c'est vrais que ces Nouvelles Technologies sont couteuses et alourdir l'états financière de notre Firme, mais rappelons bien qu'elles rapportent des gains de profit et atouts offensifs devant cette concurrence intensive mondiale dans ce secteur minier, où la demande mondiale s'est accentuée depuis la fin du 2008 jusqu'à l'heure actuelle […] un bel avenir pour cette industrie et notre Firme », montrant bien l'effort remarquable de cette Firme Tunisienne pour investir en TIC par la concrétisation d'un budget annuel spécifique pour la formation en TIC.

[32] *Fitich notes, 2006,2008,2009,2010,2011.*

En questionnant sur l'apport des TICs sur le management participatif, 74% des interviewés ont affirmé leurs présences dans l'élaboration des stratégies de recherches et développements (R&D) en TICs avec la direction générale et à l'implantation des différents systèmes de gestion des données DPS[33]. Ces bases de données, accessibles juste pour les personnels en question, sont codifiées sous précaution de sécurité d'informatique et évitant par suite l'accès des non Users, sauf sous autorisation[34] par la direction en question.

Ajoutant bien que les bonnes maitrises pour les outils TICs et les connaissances des bases informatiques, 92% des répondant suggèrent très utiles, contribuent bel et bien à soulever les diverses lacunes en ce matière sans se recourir à chaque fois à des spécialistes comme le cas des ingénieurs d'informatique. « Avec l'adoption de ces dernières innovations technologues, l'usage régulier de ces NTIC contribue à redéployer les différents taches et se remédier aux diverses problèmes survenus par des solutions adéquates en temps précis » ajoutant les cadre enquêtés.

Il apparait donc que la circulation de l'information et de communication au sein de cette Firme publique Tunisienne, en suivant la voie informatisée selon les diverses plateformes, est très privilégiée par les personnels de cette Firme, 92% préfèrent cet outil informatisé, car il raccourcit le temps de la divulgation de l'information et la réception des données et bien sûr la continuité avec les clientèles, les fournisseurs et être en état de veille sur les nouveaux entrants au marché, en générale.

En questionnant sur la place de la documentation papier avec l'adoption des TIC (comme les contrats acquisitions-ventes, les papiers circulants quotidiennement entre diverses directions – production, financière, commerciale - de la Firme), 52% des personnes interrogées sont pour ces supports papiers sans nier le support virtuel (par messagerie, Email,…etc.) en ajoutant qu'il s'agit d'un droit de réglementation réel entre les personnels et les clientèles ainsi que ces fournisseurs. Ce droit qui doit être concrétisé à main réellement entre les deux parties pour avoir ce que droit. Bien que les différents supports virtuels sont tenus pour facilité les échanges de ces supports papier, mais après confirmation des obligations et du droits des contraignants. « … il s'agit d'une complémentarité et une convergence réelle entre ces deux modes, moins qu'une rupture comme suppose la plupart » ajoutaient les cadres questionnés.

En questionnant sur le degré de la fiabilité de l'information reçue, plus de 91% jugent bien la transparence de l'information, chose impressionnante que la majorité des réponses sont en faveur la clarté et la fiabilité de l'information entre les différentes directions de la Firme à travers sa plateforme intranet (des mises à jour régulières du réseau intranet par la direction de gestion informatique, mais avec une collaboration de toutes les autres directions sans exceptions pour s'assurer de la fiabilité et la transparence des données enregistrées qui seront traitées et transmises par voie intranet à tous les utilisateurs du réseaux pour assurer la crédibilité des l'informations traitées). Vu que l'environnement économique est en mutation perpétuelle avec ces échanges des données et les innovations technologiques, La décision stratégique de la direction générale est de se rapprocher plus avec ses partenaires étrangers en ce secteur d'activité, bien évidemment ses clientèles et ses propres fournisseurs principalement étrangers par le biais d'une plateforme informatisée, dédié en ce matière connue comme réseau extranet, qui reforme tous les informations de communication utiles et qui raccourcit considérablement les délais et gain remarquable en terme du temps.

Une vue d'ensemble, sur l'apport et l'impact réel des nouvelles technologies d'information et de communication au sein de cette grande Firme publique tunisienne, montre bien ce rôle primordiale qu'occupe ces technologies d'informations au temps réel. Ces TIC ont un usage efficace voire même pertinent aux yeux des sujets questionnés, 89% de réponses, et ils seront par conséquence outils d'aide à l'élaboration de stratégie concurrentielle de la Firme.

3.2.2 INTERPRETATION CONCERNANT LA STRUCTURE CONCURRENTIELLE ET LES PARTS DE MARCHES MONDIALES

Pour s'informer sur la stratégie concurrentielle de cette Firme Tunisienne, qui opère depuis longtemps avec des partenaires principalement Européens, les dirigeants interviewés nous indiqués « … c'est vrais qu'on se base sur l'un des modèles de marketing, mais aussi sur les expériences étrangères en domaine de commercialisation qui sont très riches ces

[33] *Data projets Systems.*

[34] *Pour s'informer sur cette base DATA, malgré les pièces justifiant de permission d'accès, les informations recueillaient sont très insatisfaisantes, tenu compte que ces DATA sont très propres à la Firme touchant sa notoriété et qui doivent sous quels circonstances être divulguées par des tiers hors des personnels de la Firme, constituant une menace dans sa stratégie commerciale. C'est ce que nous ont justifié les personnels responsables de ces Bases de Données.*

dernières années… Pour notre Firme ont détient mais sans exception la démarche du Portère des 4P, mais notre vision stratégique c'est d'être en état de veille, s'armer des potentiels offensifs face au nouveaux entrants - le cas de l'Algérie en 2020 et l'Arabie-Saoudite en 2016– nous s'appuyons plus à l'effort remarquable de nos ressources humaines qui ont une expérience qui dépasse plus ceux nos voisins maghrébins dans ce secteur d'activité…. ».

En questionnant sur la crise mondiale et ses répercutions sur ce secteur qui est l'un des principaux nerfs de l'économie Tunisienne, ils nous ajoutent : « […] nous sommes, au contraire, plus optimistes malgré cette crise mondiale de 2008[35] et les perturbations sociales perverses de notre pays, […] les mains se serrent de nouveau pour acquérir d'autres parts des marchés Asiatiques, essentiellement, qui constituent un nouveau 'niche' vue la forte demande croissante qui nous parviennent par ces pays émergents Asiatiques pour la fertilisation de l'agriculture mondiale, en générale, bien que d'autres utilisations… ».

De point de vue stratégique, 62% des réponses des cadres, prouvent que cette Firme suit une démarche stratégique qui se base essentiellement sur la minimisation des couts, alors que 38% sont en faveur l'avantage qualité/prix. 41% des personnes enquêtés ont insistés sur la stratégie de partenariat et la coopération avec des Firme Internationale pour accentuer la position concurrentielle de la Firme publique Tunisienne, 55% les juge bien, pour saisir les opportunités commerciales qui constituent un facteur important générant un excédent de gains lorsque l'environnement mondial était en faveur. 83% des réponses convergent vers la même opinion de s'armer des nouveaux outils technologues pour la stratégie de diversification et de substitution des produits exportés et faire des segmentations stratégiques des parts de marchés sans perdre bien sûr les anciens parts. Cette stratégie renforce bien les forces concurrentielles de cette firme qui doit diriger vers sa cible à demande croissante, notamment la demande des pays émergents Asiatiques.

Concernant la position de la Firme envers ces clientèles, 90% des réponses pensent qu'il s'agit d'une stratégie de coopération avec les pays importateurs pour savoir leurs désires au produit minier Tunisien exporté et de les s'approcher plus pour les fidéliser. Ce qui à pour conséquence directe le renforcement des relations bilatérales avec ces pays importateurs.

Concernant la position de Firme envers ces fournisseurs, la quasi-totalité 97% de personnes questionnées a affirmé que la Firme maintient des bonnes relations assumées par la transparence et la crédibilité envers ces Fournisseurs sans distinction. Ce positionnement permet en conséquence d'exercer un pouvoir de négociation plus fort face à ses fournisseurs. Dans cette même perspective concurrentielle, 98% des réponses voient bien que leur Firme minière possède ses propres armes stratégiques face aux nouveaux entrants présumés à la future proche. Ces stratégies qui plaident en faveur cette firme (la Maîtrise des coûts de l'exploitation jusqu'à la commercialisation, le rapport qualité prix, les partenariats/ coopérations avec des Firmes de notoriétés Internationales le cas des Firmes Indiennes depuis 2008 pour la diversification et la valorisation de engrais fortement demandés pour l'agriculture mondiale, etc.) laissera à l'abri de toute crainte possible par ces nouveaux pays entrants.

Notant enfin, que la stratégie concurrentielle de cette Firme publique Tunisienne était en faveur la diversification du produit exporté, la segmentation stratégique des parts de marchés, la convergence entre la demande et la qualité du produit et la saisit des opportunités qui peuvent parvenir au marché mondial des engrais phosphatés comme était le cas de la forte demande en fin 2008. Tous ces critères doivent être bien menés, sous l'aide d'outils technologiques spécifiques, pour renforcer la stratégie concurrentielle de la Firme Tunisienne, en question.

3.2.3 INTERPRETATION CONCERNANT LES TIC ET LA STRUCTURE CONCURRENTIELLE

L'impact des technologies d'information et de communication sur la ré-modélisation de la structure concurrentielle de la Firme Minière Tunisienne peut être déduit d'après les deux premières parties du questionnaire. En effet, une utilisation efficace des technologies d'information ainsi qu'une clarté de la stratégie de la Firme font que ces nouvelles technologies ont vraiment un impact réel sur la relation de la Firme avec les différents acteurs de sa structure concurrentielle (confirmation empirique de l'hypothèse H1.). Cette déduction est confirmée par les réponses fournis à la troisième partie du questionnaire par les cadres.

[35] *Un gain très remarquable pour ce secteur, un triplement des cours vers la fin de 2008 pour tendre à un pic de 400$ le tonne du produit exporté au marché mondial des engrais phosphatés MMEP. Même après cette crise, les cours s'alignent à une moyenne de 150$ à nos jours. Donc un avenir de prospérité pour tous les pays miniers exportateurs Nord Africains, le cas de la Tunisie.*

Ces technologies d'information et de communication deviennent donc, selon les résultats fournis par la dernière partie du questionnaire (cf, tableaux des réponses ci-dessus), le moteur de la créativité de la Firme et comme source d'avantage concurrentiel agissant sur les forces de compétitivité[36] selon le modèle de Porter[37] (1985, 2001) et qui peuvent se déduire comme suit:

- Apport des TIC dans la relation de négociation avec les clients : 75% des réponses jugeaient cette relation forte, par le biais des Nouvelles Technologies, contre seulement 25% qui estiment moins important cet apport. Ceci est expliqué par le fait, que cette Firme fournit divers moyens de communication et de divulgation de l'information envers ses clientèles sans discrimination, ce qui a facilité remarquablement la tâche de commercialisation de la direction de marketing et négociations clientèles. Cette continuité est assurée par le biais d'une utilisation pertinente des outils technologiques[38], comme des plateformes d'informations pour la négociation avec les clientèles, qui sont en majorité des étrangers (Européens, Asiatiques et d'Amérique latine).
- Apport des TIC dans la relation de négociation avec les fournisseurs : la majorité (79% des personnes questionnées) affirme que les Technologies d'Information ont impact réel sur le renforcement du positionnement de la Firme face à ses propres fournisseurs, en ajoutant, « plus que la Firme investie bien en TIC, plus qu'elle oblige ses propres fournisseurs d'investir dans ces technologies compatibles à celles qu'elle possède ». Il s'agit donc d'un effet de causalité entre les deux parties en question. Par contre, une minorité d'environ 21% des réponses fournies s'oppose à cette contribution réelle des NTIC.
- Apport des TIC dans la relation avec les concurrents : en questionnant sur le positionnement concurrentiel de la Firme envers son environnent mondial où elle opère, une proportion remarquable de 87% des réponses soutient que la Firme occupe une position forte face à ses concurrents, alors que 13% accorde à cette relation le caractère de coopérative.
- Apport des TIC face aux produits de substitution : face aux produits de substitution, le rôle principal des technologies d'information est celui de la veille Stratégique. Ainsi, les réponses sont partagées entre un faible rôle accordé aux TIC et un rôle important. En effet, 81% des répondant confirme bien le rôle adéquat des TIC qui ont un pouvoir réel d'influencer la décision du clientèles de substituer un produit à un autre sur la base des rapports qualité-prix du produit fournit. Cela est possible soient par une diminution des prix, une amélioration des services ou aussi par une offre de nouveaux usages du produit en question. Contre 19% des réponses qui se répartissent entre très faible et faible cet apport des TIC aux produits de substitution.
- Apport des TIC face aux entrants potentiels : en partant de l'hypothèse que l'usage efficient des technologies d'information et de communication, conjugué à la présence régulière sur le marché mondial, peut limiter massivement les potentiels des nouveaux acteurs désirants pénétrer le jeux de l'offre et de la demande mondiales pour ses produits miniers fertilisant l'agriculture mondiale (le cas de l'Algérie en 2020, et L'Arabie-Saoudite moins éloignée en 2016), les sujets sont partagés quant à la contribution des technologies d'information dans l'occupation d'une position convenable face aux entrants potentiels. En effet, 73% des réponses confirment bien cette hypothèse, en affirmant que la Firme doit veiller à ses parts de marchés mondiaux et doit suivre l'évolution des offres et de demandes en s'armant à main de ces TIC. Celles-ci, en les maîtrisant tout au long du cycle de vie de la Firme, constituent par la suite, un obstacle devant les nouveaux futurs entrants. Alors que 17% et 10% des réponses sont respectivement, soit moins intéressées, soit indifférentes pour cet apport de positionnement extérieur par ces technologies.
- Apport des TIC dans la réalisation de la stratégie de la Firme : 76% des réponses significatives de l'échantillon jugent que les technologies d'information ont un rôle remarquable dans la réalisation de la stratégie de la Firme, à savoir : la minimisation des coûts, contre seulement 17% qui nient cet objectif, alors que 7% sont indifférents. 81% des réponses,

---

[36] *Hempell T., 2004, Productivity effects of ICT in German sevice sector, OCDE, déc.2004.*
Amabile S., Gadille M., 2003, les nouvelles technologies dans les PME : Stratégies, capacités organisationnelles et avantages concurrentiels, Revue Française e Gestion, vol 29, N 144, juin 2003, p 42-63.
Vacher B., 2002, dans quelle mesure les TIC jouent un rôle stratégique pour les PME, Revue Internationale PME, vol 15, N 36, p 36-58.
Rivard S., Talbot J. ? 1999, Une nouvelle arme stratégique : la technologie informatique, Le management Aujourd'hui, vol 28, Mai 1999, p57.

[37]

[38] *Propres services d'écoute clients du site web de la Firme, Messagerie, SMS, E-mail, Réseaux sociaux, Skype, autres réseaux web de communication, etc.*

estiment que cette stratégie vise à agir sur les coûts pour s'assurer que le produit vendu soit plus compétitif que celui des concurrents. 11% des réponses, soutiennent l'idée de proposer un produit ou un service perçu comme différent pour lequel les clients sont prêts à payer cette différence perçue. Tandis que 8% des réponses sont en faveur la concentration, qui s'explique par l'adoption de l'une des deux stratégies citées auparavant, tout en la concrétisant à un segment ou branche d'activité spécifique de la Firme. Toutefois, on a pu vérifier l'hypothèse selon laquelle, les TIC contribuaient remarquablement dans l'élaboration de la stratégie, principalement la minimisation des coûts de production de la Firme.

- ☛ Utilisation des moyens de communication comme outils stratégiques de transmission d'informations : seulement 11% des interrogés sont indifférents, alors que 88% ont souligné l'apport réel des divers moyens de communication pour l'amélioration du contexte stratégique de la Firme. D'une part, fort de constater que 98% de réponses se mettent d'accord quasi-totale de l'utilité ultime de l'internet comme vecteur stratégique déterminant de communication et de coopération des personnels. D'autre part, les réunions régulières occupent une place fondamentale au sein de la Firme avec un taux de réponse de 94%. Toutefois, les documentations périodiques, ainsi que le système d'information interne est de l'ordre de 62%, et présente aussi un rôle essentiel pour sauvegarder l'information et assurer la sécurité des data.

Ce rôle crucial et stratégique des TIC demeure indispensable, 76% des réponses ce rôle important, en affirmant qu'il s'agit d'un soutien remarquable, voire même primordial à la structure concurrentielle où elle opère, et au rythme de croissance de la Firme, en général. 71% des répondants ont expliqué que ce rapport de convergence est dû en fait aux résultats satisfaisants de l'usage efficace des ces nouvelles technologies, comparativement aux périodes antérieures à usage quasi-superficiel des Technologies. C'est ainsi que la Firme a enregistré, ces dernières années de la première décennie de XXIe siècle, une valeur ajoutée remarquable, ce qui lui a permis de renforcer sa compétitivité externe sur le marché mondial.

4 CONCLUSION

A nos jours, l'évolution et le progrès dans les technologies d'information et de communication sont parmi les plus surprenants. Ces technologies ne cessent de se développer en répondant de mieux en mieux aux besoins ressentis aussi bien par les particuliers que par les entreprises. Les domaines d'utilisation des TIC par ces derniers sont innombrables et leur potentiel ne connaît pas de limite. De plus, fort de constater que les TIC sont aujourd'hui considérés comme un outil majeur pour la construction de la compétitivité. Les entreprises qui gagnent sont celles qui savent établir des coopérations et des partenariats sur place et en ligne dans leur secteur d'activité, travailler en réseau, produire et utiliser collectivement les connaissances dont elles ont besoin pour générer ces parts de marché et être en état de veille pour toute menace imprévues des nouveaux entrants.

Plusieurs Firmes, le cas de la Firme Tunisienne tenue comme cadre d'étude, ont su profiter pleinement de ces technologies et en tirer un avantage stratégique qui devient de plus en plus difficile à acquérir. D'autant plus que ces entreprises évoluent dans un milieu caractérisé par l'instabilité et l'incertitude, où cette Firme ne fait pas l'exception. Dans cet environnement, la concurrence ne peut se limiter aux concurrents directs de l'entreprise. En effet, des Firmes opérant dans un secteur peuvent être attirées par la rentabilité d'un autre secteur et grignoter ainsi des parts de marché. La menace des produits de substitution est difficilement prévisible et peut causer la faillite de tout un secteur. Les fournisseurs et les clients exercent une pression permanente sur les entreprises, celles-ci doivent gérer cette charge avec beaucoup d'intelligence et de sagesse. Autant de facteurs et de variables ont rendu la tâche des entreprises si complexe et si délicate à nos jours du fait de l'exacerbation de la concurrence mondiale conjuguée par les dernières traces de la crise économique de 2008.

Dans ce contexte, le recours aux TIC semble être un moyen pour maîtriser et notamment contourner tous ces défis. Ce qu'on peut conclure, de cette étude sur cette Firme publique Tunisienne, c'est que l'ère des anciens systèmes d'information qui se contentent d'archiver et de stocker est en train de disparaître. Avec le développement technologique incessant et l'expansion de plus en plus large des réseaux électroniques, les TIC ne se sont pas fait attendre pour bénéficier de ce phénomène et ils constituent aujourd'hui une variable très importante dans la réussite de toute action stratégique visant un avantage concurrentiel, comme pour le cas de cette Firme.

Dans cette étude, sous la base des réponses de personnes envisagées dans cette enquête, nous avons pu montrer qu'allouer un tel objectif aux TIC n'est réalisable qu'avec une réelle attention accordée à ces Technologies et une synchronisation entre leur usage et l'objectif stratégique que vise cette Firme pour chacun des acteurs (clients, fournisseurs, partenaires,..etc.,) et sa structure concurrentielle. Ainsi, on a pu montrer que ces TIC jouent un rôle déterminant de communication entre la Firme et ces partenaires, aussi considérés comme un outil de dialogue (Magne, L & Lagrée, O.

