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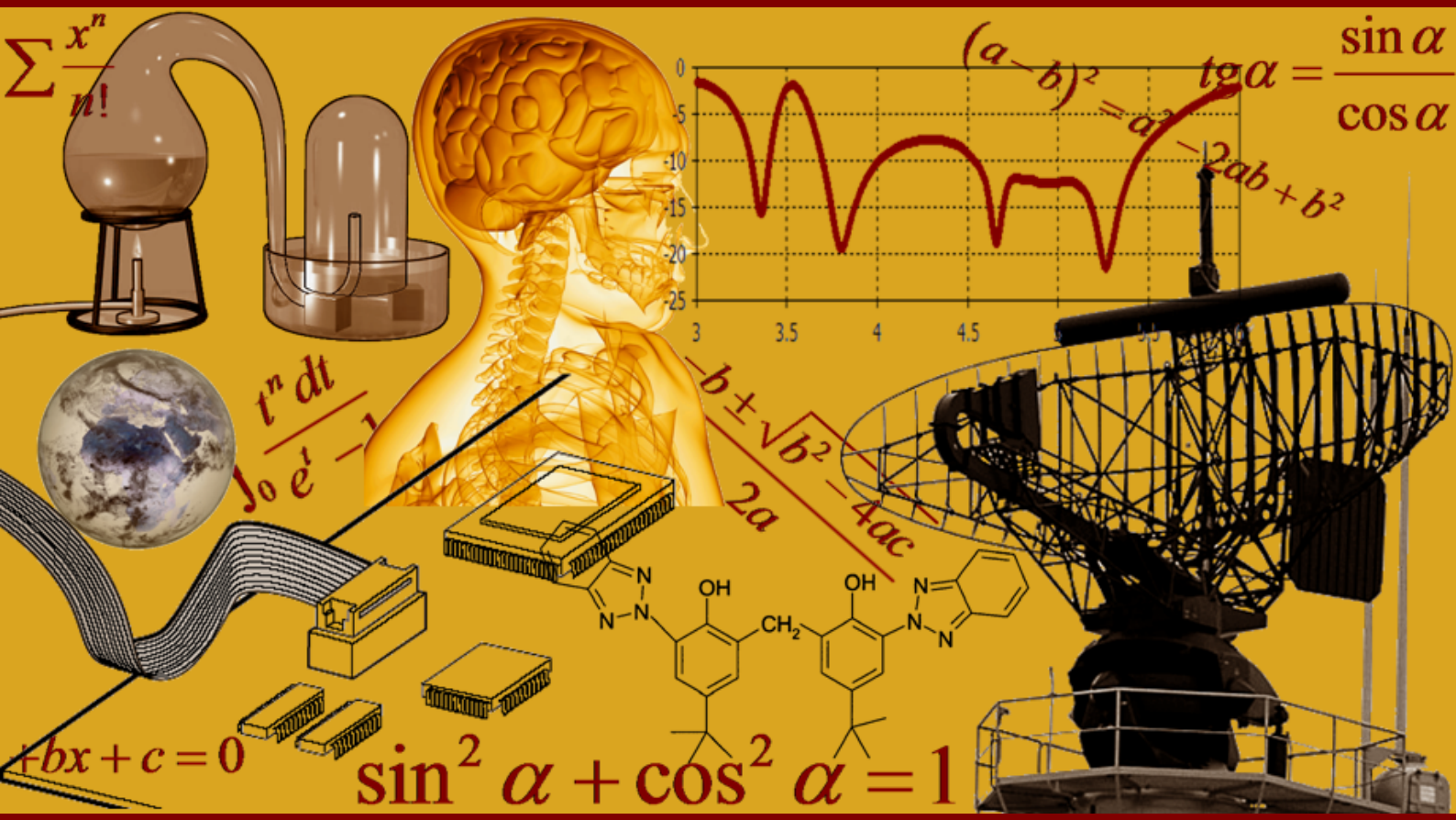

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Table of Contents

International Journal of Innovation and Scientific Research
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Hand Gesture Robot Control Using Color Recognition System

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ABSTRACT: Recently, the interaction between humans and robots has become an important issue for extending the use of robots. The purpose of this project is to show how a real-time human-robot interaction with hand gesture recognition which can be constructed using color recognition System. Hence, it is required that the following two major questions be resolved in this study. Firstly, either staying in indoor or outdoor lighting conditions, the robot must be able to detect *and spot hand gestures with a specific color from data of robot vision system*. Secondly, it is necessary that the robot also can interpret hand gestures performed by *humans*.