2001)[39] permanent avec les clientèles et les fournisseurs. Ces derniers, sous la base des moyens de télécommunications, se sentent être des véritables partenaires voire même des propres acteurs associés à Firme, ceci se justifie par la convergence des réponses de la majorité des cadres de notre échantillon pour ce rôle.

Ces derniers ont argumenté leurs réponses en affirmant : « […] , bien entendu que notre Firme est la première à l'échelle nationale la plus ouverte depuis longtemps sur son horizon commercial et les marchés mondiaux. Pour que cette Firme puisse garantir d'accéder à de nouveaux clients importateurs de notre produit minier, aux nouveaux parts de marchés outres qu'Européens, aux fournisseurs professionnels, aux vrais partenaires internationaux, etc., il faut qu'elle soit à la hauteur de ces exigences et aux attentes de ses clients en premier lieux. A cet égard, l'adoption et l'usage efficace des TIC constitue une solution et outil majeur qui permet de faciliter et d'accélérer la communication interne et externes et accroitre par suite la productivité et l'avantage concurrentiel de la Firme en générale face à cette concurrence mondiale plus intense dans notre secteur d'activité Minière[…], »[40].

Il est vrai que l'investissement en TIC est couteux pour la Firme, comme nous affirment les dirigeants[41] de cette Firme Citoyenne Tunisienne et dépend des parts de financements (Bureautiques, Machines automatiques et engins, pièces automatisés assistées par ordinateurs…, etc.) importantes, mais en contre partie, les gains de productivités seront appréciables pour couvrir ces divers coûts.

Cette étude empirique nous parait aussi utile pour dévoiler l'impact réel des TIC sur la stratégie concurrentielle de cette Firme et son environnement mondiale de plus en plus dure où elle opère, mais ouvre d'autres chemins d'études futures plus approfondies totalement controverses, l'une porte sur l'impact positive des TIC sur la performance organisationnelle et e-managériale adoptée par la Firme afin d'approprier convenablement les opportunités offertes par ces technologies d'information. L'autre étude sur les effets négatifs présumés par le remplacement des Nouvelles Technologies la place des travailleurs (perte successives, ces dernières années, des postes d'emploi des mineurs de cette Firme en faveurs les machines assistés par ordinateur) et desserrement des formations de salarier en faveur le système d'information intégré.

Par ailleurs, Ce travail de recherche nous a permis de déceler la réalité de l'utilisation des TIC dans les entreprises tunisiennes à travers l'étude de l'une des plus importantes à l'échelle nationale qui est la Firme minière tunisienne CPGT. Cette étude nous a permis de dresser un tableau confrontant les hypothèses déjà traitées à la réalité du contexte de cette Firme minière leader en leur secteur d'activité.

Tableau 21. Validation des hypothèses

Hypothèses	Validation théorique	Validation pratique
H1.1 Les TIC sont devenues incontournables pour le bon fonctionnement d'une Firme.	oui	oui
H1.2 TIC peuvent aussi bien remplir des fonctions opérationnelles que de gestion.	oui	oui
H1.3 Le rôle des TIC peut évoluer d'un rôle de soutien à un rôle stratégique et à vocation concurrentielle.	oui	oui
H2.1 La structure concurrentielle d'une entreprise ne se limite pas aux seuls concurrents du secteur mais peut être étendu vers d'autres acteurs.	oui	non
H2.2 Plusieurs stratégies peuvent être utilisées pour faire face aux acteurs de la structure concurrentielle.	oui	oui
H3.1 Les TIC contribuent à la remodélisation et la redéfinition des rapports de force entre la Firme et sa structure concurrentielle.	oui	non
H3.2 Les TIC sont un moyen efficace pour réussir la stratégie mise en œuvre par la Firme.	oui	oui
H3.3 Les TIC, avec leur pouvoir de diffusion, peuvent influencer les actions futures des acteurs concurrentiels et promouvoir une stratégie efficace au sein de la Firme.	oui	oui

[39] Magne, L. & Lagrée, O., 2001, 'e-management, comment les nouvelles technologies transforment le rôle du manager', Dunod, 2001, p.116.

[40] Suite du discours d'interviewés en rapport à l'usage des TIC et les impacts réels à la stratégie concurrentielle de la Firme.

[41] En questionnant sur les coûts énormes en TICs et l'incertitude possible de ces outils qui pèsent lourds au budget financière de la firme.

Ce tableau nous a permis, en tenant compte du résultat de la recherche sur le terrain et des entretiens avec les responsables sur l'orientation stratégique de cette Firme à moyen et long terme au niveau de l'infrastructure technologique et informationnelle ainsi qu'au niveau concurrentiel, de dégager un plan d'action stratégique articulé autour des axes suivants :

- **Axe stratégique N°1 :**

  Procéder à un diagnostic du système d'information en place et détecter les anomalies.

- **Axe stratégique N°2 :**

  Procéder à l'élaboration d'un plan de réforme en renforçant les liens entre la fonction informatique et les autres fonctions de la société.

- **Axe stratégique N°3 :**

  Maîtriser les atouts stratégiques des technologies de l'information et en profiter de manière à améliorer la position concurrentielle. Il faut d'une part que l'utilisation de ces technologies au niveau interne soit au point et d'autre part qu'un plan de formation et de sensibilisation du personnel soit mis en place pour atteindre cet objectif.

- **Axe stratégique N°4 :**

  L'élargissement de l'architecture informationnelle de la Firme de façon à toucher tous les cadres et personnels dans un premier plan et les partenaires de la Firme minière dans un deuxième plan.

- **Axe stratégique N°5 :**

  Développer un meilleur contact et une plus large communication entre le personnel et les hauts cadres de la société de façon à n'exclure aucun employé dans le processus de formulation-formalisation des orientations stratégiques.

REFERENCES

[1] Amabile S., Gadille M., 2003, «les nouvelles technologies dans les PME: Stratégies, capacités organisationnelles et avantages concurrentiels», Revue Française e Gestion, vol 29, N 144, juin 2003, p 42-63.
[2] Aoki M., 1990, «Toward an economic model of Japanese Firm», Journal of economic litterature, mars. 1990.
[3] Armiger. W.H et M.Fried., 1957, « The plant availibility of various sources of phosphate rock». Soil science society of America proceedings, V2. 1957. P24.
[4] Barrett S., Konsybski B., 1982, «inter-organization information sharing systems», management information systems quaterly, n° 5.
[5] Blanchet A., et Gotman A., 1992, « l'enquête et ses méthodes : l'entretien ». Paris, Nathan.
[6] Blanchet A., et Gotman A., 2007, « l'enquête et ses méthodes : l'entretien ».(2e éd.) Paris, Armand Colin.
[7] Bayart D., Berry M., 1988, « Pour une automatisation raisonnable de l'industrie», Annales des mines, numero special, janvier.1988.
[8] Benghozi P.J., kavassalis P., et solomon R-J., 1996, « Open standards and interoperability : new learning models for electronic communications», revue d'économie industrielle, n° 75, 1 er trimestre.
[9] Bernasconi M., 1996, «Les systèmes d'information organisationnels sont-ils toujours source d'avantages concurrentiels durables ?", système d'Information et Management, vol. 1, n° 1.
[10] Brousseau E., Rallet A., 1995, «Efficacité et inefficacité de l'organisation du bâtiment : une interprétation en termes de trajectoires organisationnelles», Revue d'Economie Industrielle, n° 74.
[11] Brousseau E., et Rallet A., 1997, «TIC et organisation générale de l'entreprise", in La "Révolution Informationnelle" : Technologies de l'Information et Dynamique du Système Productif», document de travail ATOM, IRIS.
[12] Bussler L., et Davis E.,2002, « Information system : The quiet revolution in human resource management », Journal of Computer Information System, Vol124, 2002, p.17-18.
[13] Cette, Gilbert & Mairesse, Jacques & Kocoglu, Yusuf, 2005. "Effets de la diffusion des technologies de l'information sur la croissance potentielle et observée," L'Actualité Economique, Société Canadienne de Science Economique, vol. 81(1), pages 203-230, Mars-Juin.2005.
[14] Chandler A.J., 1962, «strategy and structure", in history of the industrial enterprise.1962
[15] Ciborra C.U., et Jelassy T., 1994, «Strategic information systems: an European perspective», Wiley. 1994.
[16] Consul Study, 2000, « ICT impacts on te industry Firms cometitivity », OCDE, 2000.
[17] CPGT, Mars 2008, Déc2011. Cente de Documentation.

[18] David P.A, 1990, « the dynamo and the computer : an historical perspective on the modern productivity paradox», American economic review, n° 80 (2). 1990
[19] Desbien J., 1998, « comment augmenter la productivité dans le secteur public », Revue Internationale de Gestion, Vol 36, 1998, p. 62
[20] Duchesne S., et Haegel F., 2008, « L'entretien collectif : l'enquête et ses méthodes » (2e éd.). Paris, Armand Colin.
[21] Fitich notes, 2006,2008,2009,2010,2011.
[22] Greenan N., Mairesse J., & Topiol, A., 2001, « Information technologie and research an development impacts on productivity and skills : looking for correlations on Franch Firm level Data » OCDE, 2001.
[23] Gera S., et Gu W., 2004, « Effets des innovations organisationnelles et des technologies de l'information sur le rendement des Entreprises », Analyse microéconomique, Stata Canada, 2004.
[24] Hart P., Estrin D., 1991, « inter-organizational networks, computer integration and shifts in interdependance : the case of semiconductor industry», ACM transactions on information systems, vol. 9 n° 4, octobre.1991.
[25] Hempell T., 2004, « Productivity effects of ICT in the German service sector» OCDE, Sep, 2004.
[26] Howells J.R.,1995, « going global : the use of ict networks in research and development», research policy, n° 24.
[27] Jacob R., 1999, « Anatomie d'une rencontre de 3e type : gestion stratégique de l'interrelation entre les personnes, les NTIC & l'organisation », Colloque management technologique, Groupe ESC Grenoble, 14-17 Déc. 1999. France
[28] Jacques M., & Cette G.,& Yussuf Kocoglu, 2000. « Les technologies de l'information et de la communication en France : diffusion et contribution à la croissance », Économie et Statistique, Programme National Persée, vol. 339(1), p.117-146.
[29] Johnson H.R., Vitale M.R., 1988, «Creating competitive advantage with inter-organizational information systems», mis quaterly, juin. 1988.
[30] Jonsher C.J., 1999, «An economic study of the information revolution. the corporation of the 1990's : information technology and organizational transformation », oxford university press.1999.
[31] Leeuwen G., Hempell T., et Wiel., 2002, « ICT, innovation and business performance in services: Evidence for Germany and the Netherlands», OCDE, Mai. 2002.
[32] Mayerer A., 1999, « Les effets de l'introduction d'outils d'information et de communication mobile dans l'entreprise », revue Française de gestion, mars-avril-mai 1999, 11.
[33] Marmuse C. 1997, C Performance », Encyclopédie, Editions d'organisation, 1997, Paris, p.21.
[34] Mallet Poujol, 1998, Nouvelles technologies de l'information et libertés individuelles », Doc Francaise, juillet 1998.
[35] Kambil A., 1991, «Information technology and vertical integration : evidence from the manufacturing sector», electronic services networks : a business and public policy challence, guerin calvert & wildman (eds.), praeger, new york.
[36] Kauffmann J.R., Weill P., 1989, «An evaluative framework for reasearch on the performance effects of information technology investment», tenth international conference on information systems, proceed. 1989.
[37] Keen P., 1988, «Competing in time: using telecommunications for competitive advantage», ballinger press, cambridge. 1988.
[38] Mallet Poujol, 1998, Nouvelles technologies de l'information et libertés individuelles », Doc Francaise, juillet 1998.
[39] Magne, L. & Lagrée, O., 2001, « e-management, comment les nouvelles technologies transforment le rôle du manager », Dunod, 2001, p.116.
[40] Mingasson M., 2000, « Informatique et stratégie d'entreprise : Architecture et pilotage des systèmes d'information », éd Dunod, 2000, 272.
[41] Payette A., 1989, « efficacité des gestionnaires et des organisations, » les editions d'organisations, paris,1989, p7.
[42] Paillé P., et Mucchielli A., 2003, L'analyse qualitative en sciences humaines et sociales ; Paris, Armand Colin.
[43] Peaucelle J-L., 1999, « Systèmes d'information, le point de vue des gestionnaires », éd Economica, 1999, 237.
[44] Porter M.E., 1982, « Choix stratégiques et concurrence », éd Economica, 1982, 426.
[45] Porter M.E, 1997, « L'avantage concurrentiel », 1ere édition, édition DUNOD, 1997, 647, p.14
[46] Porter.M.E et Millar.V.E, 1985, « How information gives you competitive advantage », Harvard Business Review, N°4, august 1985, p.12.
[47] Payette A., 1989, efficacité des gestionnaires et des organisations, les éditions d'organisations, paris,1989, p7.
[48] Perm D., 1993, « l'impact de nouvelles technologies », Editions d'organisation, 1993, Paris, p.52.
[49] Rivard S., Talbot J. ? 1999, Une nouvelle arme stratégique : la technologie informatique, Le management Aujourd'hui, vol 28, Mai 1999, p57.
[50] Reix.R, « Systèmes d'information et management des organisations », 3e édition, édition Vuibert, 2000, 426 p,
[51] Savoie-Zajc L., 2010, « L'entrevue semi-dirigée ». Dans B Gauthier (Ed.), recherche sociale. De la problématique à la collection de données. p 337-361. Québec, Presses
[52] Scott Morton Michael S., 1995, « L'entreprise compétitive au futur : Technologies de l'information et transformation de l'organisation », Editions d'organisation, 1995, 349p.

[53] Shapiro C. et Varian H.R., 2001, « Economie de l'information : guide stratégique de l'économie des réseaux », éd DUNOD, 2001, 313p.
[54] Stoiarick K., 1999, « IT spending and Firm productivity: Additional evidence frome the manufactoring Sector », OCDE, Spg 1999.
[55] Thiétar.R. A.,1999, « Méthode de recherche en management », Dunod Paris 1999
[56] Villarmois O., 1998, « Le concept de performance et sa mesure », Acte des XIVe Journées des IAE, Nante, Vol 2, p.199-216.
[57] Villarmois O., 1998, « Le concept de performance et sa mesure », Acte des XIVe Journées des IAE, Nante, Vol 2, p.199-216.
[58] Vacher R., 2002, « Dans quelle mesure les Tic jouent-elles un rôle stratégique pour les PME », revue Internationale des PME, Vol 15, N° 364, p 37-61.
[59] Zghal. R, « Méthodologie de recherche en sciences sociales », édition Contribution à la littérature d'entreprise, 1992, 120 p.63

International Journal of Innovation and Scientific Research
ISSN 2351-8014 Vol. 10 No. 1 Oct. 2014, pp. 218-231

http://www.ijisr.issr-journals.org/

INVESTIGATING THE FEASIBILITY OF IMPLEMENTING E-VOTING SYSTEM IN GHANA

Samuel Agbesi[1], Fati Tahiru[2], and Alexander Osei-Owusu[3]

[1]Information Technology Masters Student,
Kwame Nkrumah University of Science and Technology,
Kumasi, Ghana

[2]Information Technology Masters Student,
Kwame Nkrumah University of Science and Technology,
Kumasi, Ghana

[3]Research Coordinator, Graduate School,
Ghana Technology University College,
Accra, Ghana

ABSTRACT: E-Voting has been attracting a lot of interest in the country and has been a subject for discussion in various media during the past years after elections. The current method of voting during general elections in Ghana is through paper base voting which comes with a lot of problems ranging from delay in voting resulting in long queues, double voting, result manipulations, spoilt votes due to wrong thumb-printing and delay in declaring results. To study seeks to investigate the feasibility of e-voting implementation in Ghana. The findings of this research will likely generate greater awareness about the e-voting system in Ghana and also provide useful knowledge to stakeholders about the benefit of e-voting system and also provide useful knowledge in policy formulation concerning Ghana elections. The study adopted mainly exploratory and descriptive analysis as well as a combination of qualitative and quantitative data collection approaches. Purposive and simple random techniques were used in selection and administering of questionnaires to employees of Electoral Commission and the voting population from selected regions in Ghana. The result of the findings shows that for e-voting system implementation to be successful, Government must show strong commitment to provide support by securing donor fund to improve on the existing infrastructure and provide the needed resources to support the successful implementation. The study also shows that Government need to improve infrastructure in most part of the country and Electoral Commission should also embark on educating the people on e-voting and creating awareness. It was recommended that e-voting for now should be implemented on pilot basis and run alongside paper voting until infrastructure is available nationwide.

KEYWORDS: E-Voting, DRE, I-Voting, EC, GEVS.

1 INTRODUCTION

Electronic voting, also known as **e-voting**, is a term which includes several different types of voting, that is electronic means of casting a vote and electronic means of counting votes. An electronic voting (E-Voting) system is a voting system in which the election data is recorded, stored and processed primarily as digital information. Sanjay et al (May 2011) also define e-voting as any system where voters cast their vote using an electronic system instead of paper ballot. Sanjay further explained that this electronic vote which is stored digitally is transferred from voting system to a counting system. E-Voting can be seen as a better form of voting as it eliminates several drawbacks in the traditional voting system. But Randolph C (2004) explain that even though e-voting system plays important part in the general election process, there are several other important factors that will contribute to the overall success of an election and this include processes, people and technology.

Corresponding Author: Samuel Agbesi

The current method of voting during general elections in Ghana is through paper base voting which comes with a lot of problems ranging from delay in voting resulting in long queues, spoilt votes due to wrong thumb-printing and delay in declaring results. Ghana has held eight (8) successful presidential elections after independence, but always issue of vote rigging and the credibility of the results becomes an issue. **(**Nana Karikari-Apau, 2012). These concerns arise from the fact that people don't have trust in the current paper base voting system. The current paper base system is perceived to give room for manipulation of votes by officials at various polling stations and also at the collation centers.

Also other issues faced with paper-based voting in Ghana are the perception of political opponents stuffing the ballot boxes with already voted ballot papers, and delay in counting after vote has ended. These concerns are the main initiator for the investigation into a possible electronic voting system implementation for subsequent elections in Ghana. As stated in Aviel D. Rubin (February 27, 2004) report, elections allows the citizen to select their people who they deem fit to represent them. Naturally, the integrity of the election process is fundamental to the integrity of democracy itself. He further stated that any system that is design for election must be a system that can withstand any attack, and also must be a system which the voters can accept and the various candidates can accept the election results without any dispute. But most often elections are being manipulated in order to influence their outcome. The researcher in this light intends to research into the feasibility of adopting e-voting system in Ghana national elections, and identify any potential challenges and benefits of e-voting implementation, and to determine if available ICT infrastructure can support nationwide e-voting implementation.

Several research works has been carried on E-Voting to remedy the problems associated with normal paper base voting in various countries. Most countries and politicians are proposing for some form of electronic voting system and they see a lot of possibilities in this new phenomenon. Their arguments is on the fact that E-voting will be the cheapest more efficient and quickest way of managing elections as well as vote counts. They also argue that it will increase voter turnouts and reduce the long queues during voting periods (Stănică-Ezeanu, C. "e-Voting Security", 2008). In addition, Kim K (2007) explains in his article that e-voting using internet does not require geographical proximity so far as you have internet access you can vote anywhere. E-voting system are used for elections in various countries with the sole aim of reducing voting errors such as thumb printing wrongly to invalidate the vote and to make counting faster after votes has ended (Sanjay Kumar et al, 2011). Hence implementation of e-voting in Ghana elections will aid in minimizing elections irregularities and voting populace and the various political parties will have faith in the elections results. The researcher's main concern will be to discuss the feasibility of the implementation of voting electronically using a dedicated machine at polling stations or in controlled environment termed as a Direct Recording Electronic (DRE) voting systems and remote voting via Internet termed as I-Voting.

Direct Recording Electronic (DRE)

DRE voting system as define by Dieterich, E. is any computer device that consists of a touch-screen monitor, a permanent storage medium such as a write-once memory card, and software, Congressional digest report (November 2006) by Eric A Fischer also explain DRE as any computer device that records votes directly onto a computer memory device. Randolph, C. (2004) explained that DRE voting systems was first introduce in the 1970's where votes were recorded electronically without paper ballots, and about 12% voters used this technology in 2000 US elections and 29% in 2004 elections. Furthermore he did point out that DRE comes in two types, that is the push button and the touch screen with the latter being the latest technology. Ballot information is displayed electronically on the screen which allows voters to make their choice of candidate to vote for. Ballot information or the voting program is programmed onto a chip or a storage medium which is installed into the DRE machine. Randolph, C, (2005), further stated some of the latest DRE systems use a smart card that can be used by voters for authentication. DRE voting system records votes and after voting, produce a tabulation of all votes cast stored on an internal memory. It can also provide means of transmitting the vote cast onto a central location via public network. Even though DRE system offers a lot of benefits there have been several debates about exiting security vulnerabilities and hence has recommend for the DRE system to provide paper printout after voting to confirm that their vote were cast correctly to prevent any voting fraud (Congressional Digest. Nov, 2006), and this approach was termed as VVPAT (Voter-verified paper audit trail).

Dieterich, E. also expressed similar concerns, he stated that DRE systems are subject to various risk notable among them are:

- Software errors that can affect the voting pattern which can bring the whole election process into a halt
- Fraud – whereby a fraudulent code when install into the machine can compromise the vote cast to favor one candidate

But Eric A Fischer was with a different opinion. He was of the view that even though some researchers has raise some security concerns about DRE, those security flaws are not known to have compromise any elections and also has not affected any elections integrity. He further stated that there are different models of DRE in current use and they vary substantially in

their design, hence any problem that may exist in one model may not occur in others. He argued that most of these problems are procedural but not weakness in the technology. He was clear that most of the elections problems encountered in the 2004 US elections were not associated with DRE's (Eric A. Fischer, 2005).

Remote Voting System Using Internet (I-Voting)

Another area of e-voting that has gain lot of discussion is Internet Voting known as I-Voting. I-voting can be defined as a remote voting process through the internet from an unsupervised location. Gibson (2002) also defines I-Voting as a process of casting a secure and a secret electronic ballot that is transmitted over the internet to officials. As further stated in Gibson (2002) research, I-Voting is a new phenomenon which has not being used in legally binding elections until 2000 when Arizona Democratic Party held its primary election online. Several research works has gone on in this area and more academic scholars are still researching into it. Notable among them are Mohammed Awad, Ernst L. Leiss, (2011). They believe that I-voting can provide ease to elderly citizens and people with disabilities. Also their believe is that the convenience that the internet offers will attract young voters, and hence increase voter turnout.

But the main issue with I-Voting had to do with security. Various researchers believe I-voting can be considered as another voting option if it can provide same security as the main traditional voting methods (Mohammed Awad, Ernst L. Leiss, 2011; Jefferson, D., Rubin, Aviel D., Simons, B., Wagner, D, 2004). They doubt that the current internet infrastructure is cable to support this option of e-voting. Even though I-Voting has become a major discussion subject in the Information Technology field, but because of public distrust of I-Voting (Internet Voting) and various security threats associated with it various countries that tried to implement it are taken a second look at it. In 2004 the US Department of Defense canceled their internet based voting system called SERVE (Secure Electronic Registration and Voting Experiment) because of security concerns raised. (Jefferson, D., Rubin, Aviel D., Simons, B., Wagner, D, 2004).

SERVE is an internet-based voting system built for the US Department of Defense FVAP (Federal Voting Assistance Program). FVAP's mission was to reduce voting barriers for all citizens of US oversee, that is US military service personnel and their families and non-resident US citizens. SERVE has much vulnerability and security threats, notably among them are Cyber-attacks (DOS attacks, spoofing, and virus attack on voter PC), any of these attacks can put the voting into disrepute. With internet voting also there is a great risk of outsiders hacking into the system as well as enemies, there could be vote buying and selling as well as reversing an outcome of an election (Jefferson, D., Rubin, Aviel D., Simons, B., Wagner, D, 2004).

2 OBJECTIVES

The main objectives of this research is to investigate the feasibility of implementing e-voting system in Ghana's national elections.

The specific objectives are:

- To identify the potential benefits for e-voting implementation.
- To identify potential challenges of e-voting system implementation.
- To determine whether the current ICT infrastructure can support e-voting
- To investigate whether e-voting will be the preferred voting technology by voters.

3 METHODOLOGY

For this study the researcher adopted descriptive and exploratory research methods. Descriptive research method was selected because it will help to have a clear picture of the phenomena on which data will be collected. With descriptive research the researcher gathered fact about events through surveys and observations. The aim of this research is to investigate e-voting system and their suitability for national elections and also to identify the likely challenges for e-voting implementation and potential benefits, hence descriptive method was the appropriate method since it allows both quantitative and qualitative data collection and data analysis. For this research the researcher analyzed case-studies of various electronic voting systems from various countries to have deeper understanding of how it works, its security implications, challenges and benefits. With Exploratory method, the researcher also reviewed literatures on the subject area and conducted interviews with EC staff to clarify his understanding of the e-voting adoption requirements. Experts in the area of e-voting were interviewed, this include the research department of the Electoral Commission (EC), IT department of EC and Technical department of Expresso Telecom GH.

Both quantitative and qualitative data collection and analysis techniques was used. Qualitative techniques was first used to gain in-depth understanding of the problems associated with voting by interviewing top EC officials and to get their views

on the adoption on e-voting. Secondly since the researcher want to get the opinion of a larger population of voter's quantitative methods through questionnaires was appropriate. The quantitative method help the researcher to obtain responds from a larger sample from the population of interest and this also gave the respondents ample time to respond. The population for this study consists of the entire group of eligible voters across Greater Accra, Central, Western, Eastern, Ashanti, Volta and Brong-Ahafo region who are 18 and above, and are citizens. It also include Top management and Technical staff from Electoral Commissions, and Network/Software engineers from Expresso Telecom.

The sampling method adopted for this study was simple random and purposive sampling technique. Simple random sampling techniques gives each member of the population an equal chance of being chosen and this helped achieve the needed information (Neville, H., Sidney,T. 20 June 2005). Purposive sampling allows the researcher to select the particular participant for specific information needed. The researcher adopted this sampling method for the selection of EC top officials and other staffs who has direct relation with the organization of elections as well as selected staff of Expresso telecom with ICT background. The sample size was 278, which comprised of voters from Greater Accra, Ashanti, Central, Eastern, Western, Brong-Ahafo and Volta region, as well as Top management and technical staff of EC head office in Accra as shown in Table 1.1. These companies were grouped into departments and units and specific staff base on their knowledge in specific fields were selected and interviewed, and others were randomly selection to responds to the close-ended questions. Qualitative and quantitative procedures were used to analyze the data collected during this study. The Statistical Program known as **SPSS** was used to analyze the quantitative data which was generated from the questionnaires and the result was presented in tables using frequencies and percentages. Microsoft Excel was used to generate graphs from the results of the respondents.

Table 1.1 – Questionnaire distribution to EC and Voting population

	Top management, Research and Technical Department of EC Office Accra	Voting Population
Number of questionnaires distributed	22	300
Number of responses	22	256
Response rate (%)	100	85.3

4 RESULTS AND DISCUSSIONS

This section presents the results of findings and analysis of the field data in line with the research questions and objectives. The findings have been analyzed in frequency tables and charts**.**

Objective 1: To identify the potential benefits for e-voting implementation

From figure 1 and figure 2 below, the potential advantages has been grouped and ranked and it can be observed that the highest rank of the benefits are e-voting eliminating voting errors, eliminating delays in vote counting and speeding up voting process.

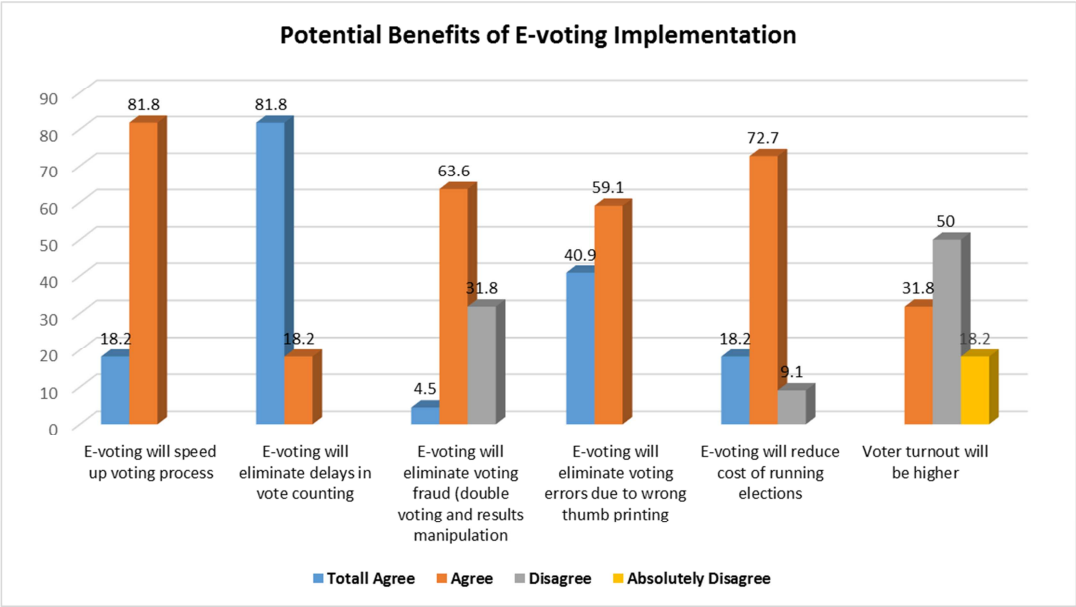


Figure 1- Potential Benefits of E-voting Implementation (Source: Fieldwork, 2013)

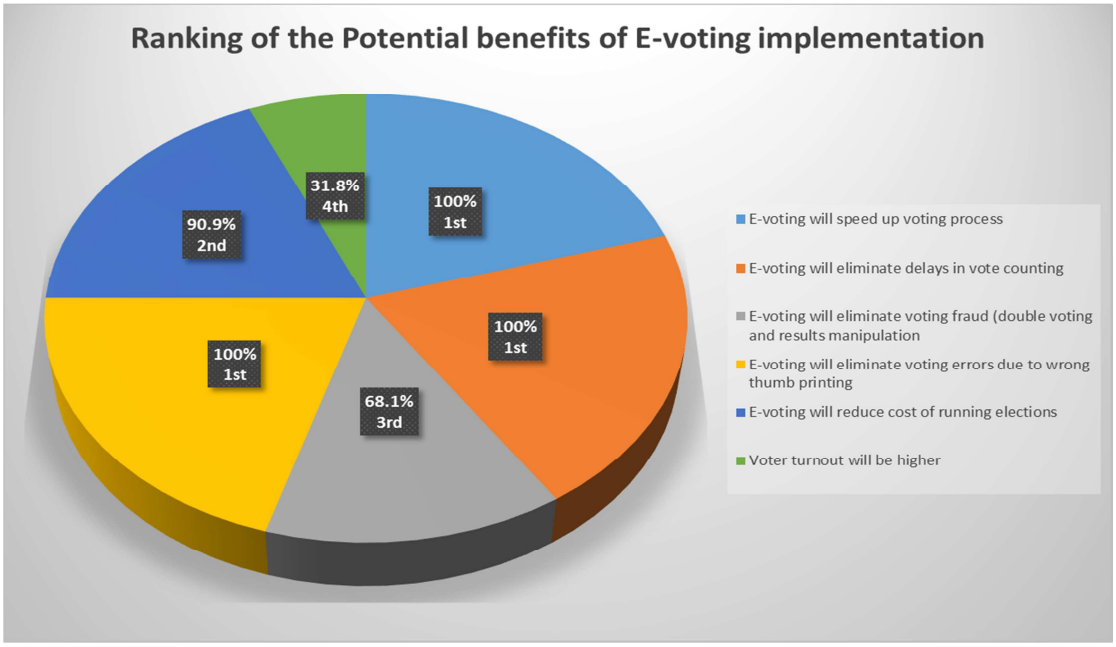


Figure 2 - Ranking of the Potential Benefits of E-voting Implementation (Source: Fieldwork, 2013)

Objective 2: To identify potential challenges of e-voting system implementation

The challenges has been grouped into technical challenges and general challenges. Figure 3 and 4 shows the technical challenges that are likely to surface if e-voting is implemented. Base on the ranking it was obvious that power outages to disrupt elections has the highest ranking. This is due to the fact that most of election polling centers has no efficient electricity power. This was followed by Security issues and unstable communication link on Election Day.

For the general challenges as shown in figure 5 and figure 6, it can be observed that the challenges raked highest is the difficulty of the use of the e-voting system due to higher illiteracy rate in the country, this was followed by how voters will confirm their vote cast and the cost of the e-voting implementation.

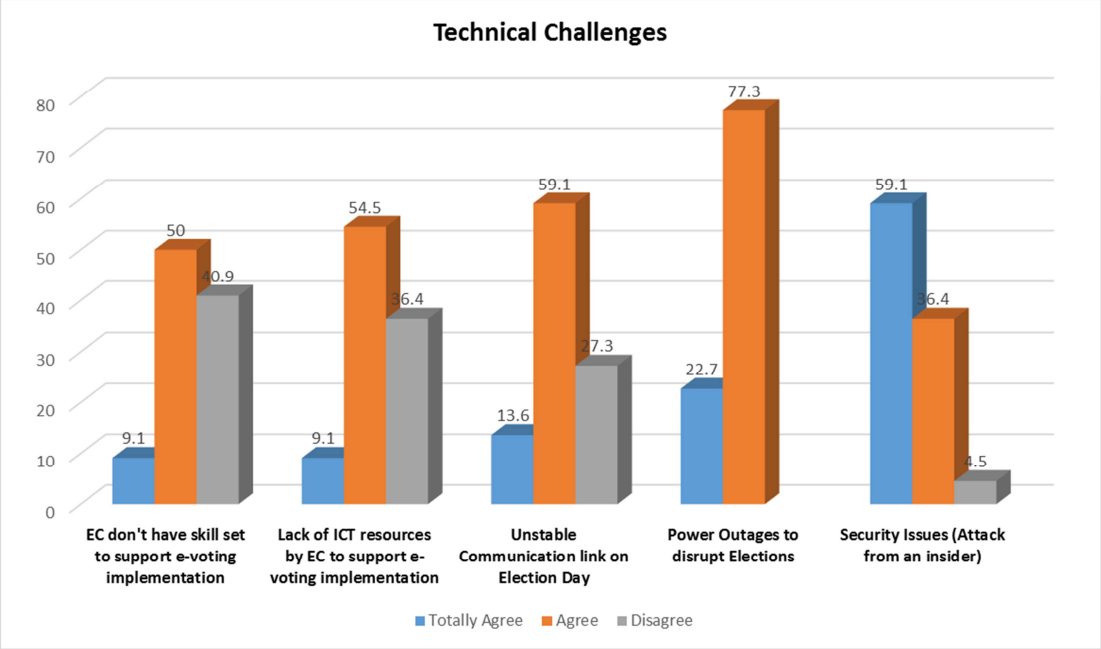


Figure 3 – Technical Challenges (Source: Fieldwork, 2013)

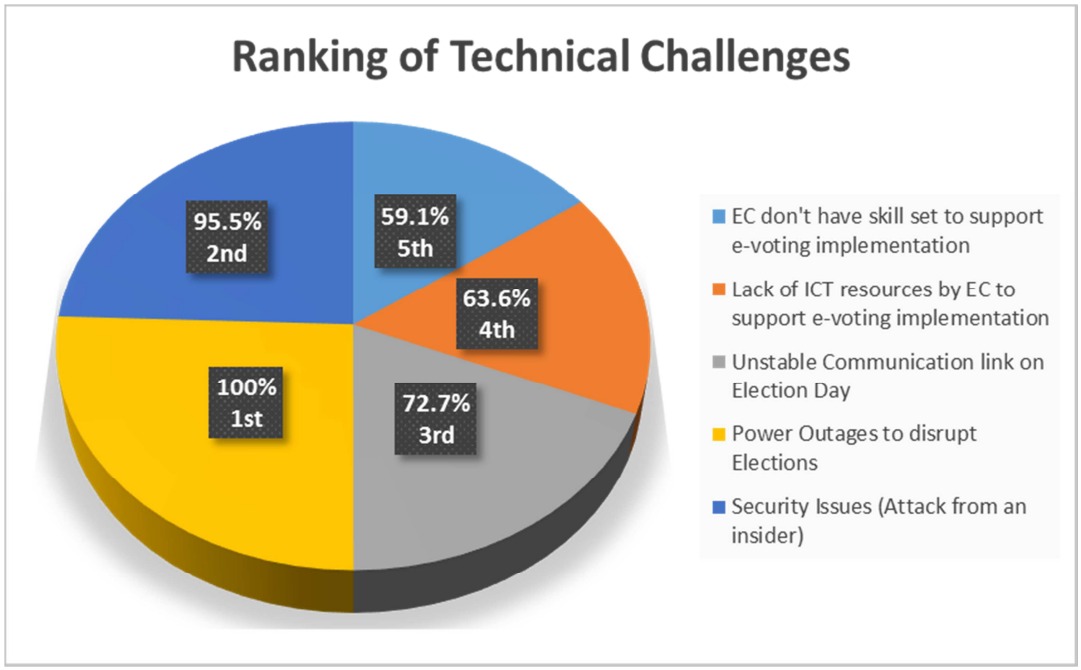


Figure 4 – Ranking of Technical challenges (Source: Fieldwork, 2013)

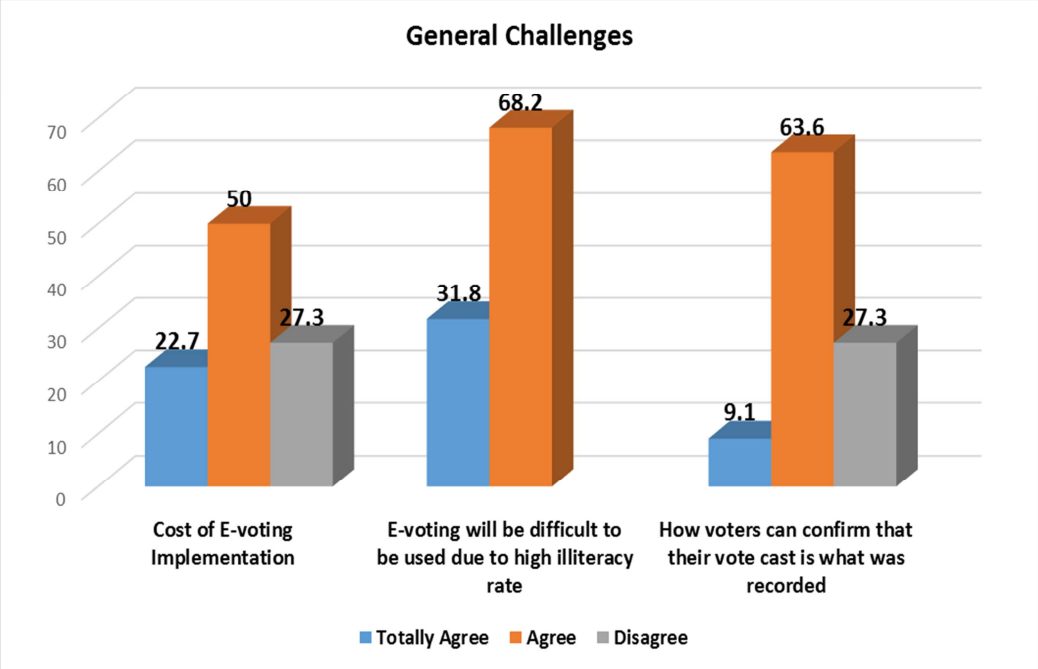


Figure 5 - General Challenges (Source: Fieldwork, 2013)