KEYWORDS: Digital Image Processing, hand gesture control, open cv, color recognition.

1 INTRODUCTION

In today's world generally robots are controlled using remote controls or joysticks. But if the remote gets damaged or if it doesn't work then there is no medium to give commands to the robots. So we have come up with a project which would control the robots on the basis of commands given through hand gestures.

In this article a camera is placed in front of the controller of the robot. The controller of the robot will make gestures which will be captured by the camera placed in front of the controller. Then the gestures will be recognized using image processing algorithms to convert them into appropriate commands for the robot. The commands will be then given to the robot and accordingly the robot will execute.

Thus by using our project the limitation of using a remote or a joystick will overcome which will improve the efficiency of the robot as the distance at which a joystick or remotecommunicates is limited. By using our project the distance at which we can communicate can be improved at a range of 5– 6 Km.

A. Existing System

Robot Control using remote Control or Joystick

In today's world generally robots are controlled usin remote controls or joysticks. Although remote control system is very much popula , it has some limitations.

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Fig1. Robot Control through Robot

Limitation of remote control system :

If the remote gets damaged or if it doesn't work then there is no medium to give commands to the robots.

Also Remote control robots are a bit more complex to control than some other devices. There are more moving parts on these devices in most cases, as well as more actions for them to perform

B. Proposed Hand Gesture Robot Control System

To overcome the limitations of existing system, we have come up with a project which would control the robots on the basis of commands given through hand gestures.

In this proposed system, a camera is placed in front of the controller of the robot. The controller of the robot will make gestures which will be captured by the camera placed in front of the controller. Then the gestures will be recognized using image processing algorithms to convert them into appropriate commands for the robot. The commands will be then given to the robot and accordingly the robot will execute.

Thus by using this technique the limitation of using a remote or a joystick will overcome which will improve the efficiency of the robot as the distance at which a joystick or remote communicates is limited. By using this technique the distance at which we can communicate can be improved at a range of 5 – 6 Km.

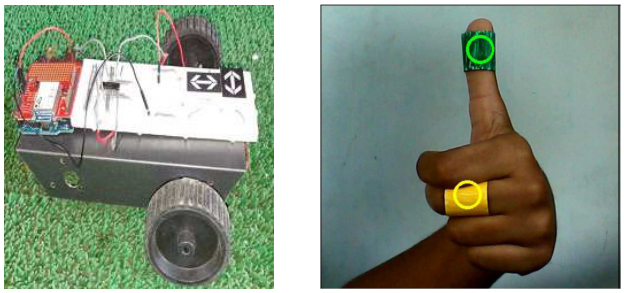

Fig 2. Robot Control through Hand Gesture

Requirements for this system:

Software requirement: - .net framework, Open CV SDK

Hardware requirement:- Robot, webcam, 1 Gb RAM, Pentium4 processor with parallel port

Advantage: - Easy to use, Friendly interaction. No need forremotes so cost effective

Disadvantage: - High processing power required for imageprocessing.

Flow for the software development:-

Training module

1) Initialize camera
2) Capture frame
3) RGB to Grey conversion
4) Grey to Binary conversion
5) Train colors to system

2 TECHNOLOGIES USED

In this project, we propose a gestures recognition method to recognize a number of well-defined hand gestures representing a limited set of commands that the humans can give to the mobile robot Firstly, by analyzing the distribution of the specific color in hue saturation intensity (HSV) colorSpace, a color multithresholding method was developed for detecting hand gestures in video sequence under varying lighting conditions. Secondly, the feature extraction of hand gestures was performed by the detection algorithm and by applying threshold value. Thirdly we can obtain the particular signal for robot movement subtracting the coordinates of the two colors. Finally, a real-time vision system on hand gesture recognition for a human-robot interaction is presented. The frames captured by the camera are in HSV format. We convert it to grayscale image. Then applying threshold value for one color the gray image is converted to binary image. In binary image the threshold color turns white & the background becomes black. Now using moments we can find the co-ordinates of this blob. Same thing has to be done for the other color. Now we have the co-ordinates of the two colors. On subtraction of x & y co-ordinates we get the direction of the vector. Thus then we give command to the robot in this way.

Flow chart for recognizing gesture & give commands to the robot Algorithm for the program which converts the gestures to commands for the robot is as follows:

1) Capture a frame from camera. It's in BGR format.

2) Convert this BGR image to HSV OR RGB. (HSV is preferred since it is more noise free than RGB).