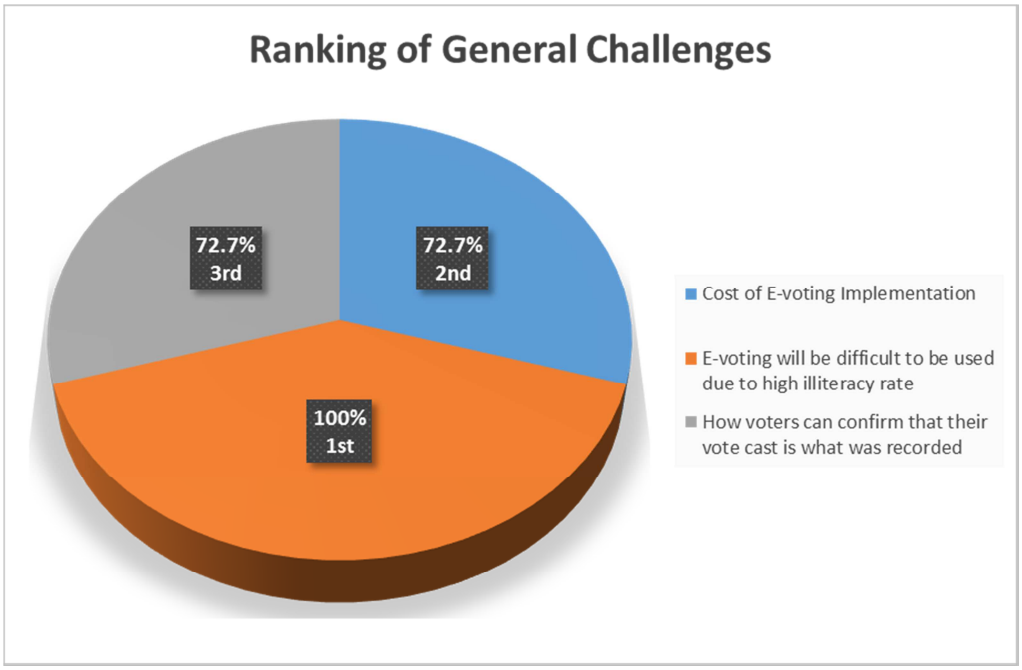


Figure 6 – Ranking of general challenges (Source: Fieldwork, 2013)

Objective 3: To determine whether the current ICT infrastructure can support e-voting

From figure 7, it is believed that the current ICT infrastructure cannot support nationwide e-voting implementation. The electoral commission believes that this infrastructure have to be improve to allow for nationwide e-voting adoption.

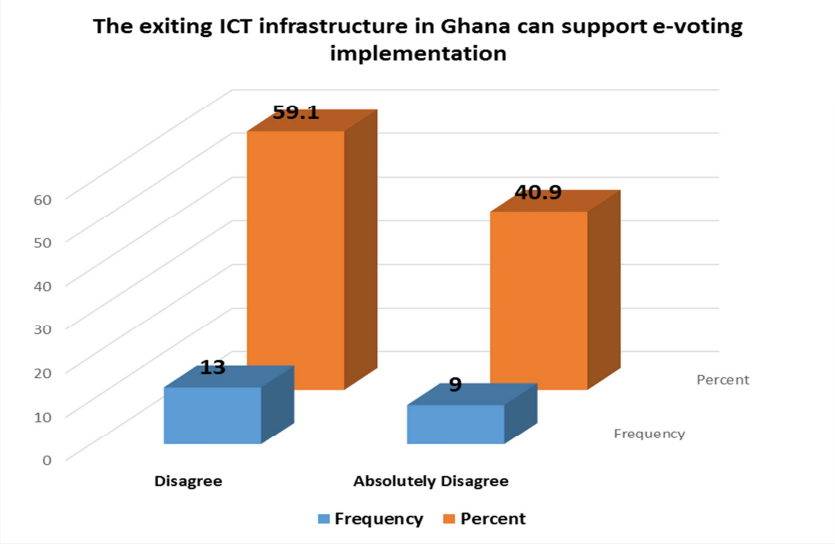


Figure 7 - To determine whether the current ICT infrastructure can support e-voting (Source: Fieldwork, 2013)

Objective 4: To investigate whether e-voting will be the preferred voting technology by voters

From figure 8 below, it can be observed that the voting populace are willing to use e-voting technology in casting their votes as a total of 78.9% opted to use e-voting instead of paper-based voting

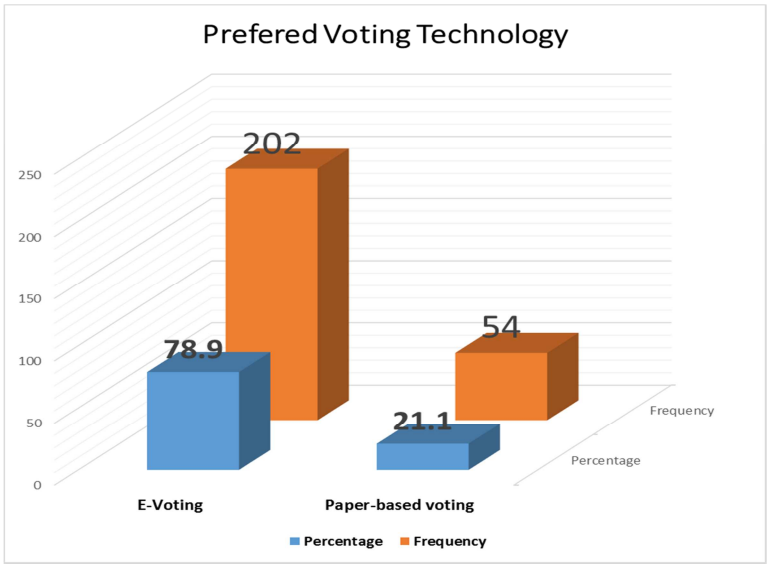


Figure 8 – Preferred Voting Technology (Source: Fieldwork, 2013)

5 OBJECTIVE NON-QUALITATIVE EVIDENCE (EXPERIMENT CONDUCTED)

The experiment consist of participants voting using GEVS DRE and also voting with paper ballots. The participants were first introduce to how the GEVS system work by taking them through the various interfaces for each slot. They were also taking through the manual (paper) voting steps. Participants were purposively selected based on their age, education and computer experience. A 5-point likert scale was used to assess self-rated computer experience with 1 representing a novice and 5 representing expert. A total of 31 participants were involved in the experiment and their ages range from 20-70 with a mean age of 37.48 years with a standard deviation (SD) of 14.66 (table 1). All the participant had previous voting experience.

Table 1 - Mean Age

Age

N	Valid	31
	Missing	0
Mean		37.48
Std. Deviation		14.651

The DRE used was the GEVS system created by the researcher, and the ballot papers were with the same candidates as in the GEVS system for both presidential and parliamentary interfaces. The System Usability Scale (SUS) was used to assess the subjective user experience with the GEVS and the Paper ballot voting methods. In addition a survey questions were answered by each participant after voting. Each participant were instructed to vote for specific candidates as agreed upon for both presidential and parliamentary. Participants cast two ballots, one with GEVS DRE and another with paper-based voting system. The SUS was administered after each ballot was completed.

Evidence 1 – E-voting will speed up voting process

For both GEVS DRE and paper ballot, the completed time was measured from the time the participant entered the voting booth and ends at the time the participant exit the voting booth. The average ballot completion time for GEVS (Table 2) was 54.6 seconds (SD=10.15), while the average ballot completion time for paper voting (table 3) was 95.7 seconds (SD=8.7).

Table 2– DRE Completion Time

DRE completion Time

N	Valid	31
	Missing	0
Mean		54.6129
Std. Deviation		10.14783

Table 3- Paper Completion Time

Paper Vote Completion Time

N	Valid	31
	Missing	0
Mean		95.7419
Std. Deviation		8.70237

Completion time for GEV and paper is shown in Table 4 shows a mean Paper vote of 95.74 seconds (SD=8.7), and a mean DRE competition time of 54.61 (SD=10.15)

Table 4 - Paired Samples Statistics for DRE and Paper vote completion time

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Paper Vote Completion Time	95.7419	31	8.70237	1.56299
	DRE Competition Time	54.6129	31	10.14783	1.82260

Paired t-test shows a statistical reliability between GEVS DRE and Paper voting, t=22.3, p=0.01. Another observation from the experiment shows that participant who rated themselves higher in computer experience took less time to vote on the DRE than those with less compute experience (Figure 9).

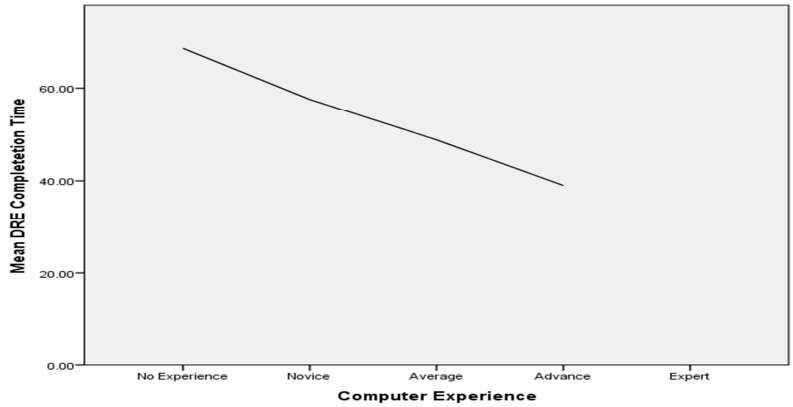


Figure 9 – Average DRE ballot Completetion time by computer expertise

Evidence 2 – E-voting will reduce voting errors

Errors

In this experiment paper based voting errors is define as:

- Wrong thumb printing
- Voting more than one candidate
- Ballot without thumb print
- Voting for wrong candidate (voting for a different candidates as compared to what was agreed on)

For DRE, errors were defined as:

- Voting for a wrong candidate
- Incomplete voting process

Out of the 31 ballots counted for paper-based voting 4 representing 12.9% had error, with mean error rate of 0.13 (SD= .34). These errors were combination of wrong thumb printing, and multiple thumb printing on ballot paper. For DRE, out of 31 voters who cast their vote electronically only 1 representing 3.2% had errors with mean error rate of 0.03 (SD= .18). The only type of error encountered was a voter not completing the vote after the vote summary was displayed.

Evidence 3 – E-voting will be the preferred voting technology

Subjective Usability

The average System Usability Scale (SUS) scores in terms of the satisfactory level of the two voting methods is presented in table 5. The satisfactory level of the voting methods were rated from 1 to 10, with 10 being the highest satisfactory level.

Table 5 – Mean Scores between DRE and Paper Voting

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	DRE Satisfaction Rate	8.0968	31	.59749	.10731
	Paper Satisfaction Rate	4.2581	31	.72882	.13090

DRE mean scores were reliably superior than paper base, with a mean score of 8.1 (SD= .60) and paper mean score of 4.26 (SD = .72)

In comparing the GEVS DRE against the Paper-based system, there were differences between the two in terms of efficiency, effectiveness and satisfaction. But the major difference were seen in the satisfaction level of the use of DRE against Paper voting. Participant preferred the use of the DRE system to Paper-based system. It was also observed that participant with less computer experience waste more time in voting, but this does not affect the satisfaction level of the DRE system.

6 MAJOR FINDINGS

The results from survey, experiments and the interviews conducted with the EC official's shows that e-voting implementation in Ghanaian elections is feasible, and also the survey also revealed that there are problems in the current paper-based voting and e-voting technology can reduce these election problems and irregularities. The study further reveals that the potential challenges that are likely to impede the adoption and implementation of e-voting in Ghana will be that lack of adequate infrastructure, high illiteracy rate among voting populace and security issue. It was further reveal that the existing Infrastructure in Ghana cannot support nationwide e-voting implementation for now. EC believes that governments must show strong commitment and support by securing funds through donor organizations, to provide the necessary IT infrastructure and other resources needed to support the e-voting implementation. There were some suggestion that, e-voting can be introduce as pilot project for political party elections, and it will help the EC to identify any challenges and find ways to mitigate it.

7 CONCLUSION

From the case studies, the survey and the experiment conducted in the preceding chapters, the researcher can conclude that E-voting can reduce the irregularities and problems associated with our paper-based voting and voters will prefer to use e-voting system to paper technology. Electronic voting system adoption and implementation in Ghana is possible, but the necessary infrastructure must be available and voter education must begin now. Also EC can begin to implement e-voting system for political party's elections, this will help the commission to identify any potential challenges and find ways to mitigate those challenges.

8 RECOMMENDATION

E-voting should be introduced on pilot basis and should run alongside manual paper voting until such a time where we will have adequate infrastructure spread across the entire country. Most Ghanaians in the rural areas need to be educated on the use of the system as well as general computer literacy, and EC should create the awareness of e-voting using the print and electronic media. EC with support from the Government should introduce a new type of Identity Card (ID card) or smart-card for registered voters that has an embedded chip similar to what Estonia is using. This chip should have security features that can be used to encrypt electronic vote for online transmission and also to authenticate the voter.

REFERENCES

[1] A Comparative Assessment of Electronic Voting (http://www.elections.ca/content.aspx?section=res&dir=rec/tech/ivote/comp&document=benefit&lang=e) (accessed 10 August, 2013)

[2] African elections database, (2007). (http://africanelections.tripod.com/gh.html#1960_Presidential_Election) (accessed January 27, 2013)

[3] Ahmed H. Tolba et al " Individual and cultural factors affecting diffusion of innovation" (http://www.aabri.com/manuscripts/11806.pdf) (accessed 10 August, 2013)

[4] Alan D. Smith, John S. Clark, (2005),"Revolutionising the voting process through online strategies", Online Information Review, Vol. 29 Iss: 5 pp. 513 – 530 (http://dx.doi.org/10.1108/14684520510628909) (accessed 19 September, 2012)

[5] Alhaji Mohammed Salisu Baba, (2011) **"**What is e-voting? Various types Of e-voting, USA to Venezuela - Issues to consider**"** (http://www.danquahinstitute.org/docs/prospectsevotingghana.pdf) (accessed 10 July, 2013).

[6] Amit Chakradeo Inc. (May 2005) "India's Electronic Voting Machines compared to Diebold" (http://amit.chakradeo.net/2004/05/14/indias-electronic-voting-machines-compared-to-diebold/) (accessed February 16, 2013)

[7] Amoakohene M. "Ghana : Media and Democracy in 50 Years of Independence" (http://www.ucalgary.com/tettey/files/tettey/ghana_media_democracy.pdf) (accessed January 20,2013)

[8] Anderson D., (2006) Qualitative and Quantitative research (http://www.icoe.org/webfm_send/1936) (accessed August 6, 2012)

[9] Aurora. (April 2009). "Electronic voting machines: A boon in Indian elections" (http://www.sankalpindia.net/drupal/electronic-voting-machines-boon-indian-elections) (accessed February 16, 2013)

[10] AVIEL, D., TADAYOSHI K., ADAM S. (July 23 2004) "Analysis of an Electronic Voting System" (http://avirubin.com/vote.pdf) (accessed on the 10 July, 2012)
[11] Bishop, Matt; Wagner, David. "Risks of E-voting" Communications of the ACM. Nov2007, Vol. 50 Issue 11, p120-120.
[12] Brooke, J. (1996) SUS: A "quick and dirty" usability scale. In P. W. Jordan, B. Thomas, B. A. Weerdmeester, & A. L. McClelland (Eds.), *Usability evaluation in industry* (pp. 189-194). London: Taylor and Francis.
[13] Business Dictionary (http://www.businessdictionary.com/definition/survey-research.html) (accessed 12 July, 2013)
[14] CODEC (2013), "WAEON Press Release on Post–Election Violence in Ghana" (http://codeoghana.org/index.php/waeon-press-release-on-post-election-violence-in-ghana) (accessed 10 July, 2013)
[15] Commonwealth Secretariat, 2008 "Commonwealth Observer Group says Ghana's run-off presidential election was robust and credible" (http://secretariat.thecommonwealth.org/news/190591/163072/186347/301208ghanainterim.htm) (accessed 10 July, 2013)
[16] Comparison of electronic voting machines: India and elsewhere (http://lifeearthlife.wordpress.com/2009/04/20/electronic-voting-machines-india-and- elsewhere/) (accessed 10 July, 2013)
[17] Cooper, D. R. and Schindler, P.S. (2006), Business Research Methods, 9th Ed. McGraw-Hill.
[18] Cory Janssen "Rapid Application Development" (www.techopedia.com/definition/3982/rapid-application-development-rad) (accessed May 10, 2013)
[19] Diebold Election System, (2006)."Electronic Voting Information Machine Sheet" (http://w2.eff.org/Activism/E-voting/infosheets2006/DieboldAccuVoteTSx.pdf) (accessed December 16,2012)
[20] Dieterich, E."Direct Recording Electronic Voting Systems" (http://www.leagueissues.org/tutorial.html) (accessed December 16, 2012)
[21] Direct Recording Electronic Voting Machines. (Nov 2006) Congressional Digest; Nov2006 Vol. 85 Issue 9, p262-288, 8p
[22] Dogbevi E. (2011)"Internet users in Ghana reach 14.11% of population in 2011 – ITU. (http://www.ghanabusinessnews.com/2012/09/04/internet-users-in-ghana-reach-14-11-of-population-in-2011-itu/) (accessed January 20, 2013)
[23] Election Protection, (2006), "Election Systems & Software - iVotronic" (http://w2.eff.org/Activism/E-voting/infosheets2006/iVotronic.pdf) (accessed February 18, 2013)
[24] Electoral Commission of Ghana, "Electoral Reform" (http://www.ec.gov.gh/page.php?page=375&section=42&typ=1)
[25] Electoral Commission of Ghana. (2000) "Demarcations of the Electoral Boundaries" (http://www.ec.gov.gh/page.php?page=374&section=42&typ=1) (accessed February 09, 2013)
[26] Electoral Commission of Ghana. (2000) "Mission, Vision and Functions Vision" (http://www.ec.gov.gh/page.php?page=286&section=41&typ=1) (accessed February 09, 2013)
[27] Electoral Commission of Ghana. (2000) "Steps on how to Vote" (http://www.ec.gov.gh/page.php?page=504&section=49&typ=1) (accessed February 18, 2013)
[28] Electoral Commission of Ghana. (2000) "Structure of the Electoral Commission" (http://www.ec.gov.gh/page.php?page=341&section=41&typ=1) (accessed February 09, 2013)
[29] Electoral Commission of Ghana. (2000) "Voter Registration" (http://www.ec.gov.gh/page.php?page=391&section=49&typ=1) (accessed February 18, 2013)
[30] ELECTRONIC VOTING NOW!…Remedy to possible violence in 2016 (http://www.todaygh.com/2013/09/11/electronic-voting-now-remedy-to- possible-violence-in-2016/) (accessed 10 August 2013)
[31] Eric A. Fischer, (2005) "The Direct Recording Electronic Voting Machine (DRE) Controversy" http://fpc.state.gov/documents/organization/60725.pdf (accessed December 16,2012)
[32] Erika D. Smith. "Startups Challenge Diebold in E-Voting Machine Paper Trail Scramble" Akron Beacon Journal (OH). 04/20/2004
[33] Estonia.eu, 2005 "Estonian e-voting system" (http://estonia.eu/about-estonia/economy-a-it/e-voting.html) (accessed February 18, 2013)
[34] Ghana Election 2013 (http://elections.myjoyonline.com) (accessed February 18, 2013)
[35] Ghana Statistical Service (2012). "2010 Population Census" (http://www.statsghana.gov.gh/docfiles/2010phc/Census2010_Summary_report_of_final_results.pdf) (accessed February 18, 2013)
[36] Ghana's Electoral Commission boss voices pessimism on e-voting (http://www.humanipo.com/news/4422/ghanas-electoral-commission-boss-voices-pessimism-on-e-voting/)

(accessed 10 August 2013)
[37] Gibson, R. "Elections Online: Assessing Internet Voting in Light of the Arizona Democratic Primary " Political *Science Quarterly.* Winter2001/2002, Vol. 116 Issue 4, p561. 23p
[38] Hari K et al (2010) "Security Analysis of India's Electronic Voting Machines"
[39] Hines, Matt. "E-voting and security concerns" eWeek. 10/27/2008, Vol. 25 Issue 31, p12-12. 3/4p.
[40] Human Right Watch (2011) "Nigeria: Post-Election Violence Killed 800" (http://www.hrw.org/news/2011/05/16/nigeria-post-election-violence-killed-800) (accessed 10 July, 2013)
[41] Illiteracy rate in Ghana will not impede e-voting – PPP (http://graphic.com.gh/Politics/illiteracy-rate-in-ghana-will-not-impede-e-voting-ppp.html) (accessed 10 August 2013)
[42] Indian Electronic Voting Machine compared with Diebold (US Voting System)" (http://www.asadasif.com/?itemid=59) (accessed February 18, 2013)
[43] Instruments and Procedures (http://linguistics.byu.edu/faculty/henrichsenl/ResearchMethods/RM_2_17.html) (accessed August 7, 2012)
[44] International Committee for Information Technology Standards. ISO 9241-11. (1998). Ergonomic requirements for office work with visual display terminals (VDT)s - Part 11. Guidance on usability.
[45] Internet Penetration Grows To 10% (http://www.ghana.gov.gh/index.php/news/features/11725--internet-penetration-grows-to-10) (accessed February 18, 2013)
[46] Internet Usage Statistics for Africa (http://www.internetworldstats.com/stats1.htm) (accessed January 20, 2013)
[47] Internet World Statistics. (http://www.internetworldstats.com/stats1.htm) (accessed February 18, 2013)
[48] Jefferson, D., Rubin, Aviel D., Simons, B., Wagner, D. "A Security Analysis of the Secure Electronic Registration and Voting Experiment (SERVE)" Technical report, 2004. (http://servesecurityreport.org/.) (accessed January 19, 2013)
[49] Jefferson, D., Rubin, Aviel D., Simons, B., Wagner, D. "ANALYZING INTERNET VOTING SECURITY." *Communications of the ACM.* Oct2004, Vol. 47 Issue 10, p59-64. 6p. 1 Illustration, 1 Chart.
[50] John Amponsah, (29 November 2009) "Electronic Voting Machines and New Era of Fixing Elections" (http://www.ghanaweb.com/GhanaHomePage/NewsArchive/artikel.php?ID=172603) (accessed 13th Decemeber,2012)
[51] John Marcheur, eHow Contributor "The Disadvantages of Manual Elections" (http://www.ehow.com/info_8740257_disadvantages-manual-elections.html) (accessed 13th July, 2013)
[52] Kevin Zhu, et al (2006) "Innovation diffusion in global contexts: determinants of post-adoption digital transformation of European companies"
[53] Kim, K., Hong, D. (2007). "Electronic Voting System using mobile terminal" Proceedings of World Academy of Science: Engineering & Technology Vol. 36, p33-37, 5p, 4
[54] Kitcat, Jason. (2007)."Is e-voting a threat to our democracy? "Computer Weekly. 2/27/2007, p20-20. 2/3p. 2
[55] Larsen, Kai R.T. (1999) "VOTING TECHNOLOGY IMPLEMENTATION" Communications of the ACM. Dec1999, Vol. 42 Issue 12, p55-57. 3p.
[56] Laskowski, S. J et al. (2004). *Improving the usability and accessibility of voting systems and products*. NIST Special Publication 500-256.
[57] Leigh Egerton, 2012 "Electronic Voting Counting System" (http://www.niassembly.gov.uk/Documents/RaISe/Publications/2012/ofmdfm/9112.pdf) (accessed 13 July, 2013)
[58] Madise U., Martens T. "E-voting in Estonia 2005. The first practice of country- wide binding Internet voting in the world" (http://neu.e-voting.cc/wp-content/uploads/Proceedings%202006/1.1.madise_martens_e- voting_in_estonia.pdf) (accessed February 18, 2013)
[59] Mohammed Awad, Ernst L. Leiss, (2011),"Internet voting in the USA: analysis and commentary", Transforming Government: People, Process and Policy, Vol. 5 Iss: 1 pp. 45 – 55 (http://dx.doi.org/10.1108/17506161111114644) (accessed December 12, 2012)
[60] Musah Yahaya Jafaru "'Adopt E-Voting For 2012 Election'" Daily Graphic publication (http://www.modernghana.com/news/289272/1/039adopt-e-voting-for-2012-election039.html) (accessed 10 August, 2013)
[61] Nana Karikari-Apau, (2012) "Ghana president re-elected, a result opposition claims was 'manipulated" (http://edition.cnn.com/2012/12/09/world/africa/ghana-elections/) (accessed 10 July, 2013)
[62] Neville, H., Sidney,T. (20 June 2005) "Simple Random Sampling" http://www.coventry.ac.uk/ec/~nhunt/meths/random.html (accessed August 6, 2012)
[63] Obetsebi-Lamptey, J. "NDC, some EC officials colluding to doctor election results"

(http://www.modernghana.com/news/434976/1/ndc-some-ec-officials-colluding-to-doctor-elect.html) (accessed December 9,2012)
[64] Otchere-Darko Gabby Asare, (2009) "Why Ghana must soon decide on E-voting" (http://ghanaweb.net/GhanaHomePage/soccer/artikel.php?ID=170417) (accessed 10 July, 2013)"
[65] Plumer B. (2012) "Estonia gets to vote online. Why can't America?" (http://www.washingtonpost.com/blogs/wonkblog/wp/2012/11/06/estonians-get-to-vote-online-why-cant-america/) (accessed February 18, 2013)
[66] Quarshie, H.O, Ami-Narh, J. "The Growth and Usage of Internet in Ghana" (http://cisjournal.org/journalofcomputing/archive/vol3no9/vol3no9_6.pdf) (accessed February 18, 2013)
[67] Rajasekar S et al (2006) "RESEARCH METHODOLOGY" (http://arxiv.org/pdf/physics/0601009.pdf) (accessed February 18, 2013)
[68] Rajaseker S. (2013) "Research Methodology" (http://arxiv.org/pdf/physics/0601009.pdf) (accessed 12 December, 2013)
[69] Randolph, C.(2004) "Electronic Voting Offers Opportunities and Presents Challenges" GAO Reports, 7/20/2004, p1, 47p
[70] Roger Clarke, (1999). "A Primer in Diffusion of Innovations Theory" (http://www.rogerclarke.com/SOS/InnDiff.html) (accessed 10 July, 2013)

International Journal of Innovation and Scientific Research
ISSN 2351-8014 Vol. 10 No. 1 Oct. 2014, pp. 232-237

http://www.ijisr.issr-journals.org/

Mosfet Based Inverter with Three Phase Preventer & Selector for Industrial Application

Ms. Dipali S. Sarode[1], Prof. A.R. Wadhekar[2], and Prof. R.M. Autee[3]

[1]Electronics & Communication Department,
Deogiri Institute of Engineering & Management Studies, BAMU,
Aurangabad, Maharashtra, India

[2]Assistant Professor, Electronics & Communication Department,
Deogiri Institute of Engineering & Management Studies, BAMU,
Aurangabad, Maharashtra, India

[3]Head of the Electronics & Communication Department,
Deogiri Institute of Engineering & Management Studies, BAMU,
Aurangabad, Maharashtra, India

ABSTRACT: In this competing world where efficient and effective production takes place, industries uses 3 phase supply that cannot afford a failure of even a single phase. Failures of any phases make appliances prone to erratic functioning and may even lead to failure of that appliance. Goal is to build a system that can support one of the phase supplies with the help of existing phase supply. The development of this system will be achieved by using microcontroller which can be programmed using embedded. This microcontroller is then coupled with inverter using driver circuitry. If we go to have a three-phase inverter, which is available in market the cost of it is more. So, here is an attempt made to have single phase to three phase inverter using Microcontroller, which saves money up to great extent.

KEYWORDS: RYB indicator; automatic phase selector circuit; MOSFET based inverter.

1 INTRODUCTION

In this fast changing world, electronics has made a great impact in each and every field. Just press of button tedious jobs performs easily. Now day's electric supply has become one of the basic needs but due to Environmental conditions and practical limitation the generation of electricity is Insufficient hence to fulfill the electricity requirement load shading is used, but is not satisfying the complete requirement. Inverter is used to obtain A.C. supply from battery. In industries three phase Appliances are frequently used due to their advantages over single-phase power supply. If we go to have a three-phase inverter, which is available in, market cost of it is more. So, here is an attempt made to have single phase to three phase inverter using Microcontroller, which saves money up to great extent. Now day's different inverters are used to avoid the erratic functioning. Here, in particular the circuit is used to generate the three-phase variable frequency supply required in the industries for controlling the various appliances. Basically, in this total hardware project one can generate the variable frequency from 10Hz to 100Hz to operate the appliances used in the industries. We can control the phase induction motor from this inverter. Due to feature of variable frequency we can control the speed of the three phase induction motor.

Corresponding Author: Ms. Dipali S. Sarode

1.1 DEFINITION AND CONCEPT OF INVERTER

The d.c. to a.c. power converters are known as inverters. In other words, an inverter is a circuit which converts a d.c. power into an a.c. power at desired output voltage and frequency. The a.c. output voltage could be fixed at a fixed or variable frequency. This conversion can be achieved either by controlled turn-on and turn off devices (e.g. BJTs, MOSFETs, IGBTs, and MCTs). The output voltage waveform of ideal inverter should be sinusoidal. The voltage waveforms of practical inverters are, however non-sinusoidal and contain certain harmonics. Square wave or quasi square wave voltages may be acceptable for low and medium power applications, and for high power application low-distorted, sinusoidal waveforms are required. The d.c. power input to the inverter may be battery, fuel cell, solar cells or other d.c. source. But in most industrial application, it is fed by a rectifier.

1.2 CLASSIFICATION OF INVERTERS

Based on the nature of input power source, inverters are classified as i) Voltage source inverter (VSI) ii) Current source inverter (CSI). In case of VSI, the input to the inverter is provided by a ripple free dc voltage source whereas in CSI, the voltage source is first converted into a current source and then used to supply the power to the inverter. The inverters can be again classified according to the nature of output voltage waveforms as: i) Square-Wave inverter ii) Quasi-Square Wave inverter iii) Pulse Width Modulated (PWM) inverter. A square wave inverter produces a Square-Wave ac voltage of constant magnitude. The output voltage of this type of inverter can only varied by controlling the input dc voltage. Square wave ac output voltage is adequate for low and medium power applications. The second method, pulse width modulation uses a switching scheme within the inverter to modify the shape of the output voltage waveform.

2 LITERATURE SURVEY

The three phase inverters are used for high power applications such as an ac motor drives, induction heating, and ups. A three phase inverter circuit changes DC input voltage can be from a DC source or a rectified AC voltage. A three phase bridge inverter can be constructed by combining three single phase half bridge inverter. In three phase inverter which is based on a novel three-phase uncontrollable rectifier inverter without or with a quite small dc-link capacitor. This inverter has many advantages such as simpler structure, higher reliability, more effective harmonics elimination (P. Hammond et al, 1997). Inverter are widely used in many industrial applications such as variable-frequency velocity modulation, UPS, VAR compensator etc. In order to supply high quality power for loads, it is significant for this inverter to eliminate harmonics in output voltage effectively. Pulse width modulation (PWM) technique that has satisfied performance in harmonics elimination, voltage regulation, responding speed is widely used in all kinds of inverters. Another system which is based on Multilevel Inverter-Fed Induction Motor Drive in which the output harmonic content is reduced by using multilevel inverter. In symmetrical circuit, the voltage and power increase with the increase in the number of levels of inverter. The switching angle for the pulse is selected in such way to reduce the harmonic distortion. This drive system has advantages like reduced total harmonic distortion and higher torque. The model of the multilevel inverter system is developed with SVM strategy to control the induction motor (L. M. Malesani et al, 1995). Cascaded H-Bridge Multilevel Inverter Using Micro-Controller for Single Phase Induction Motor (Richa Bhargava et al, 2012), this paper presents a micro controller based control of multilevel inverter for single phase Induction motor. IGBT is used as power element. It is based on the symmetric regular sampling PWM with a single carrier and multiple modulating signals. This algorithm is implemented by a low-cost fixed-point microcontroller on an experimental five level cascaded inverter test-rig. In this paper the hardware is implemented using the PIC microcontroller PIC16F877. The advantages of the PIC microcontroller is that the instruction set of this controller are fewer than the usual microcontroller. Unlike conventional processors, which are generally complex, instruction set computer (CISC) type, PIC microcontroller is a RISC processor. The advantages of RISC processor against CISC processor are RISC instructions are simpler and consequently operate faster A RISC processor takes a single cycle for each instruction, while CISC processor requires multiple clocks per instruction. In the main routine the port c, inputs to the IGBT gate driver circuit produced by the controller, are used, firstly, we determine the IGBT combination to be switched ON and output values to the corresponding port C which is connected too gate driver circuit. After each PWM counter next combination is switched ON. This system having some demerits like Limited to certain applications where separate DC Sources are available, Usage of the power semiconductor switches increases exponentially whenever the level is to be increased and Each H-bridge needs an isolated DC supply compared to the other solutions which need only one supply.

Enhanced Performance of Multilevel Inverter Fed Induction Motor Drive (Venkata Anil Babu Polisetty et al, November 2013) Multilevel inverter technology generally used for high power medium-voltage control and also for improving the total harmonic distortion by reducing the harmonics. the poor quality of voltage and current of a conventional inverter fed

induction machine is obtained due to the presence of harmonics and hence there is a significant level of energy losses. this paper presents the simulation of three phases nine level inverter fed induction motor drive. In inverters by increasing the number of steps it generates the very high quality of the output voltage and current. This paper presents a nine levels multi level inverter and these nine levels can follow a voltage reference with accuracy and with the advantage that the generated voltage can be modulated in amplitude instead of pulse-width modulation. Therefore a harmonic elimination method is applied to eliminate any number of specific higher order harmonics of multilevel converters with unequal dc voltages. The effectiveness of the system is verified through simulation using MATLAB / SIMULINK package. Nine level inverter consists of a series of diode clamped inverter units connected to three phase induction motor. The general function of this multilevel inverter is to synthesize a desired voltage from several dc sources. The ac terminal voltages of each bridge are connected in series. This configuration is useful for constant frequency applications such as active front-end rectifiers, active power filters, and reactive power compensation.

Implementation of Multilevel Inverter-Fed Induction Motor Drive (Mr. G. Pandian et al, June 2008) this paper presents the simulation and implementation of multilevel inverter fed induction motor drive. The output harmonic content is reduced by using multilevel inverter. In symmetrical circuit, the voltage and power increase with the increase in the number of levels of inverter. The model of the multilevel inverter system is developed with SVM strategy to control the induction motor. SVM is based on vector selection in the q-d stationary reference frame. The induction motors were mainly used for essentially constant speed applications because of the unavailability of the variable-frequency voltage supply. The concept of multilevel inverter control has opened a new possibility that induction motors can be controlled to achieve dynamic performance equally as that of DC motors. AC input is rectified using a diode rectifier. It is filtered using a capacitor filter. DC is applied to the multilevel inverter. The output of the inverter is fed to the induction motor. The pulses are generated using SVM method. The speed loop ensures that the actual speed of the motor is equal to set speed. The torque of the motor is improved due to the elimination of the fifth harmonic, which produces negative torque. A Microcontroller based gating circuit generates the pulses required by the inverter.

Automatic phase changer (Muhammad ajmal p., july 2007) The circuit provides correct voltage in the same power supply lines through relays from the other phase where correct voltage is available. Automatic phase changer (rax tech, 2013) Automatic phase changer needs to be designed with abuse and longevity in mind. Avail brand APC Monitors the incoming voltage in all 3 phases using reliable and rugged sensors. In the event of power failure or low voltage in up to 2 of the 3 incoming phases, the Avail APC automatically transfers your equipment supply to the healthiest phase. The Low Voltage Cut off is a smart unique feature with Avail APC protects equipment from the harmful effects of unhealthily low voltage. In all these system inverters are used that converts dc into ac but when any one phase is missed at that time all the work is stop. In farm when motors are ON and when there is overload on system at that time any one phase is fail so in that case motor damage. So the system that prevent the damage and it will avoid the interruption between the work is necessary now a days. Because in case of large scale industries no single interruption is desirable.

3 SYSTEM OVERVIEW

A scheme that address on building up system as a mention above is presented here single phase to three phase converter for load schedule management using embedded. The government of Maharashtra has been decided for single phasing. So it is useful in industrial equipment or home appliances. So we can use such a system to drive the applications. When phase are present at the same time 4 pole 4 way relay will activate and 3 phase will connect directly to load or motor. If there is any missing phase then suddenly motor will disconnect from 3 phase. It will prevent motor or load. Auto phase selector circuit select particular phase which is present in sequence of R Y B phase, & .After B phase again cycle is continue to R phase. Present single phase is converted AC to DC using bridge rectifier circuit to making of 350 volt dc supply to use across the MOSFET based power inverter circuit. To convert from DC to AC the present single phase connects to 4 winding transformer. In replace of 6 transformers we can use one transformer.

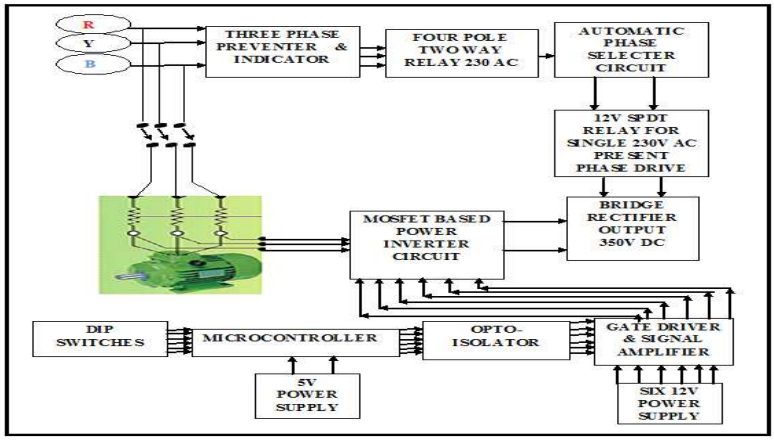


Fig. 1. Block Diagram

3.1 VARIOUS ATTRIBUTES

- DIP Switches- DIP switches are used as input to the microcontroller 89C52. The DIP switches are consisting of 8 parallel switches. The output of the DIP switches is given to the port 1 of microcontroller 89C52 is used to select the appropriate frequency as well as to select the mode of operation.
- Optoisolator- It isolates the control circuitry from the power circuitry. Power circuitry operates on 350v and control circuitry operates on 5v so to isolate these voltage optoisolator is used.
- Signal Amplifier- The output of optocoupler is not sufficient for driving the mosfet so amplification of signal is required due to that signal amplifier is used.
- RYB indicator- R, Y & B phase are indicating by three led. Presence of phase is indicate by these led.
- Inverter circuitry- The inverter circuitry consisting of power device named as mosfet; they are connected in the bridge configuration. MOSFET stands for metal oxide semiconductor for filled effect transistor which having many advantages over the other power device like MOSFET, FET and SCR. The output of inverter is can be obtained in either 180deg or 120 deg depending on the user's requirement. In the 120deg mode phase voltage waveform is quasi square while line voltage is of six step waveform. In 180deg mode the phase voltage is of six step waveform while line voltage waveform is quasi square waveform.

4 RELEVANCE OF PROJECT

This project can be used in different areas like house, industries, chemical plant etc. The application circuit can be changed to control various home appliances or industries. All the number of applications can be increased with very minor changes.

5 RESULTS

Microcontroller 89c51 is used for PWM pulse generation. These six pulses are given to optocoupler PC-817. This optocoupler is used for isolation of voltage between the control circuit and power circuit. Gate driver voltage is 3.2v across the output of signal amplifier. Signal amplifier TIP-122 is used for current boosting. Time period calculation of PWM pulses.

$T_{ON} = 1.4 \times 5 \times 10^{-3}$ sec
$T_{OFF} = 2.6 \times 5 \times 10^{-3}$ sec
$T = T_{ON} + T_{OFF}$
T = 20 msec
F =1/T
F= 50 Hz

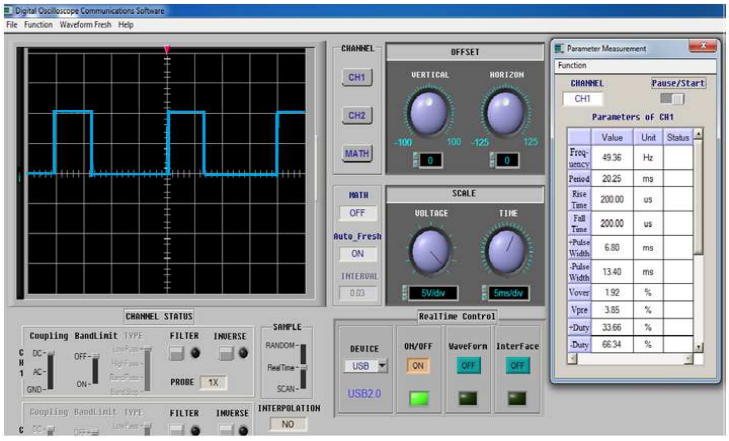


Fig. 2. Gate driver waveform

Line Voltage: Voltage across any two line is called as line voltage
$V_{RY} = V_{YB} = V_{BR}$ = Line voltage = V_L
Practically calculated Line voltage
V_{RY}= 247v
V_{YB}= 252 v
V_{BR}= 250v

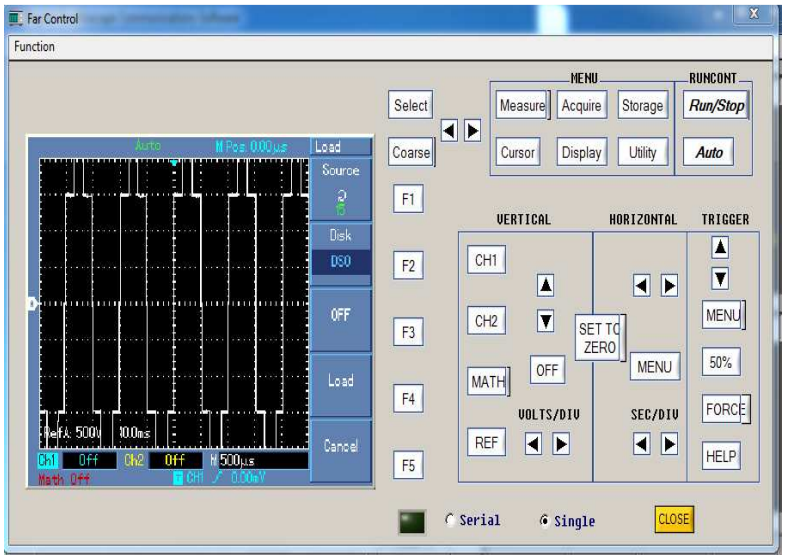


Fig. 3. Line Voltage waveform

Phase Voltage: Voltage across the line with respect to the Neutral is known as phase voltage.
$V_{RN} = V_{YN} = V_{BN}$ = Phase voltage = V_{PH}
Practically calculated phase voltage
V_{RN} = 113v
V_{YN} = 109v
V_{BN} = 121v

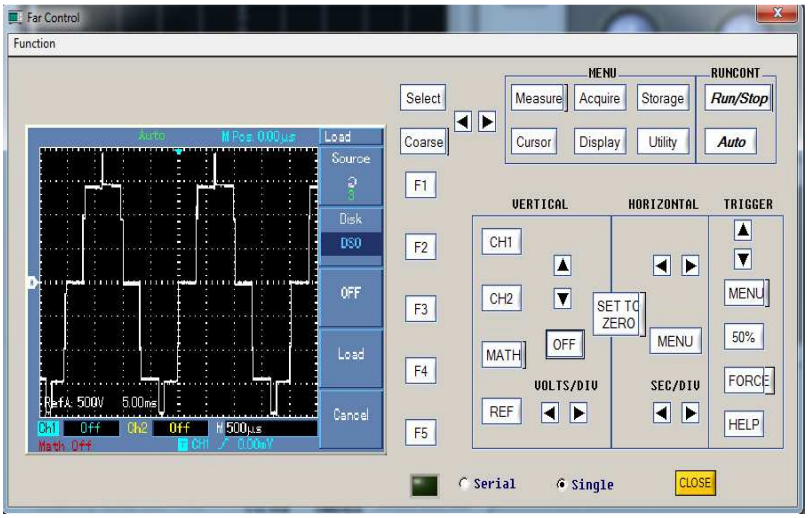


Fig. 4. Phase Voltage Waveform

We get these line voltages and phase voltages across output when R phase is missing. We get the three phase output with this system by using mosfet based inverter and microcontroller assembly.

1 CONCLUSION

The system has significant excellences such as continue supply and low expenses. A scheme that address on building up system single phase to three phase converter for load schedule management using embedded. Different inverters are used to avoid load scheduling but when any phase lost in that case that system doesn't work. The basic aim of proposed system is to generate the three-phase inverter from Single phase using microcontroller using the assembly language of microcontroller. Here we can generate six pulse PWM output. The frequency of the PWM output can be varied from 10Hz to 100Hz.

ACKNOWLEDGMENT

Completion of this system is a task which would have not accomplished without cooperation and help from my guide.. At the outset, I wish to express my deep sense of gratitude to my guide Prof. A.R.Wadhekar for her guidance and constant encouragement, without which it would have not been possible. I would like to thank Prof. R.M.Autee Head, Electronics & Communication Department for his encouragement & guidance all the time. At last I also thank my parents. I am also thankful to my friends who have helped me in completion of this system.

REFERENCES

[1] P. Hammond, "A new approach to enhance power quality for medium voltage AC drives", IEEE Trans. Ind. Applicant., vol. 33, pp.202–208 (Jan./Feb. 1997.).
[2] L. M. Malesani, L. Rossetto, P. Tenti, and P. Tomasin, "AC/DC/AC PWM converter with reduced energy storage in the DC link", IEEETrans. Ind. Applicant. vol. 31, pp. 287 292 (ar./Apr.1995).
[3] richa bhargava, amit shrivastava, "cascaded h-bridge multilevel inverter using micro controller for single phase induction motor", International Journal on Emerging Technologies 3(2): 101-108 (02 december, 2012).
[4] Venkata Anil Babu Polisetty, B.R.Narendra, "Enhanced Performance of Multilevel Inverter Fed Induction Motor Drive", International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering Vol. 2, Issue 11(November 2013).
[5] Mr. G. Pandian and Dr. S. Rama Reddy "Implementation of Multilevel Inverter-Fed Induction Motor Drive", journal of industrial Electronics ,Volume 24(June 2008).
[6] Muhammad ajmal p, "automatic phase changer" (july 2007).
[7] Power Electronics: Singh Khanchandani , 2nd Ed.
[8] Singh Khanchandani , Inverter concepts, Inc, pp.885.

International Journal of Innovation and Scientific Research
ISSN 2351-8014 Vol. 10 No. 1 Oct. 2014, pp. 238-245

http://www.ijisr.issr-journals.org/

A Multi-Item Production Lot sizing Model with Stochastic Demand

Kizito Paul Mubiru

Kyambogo University, P.O.Box 1, Uganda

ABSTRACT: This paper presents a finite horizon Markov decision process model for determining the optimal production lot size (PLS) of multiple items with demand uncertainty. The model is formulated using states of a Markov chain that represent possible states of demand for items. Using weekly equal intervals, the decision of whether or not to produce additional units is made using dynamic programming over a finite period planning horizon. The proposed model demonstrates the existence of an optimal state-dependent production lot size as well as the corresponding production-inventory costs for items. A numerical example is taken to illustrate the solution procedure of the developed model.

KEYWORDS: Multi-item, Production lot sizing, Stochastic demand.

1 INTRODUCTION

Production-inventory systems demand considerable effort in establishing optimal production lot sizes as a basis for growth and survival in manufacturing. This is a considerable challenge when the demand for manufactured items follows a stochastic trend. To achieve this goal, critical analysis is vital to effectively maintain the demand and inventory positions of items in order to sustain random demand. Two major problems have to be addressed: (i) the most desirable period during which to produce additional units of items in question and (ii) the optimal *production lot size* (PLS) given a periodic review inventory system when demand is uncertain. In this paper, a production-inventory system is considered whose goal is to optimize the production lot size and total costs associated with production and holding inventory of items. At the beginning of each period, a major decision has to be made, namely whether to produce additional units of the items in inventory or postpone production and utilize the available units in inventory.

In the article presented by Mubiru [1], an optimization model is developed for determining the EPL size that minimizes production-inventory costs of a periodic review production-inventory system under stochastic demand. Markov decision process is adopted where states of a Markov chain represent possible states of demand. A single item is considered and the approach demonstrates the existence of an optimal EPL size, lot sizing policy and production-inventory costs. In related literature by Tarim S and Kingsman B[2], a multi-period single-item inventory lot-sizing problem with stochastic demand under static dynamic uncertainty is proposed. Replenishment periods are fixed at the beginning of the planning horizon, but the actual orders are determined only at those replenishment periods and will depend upon the demand that is realized. The expected inventory holding, ordering and direct item costs during the planning horizon are minimized under the constraints that the probability that the closing inventory in each time period will not be negative and is set to at least a certain value.

Further research by Lee S and Lan S[3] illustrate how the economic production quantity may be computed when demand follows a Poisson process. A fixed lot sizing policy is implemented to minimize fluctuation of work load and smoothing production and inventory control. Under mild conditions, the expected cost per unit time can be shown to be convex.

In related literature by Roy M, Sankar S and Chaudhuri K[4], an economic production lot size model is considered in which the manufacturing process shifts from an in-control state to an out-of-control state after a time span which is exponentially distributed. Production cost, holding cost, backlogging cost, lost sale cost, reworked cost and selling price are taken together to construct the integrated profit function, which is maximized to obtain the optimal production rate, lot size and profit. The paper is organized as follows. After describing the mathematical model in §2, consideration is given to the process of

estimating the model parameters. The model is solved in §3 and applied to a special case study in §4.Some final remarks lastly follow in §5.

2 MODEL FORMULATION

We consider a designated number of items in a production–inventory system whose demand during each time period over a fixed planning horizon is classified as either *favorable* (denoted by state F) or *unfavorable* (denoted by state U) and the demand of any such period is assumed to depend on the demand of the preceding period. The transition probabilities over the planning horizon from one demand 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 produce additional units (a decision denoted by K=1) or not to produce additional units (a decision denoted by K=0) during each time period over the planning horizon, where K is a binary decision variable. Optimality is defined such that the lowest expected total production-inventory costs are accumulated at the end of N consecutive periods spanning the planning horizon under consideration. In this paper, a two item (m=2) and two-period (N=2) planning horizon is considered.

2.1 ASSUMPTIONS AND NOTATION

Varying demand is modeled by means of a Markov chain with *state transition matrix* $Q^K(m)$ where the entry $Q^K_{ij}(m)$ in row i and column j of the transition matrix denotes the probability of a transition in demand from state iє**{**F , U**}** to state jє**{**U , F**}** for item m є{1,2}under a given production lot sizing policy Kє{0,1}. The number of customers observed in the system and the number of units demanded during such a transition is captured by the *customer matrix* $N^K(m)$ and *demand matrix* $D^K(m)$ respectively. Furthermore, denote the number of units in inventory and the total (production, holding and shortage) cost during such a transition by the *inventory matrix* $I^K(m)$ and the *cost matrix* $C^K(m)$ respectively. Also, denote the *expected future cost* , the already *accumulated total cost* at the end of period *n* when the demand is in state iє{ F, U }for a given production lot sizing policy Kє{0,1} by respectively $e^K(m)$ and $a^K_i(m, n)$ and let $e^K(m) = [e^K_F(m), e^K_U(m)]^T$ and $a^K(m,n) = [a^K_F(m,n), a^K_U(m,n)]^T$ where "T" denotes matrix transposition.

2.2 FINITE PERIOD DYNAMIC PROGRAMMING FORMULATION

Recalling that the demand can either be in state F or in state U, the problem of finding an optimal PLS may be expressed as a finite period dynamic programming model.

Let $C_n(i, m)$ denote the optimal expected total production-inventory costs of item m accumulated during the periods *n,n+1,…….,**N*** given that the state of the system at the beginning of period *n* is iє{ F,U }.The recursive equation relating C_n and C_{n+1} is

$$C_n(i,m) = min_K[Q^K_{iF}(m)(C^K_{iF}(m) + C_{n+1}(F,m), C^K_{iU}(m) + C_{n+1}(U,m)]$$

i ϵ {F,U }, n=1,2……..N

m = 1,2

Together with the final conditions $C_{N+1}(F, m) = C_{N+1}(U, m) = 0$

This recursive relationship may be justified by noting that the cumulative total production-inventory costs $C^K_{ij}(m) + C_{n+1}(j,m)$ resulting from reaching state j є{ F,U } at the start of period *n*+1 from state i є{ F,U } at the start of period *n* occurs with probability $Q^K_{ij}(m)$ and hence

The dynamic programming recursive equations:

$$C_n(i,m) = min_K(e^K_i(m) + Q^K_{iF}(m)C_{n+1}(F,m)) + Q^K_{iU}(m)C_{n+1}(U,m)$$

iє{F , U} , n= 1, 2…….N , m = {1, 2} , K ϵ {0,1} (1)

$$C_N(i,m) = min_K(e^K_i(m)) \quad (2)$$

Result, where (2) represents the Markov chain stable state.

2.2.1 COMPUTING $Q^K(M)$, $C^K(M)$ AND $P^K(M)$

The demand transition probability from state iє{ F, U } to state j є{ F, U },given production lot sizing policy K є{ 0,1 } may be taken as the number of customers observed with demand initially in state i and later with demand changing to state j, divided by the sum of customers over all states for item m.

That is,

$$Q_{ij}^K(m) = N_{ij}^K(m)/[N_{iF}^K(m) + N_{iU}^K(m)] \quad (3)$$

iє{F , U} , m = {1, 2, 3}, K є {0,1}

When demand outweighs on-hand inventory, the cost matrix C^K(m) may be computed by means of the relation

$$C^K(m) = [c_p(m) + c_h(m) + c_s(m)][D^K(m) - I^K(m)]$$

where c_p (m) denotes the unit production cost, c_h (m) denotes the unit holding cost and c_s(m) denotes the unit shortage cost for all i,jє{ F, U } , m= {1, 2}

Therefore,

$$c_{ij}^K(m) = \begin{cases} [c_p(m) + c_h(m) + c_s(m)[D_{ij}^K(m) - I_{ij}^K(m)] & if \quad D_{ij}^K(m) > I_{ij}^K(m) \\ 0 \qquad if \qquad D_{ij}^K(m) \leq I_{ij}^K(m) \end{cases} \quad (4)$$

A justification for expression (4) is that D^K_{ij} (m) – I^K_{ij}(m) units must be produced in order to meet the excess demand. Otherwise production is cancelled when demand is less than or equal to the on-hand inventory.

The following conditions must however, hold.

1. K=1 when c_p (m) > 0 and K = 0 when c_p (m) = 0
2. c_s(m) > 0 when shortages are allowed, and c_s (m) = 0 when shortages are not allowed.

3 OPTIMIZATION

The optimal PLS and production lot sizing policy for item m are found in this section for each time period separately.

3.1 OPTIMIZATION DURING PERIOD 1

When demand is Favorable (ie. in state F), the optimal production lot sizing policy during period 1 is

$$K = \begin{cases} 1 & if \quad e_F^1(m) < e_F^0(m) \\ 0 & if \quad e_F^1(m) \geq e_F^0(m) \end{cases}$$

The associated total production-inventory costs and PLS are then

$$C_1(F,m) = \begin{cases} e_F^1(m) & if \quad K = 1 \\ e_F^0(m) & if \quad K = 0 \end{cases}$$

And

$$P_F^K(m) = \begin{cases} [D_{FF}^1(m) - I_{FF}^1(m)] + [D_{FU}^1(m) - I_{FU}^1(m)] & if \quad K = 1 \\ 0 \qquad if \qquad K = 0 \end{cases}$$

respectively.

Similarly, when demand is Unfavorable (ie. in state U), the optimal production lot sizing policy during period 1 is:

$$K = \begin{cases} 1 & if \quad e_U^1(m) < e_U^0(m) \\ 0 & if \quad e_U^1(m) \geq e_U^0(m) \end{cases}$$

In this case, the associated total production-inventory costs and PLS are

$$C_1(U,m) = \begin{cases} e_U^1(m) & if \quad K=1 \\ e_U^0(m) & if \quad K=0 \end{cases}$$

And

$$P_U^1(m) = \begin{cases} [D_{UF}^1(m) - I_{UF}^1(m)] + [D_{UU}^1(m) - I_{UU}^1(m)] & if \quad K=1 \\ 0 \quad if \quad K=0 \end{cases}$$

Using (1),(2) and recalling that $a^K_i(m,2)$ denotes the already accumulated total production- inventory costs for item m at the end of period 1 as a result of decisions made during that period, it follows that

$$a_i^K(m,2) = e_i^K(m) + Q_{iF}^K(m) min\,[e_i^1(m), e_i^0(m)] + Q_{iU}^K(m)\ \ min[e_U^1(m), e_U^0(m)]$$
$$= e_i^K(m) + Q_{iF}^K(m) C_1(F,m) + Q_{iU}^K(m) C_1(U,m)$$

3.2 OPTIMIZATION DURING PERIOD 2

Using (1), and recalling that $a^K_i(m)$ denotes the already accumulated total production-inventory cost of item m at the end of period 1 as a result of decisions made during that period, when demand is favorable (ie. in state F),the optimal production lot sizing policy during period 2 is

$$K = \begin{cases} 1 & if \quad a_F^1(m) < a_F^0(m) \\ 0 & if \quad a_F^1(m) \geq a_F^0(m) \end{cases}$$

While the associated total production-inventory costs and PLS are

$$C_2(F,m) = \begin{cases} a_F^1(m) & if \quad K=1 \\ a_F^0(m) & if \quad K=0 \end{cases}$$

And

$$P_F^K(m) = \begin{cases} [D_{FF}^1(m) - I_{FF}^1(m)] + [D_{FU}^1(m) - I_{FU}^1(m)] & if \quad K=1 \\ 0 \quad if \quad K=0 \end{cases}$$

respectively.

Similarly, when demand is unfavorable (ie. in state U),the optimal production lot sizing policy during period 2 is

$$K = \begin{cases} 1 & if \quad a_U^1(m) < a_U^0(m) \\ 0 & if \quad a_U^1(m) \geq a_U^0(m) \end{cases}$$

In this case, the associated total production-inventory costs and PLS are

$$C_2(U,m) = \begin{cases} a_U^1(m) & if \quad K=1 \\ a_U^0(m) & if \quad K=0 \end{cases}$$

And

$$P_U^1(m) = \begin{cases} [D_{UF}^1(m) - I_{UF}^1(m)] + [D_{UU}^1(m) - I_{UU}^1(m)] & if \quad K=1 \\ 0 \quad if \quad K=0 \end{cases}$$

respectively.

4 CASE STUDY

4.1 CASE DESCRIPTION

In order to demonstrate use of the model in §2-3, a real case application from *Nice House of Plastics* in Uganda is presented in this section. The category of plastic items examined included jerry cans and basins; whose demand fluctuates every week. The factory wants to avoid excess inventory when demand is Unfavorable (state U) or running out of stock when demand is Favorable (state F) and hence seeks decision support in terms of an optimal production lot sizing policy, the associated production-inventory costs and specifically, a recommendation as to the PLS of jerry cans and basins over the next two-week period is required.

4.2 DATA COLLECTION

The following data was captured over the first week of the month when demand was Favorable (F) or Unfavorable (U). The number of customers, demand and inventory for jerry cans and basins under the respective state transitions and production lot sizing policies are presented below:

Plastic Jerry cans (m=1):

State Transition (i,j)	Production Lot sizing Policy (K)	Customers $N^K_{ij}(1)$	Demand $D^K_{ij}(1)$	Inventory $I^K_{ij}(1)$
FF	1	91	156	95
FU	1	71	115	93
UF	1	64	107	93
UU	1	13	11	94
FF	0	82	123	43.5
FU	0	50	78	45
UF	0	56	78	46.5
UU	0	25	15	45.5

Plastic Basins (m=2):

State Transition (i,j)	Production Lot sizing Policy (K)	Customers $N^K_{ij}(2)$	Demand $D^K_{ij}(2)$	Inventory $I^K_{ij}(2)$
FF	1	45	93	145
FU	1	59	60	145
UF	1	59	59	78.5
UU	1	13	11	79.5
FF	0	54	72	81
FU	0	40	77	78.5
UF	0	45	75	79.5
UU	0	11	11	78.5

The unit production, holding and shortage costs (in UGX) for each individual item at the factory are as follows:

Jerry cans (m=1)

$c_p(1) = 4500$, $c_h(1) = 1200$, $c_s(1) = 300$

Basins (m=2)

$c_p(2) = 4800$, $c_h(2) = 900$, $c_s(2) = 300$

4.3 COMPUTING $Q^K(M)$,$C^K(M)$,$E^K_I(M)$ AND $A^K_I(M,N)$

Using (3) and (4),

$$Q^1(1) = \begin{bmatrix} 0.5697 & 0.4303 \\ 0.8312 & 0.1688 \end{bmatrix} \qquad Q^1(2) = \begin{bmatrix} 0.4660 & 0.5340 \\ 0.8429 & 0.1571 \end{bmatrix}$$

$$C^1(1) = \begin{bmatrix} 0.366 & 0.132 \\ 0.084 & 0.025 \end{bmatrix} \qquad C^1(2) = \begin{bmatrix} 0.047 & 0.077 \\ 0.018 & 0.062 \end{bmatrix}$$

$$Q^0(1) = \begin{bmatrix} 0.6212 & 0.3722 \\ 0.6914 & 0.3086 \end{bmatrix} \qquad Q^0(2) = \begin{bmatrix} 0.5400 & 0.4600 \\ 0.8036 & 0.1964 \end{bmatrix}$$

$$C^0(1) = \begin{bmatrix} 0.477 & 0.198 \\ 0.189 & 0.037 \end{bmatrix} \qquad C^0(2) = \begin{bmatrix} 0.008 & 0.001 \\ 0.004 & 0.061 \end{bmatrix}$$

When additional units are produced (K = 1), the matrices $Q^1(1)$, $C^1(1)$, $Q^1(2)$ and $C^1(2)$ yield the costs(in million UGX)

$$e^1_F(1) = (0.562)(0.366) + (0.438)(0.132) = 0.2634$$

$$e^1_U(1) = (0.831)(0.084) + (0.169)(0.025) = 0.074$$

$$e^1_F(2) = (0.4660)(0.047) + (0.5340)(0.077) = 0.0627$$

$$e^1_U(2) = (0.8194)(0.0176) + (0.1804)(0.0617) = 0.0256$$

However, when additional units are *not* produced (K= 0), the matrices $Q^0(1)$, $C^0(1)$, $Q^0(2)$ and $C^0(2)$ yield the costs (in million UGX)

$$e^0_F(1) = (0.6212)(0.477) + (0.3788)(0.198) = 0.3713$$

$$e^0_U(1) = (0.6914)(0.189) + (0.3086)(0.037) = 0.1421$$

$$e^0_F(2) = (0.540)(0.008) + (0.460)(0.0014) = 0.005$$

$$e^0_U(2) = (0.804)(0.004) + (0.196)(0.0608) = 0.0152$$

The results are summarized in Table 1 below:

Table 1: The expected production-inventory costs, production lot size and lot sizing policies of plastic items during week 1

Plastic jerry cans (m=1)	K = 1	K = 0
$e^K_F(1)$	0.265	0.371
$e^K_U(1)$	0.087	0.142
$P^K_F(1,1)$	83	0
$P^K_U(1,1)$	14	0
Plastic basins (m=2)	**K = 1**	**K = 0**
$e^K_F(2)$	0.063	0.005
$e^K_U(2)$	0.026	0.015
$P^K_F(2,1)$	0	0
$P^K_u(2,1)$	0	0

The cumulative total costs $a^Z_i(m,n)$ are computed using (1) for week 2 and results are summarized in Table 2 below:

Table 2: The accumulated production-inventory costs, production lot size and lot sizing policies of plastic items during week 2

Plastic jerry cans (m=1)	K = 1	K = 0
$a^K_F(1,2)$	0.449	0.568
$a^K_U(1,2)$	0.320	0.531
$P^K_F(1,2)$	83	0
$P^K_U(1,2)$	14	0
Plastic basins (m=2)	K = 1	K = 0
$a^K_F(2,2)$	0.073	0.015
$a^K_U(2,2)$	0.032	0.022
$P^K_F(2,2)$	0	0
$P^K_U(2,2)$	0	0

4.4 THE OPTIMAL PRODUCTION LOT SIZING POLICY AND PLS

Week1

Plastic jerry cans

Since 0.265 < 0.371, it follows that K=1 is an optimal production lot sizing policy for week 1 with associated total production-inventory costs of 0.265 million UGX and a PLS of (156- 95) + 115-93) = 83 units when demand is favorable. Since 0.087< 0.142, it follows that K=1 is an optimal production lot sizing policy for week 1 with associated total production-inventory costs of 0.087 million UGX and a PLS of (107 – 93) = 14 units if demand is unfavorable.

Plastic basins

Since 0.005 < 0.063, it follows that K=0 is an optimal production lot sizing policy for week 1 with associated total production-inventory costs of 0.005 million UGX when demand is favorable. Since 0.015 < 0.026, it follows that K=0 is an optimal production lot sizing policy for week 1 with associated total production-inventory costs of 0.015 million UGX if demand is unfavorable.

PLS = 0 units regardless of the state of demand.

Week 2

Plastic jerry cans

Since 0.449 < 0.568, it follows that K=1 is an optimal production lot sizing policy for week 2 with associated accumulated production-inventory costs of 0.449 million UGX and a PLS of (156 - 95) + 115-93) = 83 units when demand is favorable. Since 0.320 < 0.531, it follows that K=1 is an optimal production lot sizing policy for week 2 with associated accumulated production-inventory costs of 0.320 million UGX and a PLS of (107 – 93) = 14 units if demand is unfavorable.

Plastic basins

Since 0.015 < 0.073, it follows that K=0 is an optimal production lot sizing policy for week 2 with associated accumulated production-inventory costs of 0.015 million UGX when demand is favorable. Since 0.022 < 0.032, it follows that K=0 is an optimal production lot sizing policy for week 2 with associated total production-inventory costs of 0.022 million UGX if demand is unfavorable. In this case, PLS = 0 regardless of the state of demand.

5 CONCLUSION

A production- inventory model with stochastic demand was presented in this paper. The model determines an optimal production lot sizing policy, production - inventory costs and the PLS of a multi-item inventory problem with stochastic demand. The decision of whether or not to produce additional units is modeled as a multi-period decision problem using dynamic programming over a finite planning horizon. The working of the model was demonstrated by means of a real case study. It would however be worthwhile to extend the research and examine the behavior of PLS of items under non stationary demand conditions. In the same spirit, the model raises a number of salient issues to consider: Production disruptions in a typical manufacturing set up including scheduled maintenance and repair, material shortages etc. Finally,

special interest is sought in further extending the model by considering PLS determination in the context of Continuous Time Markov Chains (CTMC) and Just-in Time (JIT) manufacturing concepts.

REFERENCES

[1] Mubiru P "A Markov Decision Model for Optimizing Economic Production Lot size under Stochastic Demand", *ORiON*, vol.26, issue 01, p.45, 2010.

[2] Tarim S,Kingsman B " The Stochastic Dynamic Production/Inventory Lot sizing Problem with Service Constraints", *International Journal of Production Economics*, vol.88,issue 01,106-119,2004.

[3] Lee S, Lan S & Yang C "Economic Production Lot sizing Model with stochastic demand", *Asia Pacific Journal of Operational Research*,vol.31,issue 03,2004.

[4] Roy M,Sankar S& Chaudhuri K"An Economic Production Lot size Model for defective items with stochastic demand, backlogging and rework", *IMA Journal of Management Mathematics*,vol.25,issue 2,p.159,2014.

International Journal of Innovation and Scientific Research
ISSN 2351-8014 Vol. 10 No. 1 Oct. 2014, pp. 246-254

http://www.ijisr.issr-journals.org/

Assessment of Essential and Non-Essential Metals Concentration in Some Selected Edible Vegetables Irrigated with Municipal Waste Water in Mayham, Adigrat, Estern Tigray – Ethiopia

Gebregziabher Brhane[1], Kassa Belay[2], Kiflom Gebremedhin[2], Taame Abraha[2], Tassew Alemayehu[2], Teklay Mezegebe[2], and Mebrahtu Hishe[2]

[1]Department of chemistry, Adigrat University, Adigrat, Tigray, P.Box. 50, Ethiopia

[2]Department of Biology, Adigrat University, Adigrat, Tigray, P.Box. 50, Ethiopia

ABSTRACT: This paper presents the concentration of Cu, Zn, Fe, Pb and Cd in vegetables, soil and water samples. Samples were collected from Mayham (Adigrat, Tigray region). Total acid (7ml mixture of HNO_3, H_2SO_4, $HClO_4$) digestion method was employed and determination was made by flame atomic absorption spectroscopy. The percentage recoveries of the metals were in the range of 89% to 100% in vegetable, 84% to 100% in water and 82% to 103% in soil sample. The range of concentration(µg/g) of the metals on dry weight basis are: Cd 1.18-1.45 in vegetables, 1 in soil and 9 in water; Cu 9-18 in vegetables, 15-17 in soil and 4.3 in water; Pb 1.67-5.01 in vegetable, 3-5 in soil and 2.6 in water; Zn 40-398.5 in vegetable, 59-66.8 in soil and 9.2 in water; Fe 218.25-4987.5 in vegetables, 23705.75 – 29248.5 in soil and 177.5 in water sample. The result obtained imples that the plant is rich in iron, zinc and copper and has small concentration of non-essential trace elements like lead and cadmium.

KEYWORDS: vegetable, acid digestion, metals, Mayham garden, FAAS.

1 INTRODUCTION

Food safety is a major public concern worldwide. During the last decades, the increasing demand for food safety has stimulated research regarding the risk associated with consumption of foodstuffs contaminated by pesticides, heavy metals and/or toxins. Food safety issues and potential health risks make this as one of the most serious environmental concerns. Heavy metal accumulation in plants depends upon plant species, and the efficiency of different plants in absorbing metals is evaluated by either plant uptake or soil-to plant transfer factors of the metals. Vegetables constitute essential components of the diet, by contributing protein, vitamins, iron, calcium and other nutrients which are usually in short supply. However intake of heavy metals contaminated vegetable may pose a risk to human health. Heavy metal contamination of the food item is one of the most important aspects of food quality assurance. Dietary exposure to heavy metals, namely cadmium (Cd), lead (Pb), zinc (Zn), copper (Cu) and other has been identified as a risk to human health through the consumption of vegetable crops. Heavy metals are given special attention throughout the globe due to their toxic and mutagenic effects even at very low concentration [1, 2].

Heavy metals are among the major contaminants of food supply and may be considered the most important problem to our environment. Such problem is getting more serious all over the world especially in developing countries such as North and South Africa, Zimbabwe, Nigeria, Tanzania and Egypt. Heavy metals are non-biodegradable and persistent environmental contaminants, which may be deposited on the surfaces and then absorbed into the tissues of vegetables. Plants take up heavy metals by absorbing them from deposits on the parts of the plants exposed to the air from polluted environments as well as from contaminated soils. Contamination of vegetables with heavy metal may be due to irrigation with contaminated water, the addition of fertilizers and metal-based pesticides, industrial emissions, transportation, the harvesting process,

Corresponding Author: Corresponding Author (email)

storage and/or at the point of sale (market). Human beings are encouraged to consume more vegetables and fruits, which are beneficial for health. Publicity regarding the high level of heavy metals in the environment has created apprehension and fear in the public as to the presence of heavy metal residues in their daily food. Keeping in the potential toxicity and persistent nature and cumulative behavior as well as the consumption of vegetables and fruits, there is necessary to test and analyze these food items to ensure the levels of these contaminants meet agreed international requirements [3]. Heavy metals may enter the human body through inhalation of dust, consumption of contaminated drinking water, direct ingestion of soil and consumption of food plants grown in metal-contaminated soil. [4].

Lead and cadmium are among the most abundant heavy metals and are particularly toxic. The excessive content of these metals in food is associated with etiology of a number of diseases, especially with cardiovascular, kidney, nervous as well as bone diseases. Other metals such as copper and zinc are essential for important biochemical and physiological functions and necessary for maintaining health throughout life, but if theses metals have excessive concentration above the WHO value, which cause a diseases (5).

The health effect of these metals is less studied though a number of people are consuming vegetable day to day in its raw and sauce form that may result the accumulation of trace metals in human body. However, to the extent of assessment done, there is no literature report on the determination of the levels of heavy metals in Ethiopian vegetables (cabbage, lettuce and potato). Hence, this research is intended to determine the concentration of trace metals (cadmium, copper, zinc, iron and lead) in edible vegetables that are commonly grown.

1.1 OBJECTIVE OF THE STUDY

1.1.1 GENERAL OBJECTIVE

The general objective of this study is to assess the concentration of essential and non- essential metals in municipal waste water irrigated vegetables grown in Adigrat town, particularly in Mayham.

1.1.2 SPECIFIC OBJECTIVE OF THE STUDY

To determine the concentration of essential (Cu, Zn and Fe) and non essential (Pb and Cd) metals in soil, water and edible vegetable samples treated with sewage water for irrigation.

To compare the level of essential and non- essential metals among the soil, water and vegetables.

To assess the health of metals.

2 METHODOLOGY

2.1 DESCRIPTION OF STUDY AREA

The sample for this study was collected from Adigrat town which is located in the Northern part of Ethiopia, Tigray region 898km far from Addis Ababa and 115 km away from north of mekelle town, the capital city of Tigray regional state. It is found between 14^{o}16.453' N latitude and 039^{o}, 27.654'E longitude with altitude of 2457 masl.

2.2 CHEMICALS AND INSTRUMENTATION

2.2.1 INSTRUMENTATION

The instrument used was fully automated PC- controlled true double-beam atomic absorption spectrometer with fast sequential operation for fast multi element air acetylene flame AA determinations. Its feature have 4 lamp positions and automatic lamp selection, operated with specter AA base and pro-soft ware versions with each different hallow cathode. Therefore the general setting and optional parameters of atomic absorption spectroscopy used in this study are listed as follow.

Table2.1. Working Conditions of Atomic Absorption Spectroscopy

Element	Wavelength(nm)	Slit Width (nm)	Lamp Current (mA)	Flame type
Cd	228.8nm	0.2	4.0	Reducing
Pd	230.1nm	0.4	10.0	oxidizing
Cu	324.8nm	0.5	4.0	Air/acetylene
Zn	213.9nm	1.0	5.0	Air/acetylene
Fe	248.3nm	0.2	5.0	Air/acetylene

2.2.2 CHEMICALS

Distillated water, H_2SO_4, $HClO_4$, concentrated HNO_3, stock solutions of $Cd(NO_3)_2$, $Cu(NO_3)_2$, $CaCO_3$, $Pb(NO_3)_2$, $Fe(NO_3)_2$ and $Zn(NO_3)_2$ was used in the experiment.

2.2.3 APPARATUS AND INSTRUMENTS

Poly ethylene bags, different size volumetric flasks, oven, mixer grinder, beakers, digital analytical balance, Crucibles, pipettes, thermometer, muffle furnace, filter Paper No.41, porcelain mortar, and flame atomic absorption spectrophotometer (FAAS).

2.2.4 FLAME ATOMIC ABSORPTION SPECTROMETRY (FAAS)

FAAS is a method of detecting and measuring metallic elements. It is the most widely used technique for analysis of trace metals in contaminated wastes. The introduction of FAAS has produced a rapid and relatively inexpensive method for the quantitative determination of metals at trace level (1-100 ppm) in a wide variety of samples. This technique is based on the vaporization of the analyte sample by aspirator of the solution into the flame. The samples to be investigated have to be broken in to their atoms. This is done by aspirating the sample solution into a hot flame. Before it enters the flame the solution is dispersed into a mist of very fine droplets, which evaporates in the flame. At least a part of the vaporized molecules must dissociate into atoms of the element to be measured. Light of certain wave length produced by a special type of light source or lamp is passed through the long axis of a flat flame and into a spectrometry. The atom dispersed in the flame, absorbs some of the radiation. They do not absorb all the line emitted by the lamp, since nearly all the atoms are in their ground state. Therefore only those emission lines that correspond to transitions from the ground state will be absorbed consequently, the beam of radiation coming out of the sample misses the radiation in the corresponding wave length, which is a measure of the characteristics of the sample. The instrument to be used is the buck model 210VGP atomic absorption spectrophotometer [6].

2.3 SAMPLE COLLECTION

2.3.1 COLLECTION OF WATER SAMPLE

Water sample collection was performed by the distance of 50cm in order to get representative sample and 50 cm depth in order to exclude the dust materials. Finally the freshly collected water sample was mixed together and was taken the composite sample for digestion process. Water samples means that waste water used for irrigation was collected along with the blank (distilled water) in a 100 ml pre acid - washed polypropylene bottle and 1 ml of *8concentrated HNO_3 was added to the sample to avoid microbial activity [2].

2.3.2 COLLECTION OF SOIL SAMPLE

Soil samples were also be collected in triplicate by digging out a monolith of 10 x 10 x 15 cm size from 4 different fields from waste water irrigation sites.

2.3.3 COLLECTION OF VEGETABLE SAMPLE

Vegetables samples were air dried, crushed, passed through a 2 mm mesh sieve and were stored at ambient temperature for analysis. Edible parts of different vegetables were collected from the experimental sites. Leafy vegetables such as

cabbage, potato and lettuce, only edible portion of each of the test vegetables were collected. After washing with clean tap water to remove the soil particles, vegetable sample will be oven dried at 80°c to constant weight. The dried sample was ground, passed through 2 mm sieve and stored at room temperature before analysis [3].

2.4 SAMPLE PREPARATION AND TREATMENT

For heavy metal extraction, 1 g dried sample of vegetables or soil was digested in 15 ml of HNO_3, H_2SO_4 and $HClO_4$ mixture (5:1:1) at 80 ºC until a clear and colorless solution will be obtained. A water sample (50 ml) was digested with 10 ml of concentrated HNO_3 at 80 ºC until the solution became a clear and colorless solution. These a clear and colorless solution was filtered using Whatman number 42 filter papers and diluted to 50 ml with distilled water.

The concentrations of Cd, Cu, Pb, Zn, Fe, and Ca in the filtrate was determined by using flame atomic absorption spectrophotometer (Model 2380, Perkin Elmer, Inc. Norwalk, CT, USA), fitted with a specific lamp of particular metal using appropriate blanks solution [8].

2.5 PREPARATION OF STANDARD SOLUTIONS

Determination of the metal concentration in the experimental solution was based on the calibration curve. In plotting the calibration curves lead, cadmium and chromium stock solutions of 1000 ppm were prepared by dissolving 1.6 g of $Pb(NO_3)_2$, 2.74 g $Cd(NO_3)_2.4H_2O$ and 2.83 g K_2C-/*9+/8r_2O_7 in de- ionized water respectively. Blank solutions were prepared for the methods and, for the standard working solutions, to prepare 100 ppm, 10 mL of the standard $Pb(NO_3)_2$, $Cd(NO_3)_2.4H_2O$ and $K_2Cr_2O_7$ stock solution were pipetted and added into 100 mL calibrated flasks finally diluted with de-ionized water and the solution was mixed thoroughly. Next, to prepare 50 ppm standard solution of each metal, 50 mL of each of 100 ppm stock solution was pipetted into 100 mL volumetric flasks and diluted with de-ionized water. Finally to prepare 0.0, 0.5, 1.0, 2.0, 4.0, 6.0 ppm aliquots of this standard working solution 0.0, 0.5, 1.0, 2.0, 4.0, 6.0 mL was pipetted from 50 ppm standard solution into 50 mL calibrated flasks and made up to volume with De-ionized water [9].

2.6 ANALYTICAL PROCEDURE FOR HEAVY METAL ANALYSIS BY FAAS

Soil, water and vegetable samples were analyzed for heavy metals using FAAS. The heavy metals analysis adjustment of the operating condition was very essential target. Wavelength, slit width, limit of detection was adjusted for the analysis of the metals Pb, Cd, Fe, Ca, Zn and Cu. 1000 mg/l Standard solutions of metals was prepared in 0.1 N HNO_3 for calibration curve from the standard salt of each metal in 1000 ml volumetric flask. From this stock solution 100 mg/l of each metal was freshly prepared by diluting in 100 ml volumetric flask with distillated water and then the working solution (10 mg/l) of each metal was prepared. For the determination of these metals, four solutions was prepared for each sample from each source and four standard solutions was made for each metal which is shown below and rinse blank (distilled water) was used to flush the uptake system to reduce memory interferences [10].

Table2. 2. Standard concentration of the metals to be analyzed by FAAS

Metals	Concentration of standards (mg/kg)
Pb	0.2, 0.4, 0.8, 1.2
Cd	0.1, 0.3, 0.7, 1.1
Zn	0.5, 1.0, 3.0, 5.0
Cu	0.10, 1.0, 2.0, 4.0
Fe	0.5, 1, 2, 4

2.7 DATA ANALYSIS

The statistical analysis of all data was conducted using SPSS software (version 16.0). One way ANOVA was used to determine the significance difference of the metals among soil, water and vegetables at $P < 0.05$ of significance level.

3 RESULT AND DISCUSSION

3.1 VALIDATION OF EXPERIMENTAL RESULTS

3.1.1 DETERMINATION OF DETECTION LIMITS

Method detection limit defined as the minimum concentration of analyte that can be measured and reported with 99% confidence that the analyte concentration is greater than zero. Detection limit is the lowest concentration level that can be determined at 95% confidence level [6] or the minimum concentration that can be detected by the analytical method with a given certainty [9]. A general accepted definition of detection limit is the concentration that gives a signal three times the standard deviation of the blank or background signal. In this study the detection limit of each element was calculated as three times the standard deviation of the blank (3σ blank, n = 5), as summarized in **Table 3.1.**

element	MDL	LOQ
Cd	0.001	0.01
Cu	0.03	0.3
Pb	0.002	0.02
Zn	0.002	0.02
Fe	0.03	0.3

3.1.2 RECOVERY TESTS

The efficiency and accuracy of the optimized methods were evaluated by analyzing the digests of spiked samples. 0.02, 0.02 ppm of Pb, Cr and 0.2 ppm Cd, respectively, were taken from stock solution of each metal and spiked in a 250 mL Erlenmeyer flask containing 1g spice sample. The recoveries of metals in the spiked spice samples were 92 to 103 %. The results are given in Table 6. Generally, good recoveries were obtained for all metals, (particularly in Garlic for metals like Cd, Pb and Cr). In Cd the percentage recovery for all samples except Fenugreek were not calculated due to results obtained was not within the method detection limit. Each determination was carried out at least three times in order to ensure precision. The relative standard deviations were less than 10% for all measurements.

$$\% \textbf{ Recovery} = \frac{\textbf{Amount after Spike – Amount before Spike}}{\textbf{Amount Added}} \textbf{x 100 [9]}$$

Table 3.2: the percentage recovery test

Metal	Vegetables			water	soil		
	Cabbage	Lettuce	Potato		Cabbage	Lettuce	Potato
Pb	95	96	97	96	99	98	103
Cu	94	93	95	98	95	97	99
Cd	92	94	94	84	99	82	85
Fe	100	99	93	95	93	98	91
Zn	96	92	89	100	92	100	96

3.2 DISCUSSION

Optimum method was selected for sample digestion from the tested procedure with preconditions producing clear and colorless solutions with minimum reagent volume, less digestion time and digestion temperature. The method fulfilling such conditions considered to be optimum [11]. The efficiency of methods used for sample preparation was evaluated with spiked recoveries and the detected heavy metals indicated a recovery above 90% with relative standard deviations below 10% showing the method used was efficient.

3.2.1 DISTRIBUTION OF HEAVY METALS IN VEGETABLES OF MAYHAM GARDEN

All the three trace elements evaluated in this study were above detection limits in the edible vegetable and the method detection limits of each element were calculated as MDL = 3α blank.

Table 3.3. Distribution of trace elements (mg elements/kg dry mass) in vegetables of the mayham garden (mean± s.d for n=3).

№	element	site			
		cabbage	lettuce	Potato	Detection limit
1	Cd	1.20±0.003	1.45±0.002	1.18±0.01	0.001
2	Cu	12.50±0.23	18.75±0.22	9.75±0.1	0.03
3	Pb	2.56±0.01	5.01±0.11	1.67±0.02	0.002
4	Zn	40.25±0.6	398.5±0.88	40.00±0.66	0.002
5	Fe	466.50±0.9	4987.50±0.77	218.25±0.75	0.03

As can be observed from **figure 2** the distribution of trace metals varied as follows: Cd concentration varies in the order: lettuce > cabbage > potato, Pb, Zn and Fe was similarly varied as lettuce > cabbage > potato.

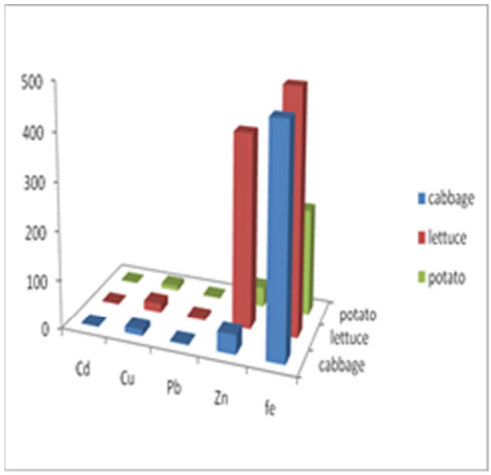


Figure 3.1. Distributions of essential and non essential metals on the vegetables

3.2.2 DISTRIBUTION OF TRACE METALS IN SOILS OF MAYHAM GARDEN

Heavy metals uptake and accumulation occurs mainly from water or soil due to the direct contact of with those vegetables I n the providing of available nutrients. The efficiency of assimilation in different plant organisms might be affected by many factors such as: ecological needs, habitat, and biology of plant organisms [12]. Due to this the concentration distribution in the soil of each vegetable of mayham garden is listed in the table below.

Table 3.4. Distribution of trace elements (mg elements/kg dry mass) in the soil of the vegetables found in mayham garden (mean± s.d for n=3)

№	element	site			
		cabbage	lettuce	Potato	Detection limit
1	Cd	1.00±0.001	1.00±0.001	1.00±0.001	0.001
2	Cu	16.00±0.02	17.30±0.32	15.30±0.45	0.03
3	Pb	5.00±0.03	3.00±0.8	5.00±0.91	0.002
4	Zn	66.80±0.07	61.00±0.9	59.00±0.6	0.002
5	Fe	29248.50±0.4	26177.75±1.5	23705.75±1.5	0.03

As can be shown in the above table the concentration variation found in the soil of each vegetable was observed slightly difference in some of those metals as well as greater difference was observed in two of those metals while the same in Cd metal. As it was tried to mention in the above the same concentration of Cd metal was recorded in the soil of each of the three vegetables. Whereas, the slight concentration difference found in Zn was placed as cabbage > lettuce > potato, Cu place as lettuce > cabbage > potato, Fe concentration was similarly varied as Zn. Out of the trace metals that they were

determined in the mayham garden Pb concentration found in the soil of each vegetables like potato and cabbage is equal in concentration but in lettuce it was less than the two vegetables.

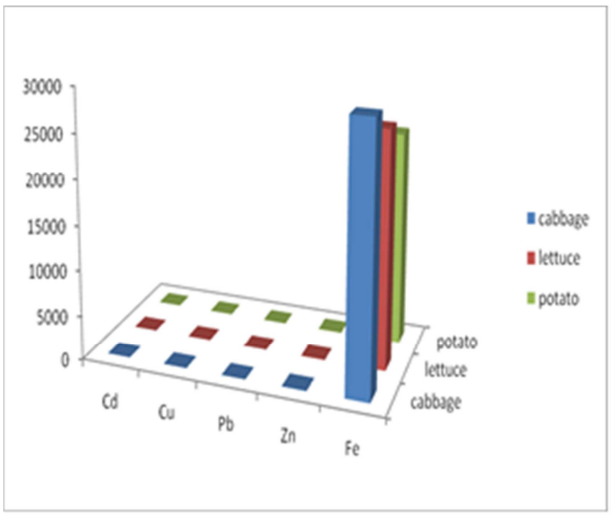


Figure 3. Distribution concentrations of metals in soil sample of the garden

3.2.3 DISTRIBUTION OF THE TRACE METALS IN WATER FOUND IN THE VEGETABLE GARDEN

Water may be one of the contributors in order to increase the trace metal accumulation of vegetables. Hence, the concentration of each trace metals in water is listed in the table below.

Table 3.5. Distribution of concentration of metals in water sample of mayham garden

Sample	Trace metals				
	Cd	Cu	Pb	Zn	Fe
Water	9±0.3 µg/l	4.3±0.1 µg/l	2.6±0.04 µg/l	9.2±0.2 µg/l	177.51±1.5µg/l

3.2.4 STATISTICAL ANALYSIS OF VARIANCE (ANOVA)

Analysis of variance (ANOVA) is powerful statistical technique which can be used for the separation and estimation of the different causes of variation of more than two means for different experiments. The possible sources of variation are due to the random error in measurement, which causes a different result to be obtained each time a measurement is repeated under the same conditions. As the means vary from one sample to another, ANOVA tests whether there is significance difference between the samples means and thus enabling to explain the cause of error. ANOVA is used to test hypothesis about difference between two or more means where there is one variable or factor being considered and replicate data from changing the level of the variables are available [13]. For this study, the significance of variation between samples was analyzed using one-way ANOVA which can be made using detail calculations following a statistical formula or by computer using excel and SPSS software. For this study SPSS (version 16) was used for statistical analysis to know the presence or absence of significant difference in mean concentration of each metal between each vegetable analyzed sample among the three sites. For $P > 0.05$ the levels of each particular metal in all vegetables as well as soil together with water were not significantly different except the concentration of Fe in all the sample ingredients. This is due to the presence of Fe metal in vegetables, soil and water naturally even though it might not beer any effect as it becomes essential.

3.2.5 COMPARISON BETWEEN THE AVERAGE HEAVY METAL CONTENT OF VEGETABLES OF THIS STUDY WITH THAT OF LITERATURE AND WHO VALUES

There are some reports from different countries on the analysis of the metal contents of the vegetables**.** It is important to compare the result obtained from the analysis of the three vegetables in this study with the values sited in other countries and WHO guideline values. Currently almost half of the concentration of trace and heavy metals that are determined in this study were in the permissible range of the international guidelines listed below. Hence, Cd, Pb and Fe were above the

maximum permissible -certified reference approved by FAO/WHO. Whereas the rest trace metals concentration were within the reference range that are found in the international guidelines. The concentration of Fe metal couldn't beer an adverse effect on the health of the society. Why is that as Fe is essential metal in nature and so has different metabolically activities of the body of human as well as in hemoglobin and so on. However, the concentration of Pb and Cd which heavy metals in nature might pose an adverse effect on the health of the society as they are toxic in small concentration in nature.

As per the finding the concentration of Cd and Pb exceeds above the international guidelines. So that this study was the pointer to be careful all over the society used in that garden.

Table 3.6. FAO/WHO guideline values for the maximum concentration of heavy metals in vegetables [11].

№	element	site				
		Maximum allowable limits of elements in fruits and vegetables mg/Kg dry weight	cabbage	lettuce	Potato	Detection limit
1	Cd	0.2	1.20±0.003	1.45±0.002	1.18±0.01	0.001
2	Cu	40	12.50±0.23	18.75±0.22	9.75±0.1	0.03
3	Pb	0.3	2.56±0.01	5.01±0.11	1.67±0.02	0.002
4	Zn	60	40.25±0.6	398.5±0.88	40.00±0.66	0.002
5	Fe	425	466.50±0.9	4987.50±0.77	218.25±0.75	0.03

4 CONCLUSIONS AND RECOMMENDATION

4.1 CONCLUSIONS

Determination of heavy metals concentration in vegetables and food products is important for health risk assessment during food consumption. Heavy metals are not only affecting the nutritive values of vegetables but also have deleterious effect on human beings using these food items. The levels of trace and heavy metals such as Fe, Pb, Cd, Cu and Zn concentration were studied lettuce, potato and cabbage vegetables, and the permissible levels with international guidelines for safe food were compared. The optimum procedure selected for digestion process produced good recovery results ranged from 91.09±1.3 up to 104±1.37 with RSD below 10% which shows the efficiency of method used. The concentration of Fe was found in the higher concentrations compared to other metals analyzed or significantly different at 95% confidence level than the rest metals studied in this study. However, the levels of the concentration of Fe, Pb and Cd exceeded the permissible level set by FAO/WHO specifications in all vegetable samples collected from mayham gardens, but Cu and Zn were below the recommended levels. The higher concentration of Pb and Cd above the permissible level in vegetables used for human food may pose health risk to consumer. However, the concentration of Fe hasn't any health effect on the body of the people's they take from the garden. Concentration results of metals between samples were also compared using one-way ANOVA to be proved statistically. The results of ANOVA indicated that there were not significantly different in the levels of most metals between the three samples each of lettuce, potato and cabbage with their soil and water of the garden except the concentration of Fe in all the sample ingredients.

Generally, the levels of metals in similar vegetable samples differed between the three sampling site, that may be due to variation in sources and processes of contaminations that could attribute to metals contamination to take place during pre-harvest and post-harvest process. Possible sources during pre-harvest include from soil type, fertilizers, pesticides, municipal wastewater and water used for irrigation, while post harvest sources may include contamination through air pollution and during transport to the market or at the point of sale.

4.2 RECOMMENDATION

Lastly the researcher recommends the following

- It is recommended that these types of vegetables should not be cultivated in farms and fields nearby urban areas which have heavy vehicle movements and irrigated with questionable water quality which could be sources of heavy metals contamination.
- This study further suggests that to reduce the health risk, vegetables should be washed properly before consumption as washing can remove a significant amount of aerial contamination from the vegetable surface.
- Markets establishments for vegetable sale should be away from motor vehicle parking and movement areas, as motor vehicle emissions can be a source of heavy metal contamination in vegetables at road side market.
- Use of good agricultural practices under supervision for proper fertilizer application.
- Further works should be carried out in the soil samples where the vegetables are grown, irrigation water and compost or fertilizers on the availability of metals to different vegetable, as it could be useful to take remedial measures by regulatory agencies of the town to abate the metal pollution and also restrict the cultivation of vegetables on contaminated soils.

REFERENCES

[1] A. Maleki and M. A. Zarasvand, Heavy metals in selected edible vegetables and estimation of their daily intake in Sanandaj, Iran, *J. Med. Scie., Sanandaj, Iran*, 39, 2 (2008) 335- 337.

[2] R. k. Sharma, M. Angrawal and F. M. Marshal, Heavy metal in vegetable collected from production and market sites of tropical urban area of India, *J. Food and Chem. Toxicol.,* 47 (2009) 583-591.

[3] M. A. Radwan and A. K. Salama, Market basket survey for some heavy metals in Egyptian fruits and vegetables, *Food and Chem. Toxicol.*, 44 (2006) 1273-1278.

[5] S. R. Khan, Farooq, S. Shahbaz, M. A. Khan and M. Sadique, Health risk assessment of heavy metals for population via consumption of vegetables, *J. World App. Scie.,* 6, 1 (2009) 1602-1606.

[6] K. P. Sampath Kumar, D. Bhowmik, Chiranjib, Biswajit and P. Tiwari, Allium cepa: A traditional medicinal herb and its health benefits, *J. Chem. Pharm. Res*., 2, 1 (2010) 283-291.

[7] M. Bunning and P. Kendall, Health benefits and safe handling of salad greens, Food and nutrition, (2007).

[8] G. Oboh, R. L. Puntel and J. B. T. Rocha, Hot pepper (capsicum annuum, tepin and capsicum chinese, habanero) prevents Fe^{2+} induced lipid peroxidation in brain – in vitro, *J. Food Chem*., 102 (2007) 178–185.

[9] D. Kanakaraju, N. A. Mazura & A. Khairulanwar, Relationship between metals in vegetables with soils in farmlands of kuching, Sarawak, *Malaysian J. Soil Scie.,* 11 (2007) 57-69.

[10] A. E. Mohamed, M. N. Rashed, and A. Mofty, Assessment of essential and toxic elements in some kinds of vegetables, *Ecotoxicol. and Environ. Safety*, 55 (2003) 251–260.

[11] Codex Alimentarius Commission (FAO/WHO), Food additives and contaminants-Joint FAO/WHO Food Standards Programme, (2001) 1-289.

[12] D. Zhang, C. Li, L. Yang and H. Sun, Determination of heavy metals in vegetables by derivative flame atomic absorption spectrometry with the atom trapping technique, *J. Anal. At. Spectrum*, 13 (1998) 1155–1158.

[13] S. A. qader and S. Mousa, Determination of lead and cadmium in food by anodic stripping voltmmetry, An-najah national university faculty of graduate studies, (2004).