3) Convert this image to binary image by applying lower range & upper range of desired color

(i.e. to make desired color white & rest black).

Flo Flow chart for recognizing gesture & give commands to the robot

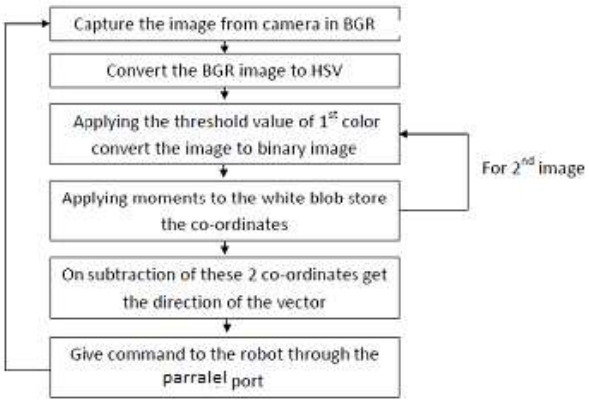

Fig 3: Flow chart for recognizing gesture

4) Find out the moment of each color on thumb and nuckel.
5) From the moments find out the coordinates of the each color viz X coordinate and Y coordinate
6) Subtract the coordinates to find out the direction of the movement of the robot.

BGR TO HSV CONVERSION

This module consists of two phases namely the image acquisition and image processing phases. The acquired images using a web cam for each hand gesture are in BGR format. We will convert it to HSV or RGB image. We prefer HSV since it is more noise free than RGB. The image is thensubjected to an image enhancement process to adjust the intensity values in HSV image to increasethe contrast of the output image. Figure 2 shows an acquired image of a sample hand gesture afterenhancement where the captured green portion is marked by a green circle & yellow portion byyellow circle. This gesture represents a vector in forward direction.

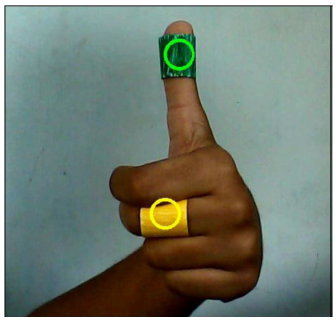

Fig 4 original hsv image

HSV TO BINARY CONVERSION (Thresholding)

Since we deal with the segmentation of color on thumb and nuckel color, a threshold value of the particular color level is chosen to convert the image to binary. The threshold value for the two colors must be different. This threshold value should be chosen carefully to avoid effect noise or any other color detection in the territory. We can convert this image to binary image by applying lower range & upper range of desired color (i.e. to make desired color white & rest black).

We are going to use software opencv because opencv has a function to convert the HSV OR RGB image (step 2) into binary image directly. i.e. no need to convert image to grayscale & then to binary. The removal of these extra results in reduction in time complexity & space complexity.

FILTERING THE BINARY IMAGE

The binary image obtained as shown in fig.4 can be filtered with help of median smoothing algorithm. This filtering is required to remove the noise if any introduce by thresholding the grayscale image. Median smoothing algorithm is the simple algorithm used for removal of the noise from the signal or an image.

FINDING THE COORDINATES

Once we obtain the binary image from thresholding the colors we get two white blobs of two colors as shown in figure. By applying logic in physics we can find out the moment of the white blob. An Image moment is a number calculated using a certain formula. With help of the moment of the blob we can find out the co- ordinates of the color on the thumb with equation 1 and 2

$$\text{X coordinate} = \frac{\text{Moment of X (1)}}{\text{Total area of the white bolb}} \qquad (1)$$

$$\text{Y coordinate} = \frac{\text{Moment of Y (2)}}{\text{Total area of the white bolb}} \qquad (2)$$

COORDINATE SUBTRACTION

Find out which movement should be there (X, Y), we will need to subtract the coordinates of the two colors.

X= X1- X2, Y= Y1-Y2

After subtracting the coordinates for two colors we are able to find direction of movement of the robot. According to the decisions made in the program the robot will move. Same procedure is followed for all the robot movements.

Once we obtain the coordinates (X1, Y1) for the color on thumb, we are able to find out the coordinates of the other color on the nuckel(X2, Y2). Fig5 shows the coordinates obtained for the green color and yellow colored ring in the fig 2 for forward direction.

3 HARDWARE ARCHITECTURE

The hardware architecture of this project is consist of two basic parts namely Transmitter unit, Receiver unit. The block diagram of these parts is as shown in figure 5 and figure 6 respectively. On the transmitter side it is consist of PC with gesture recognition software connected to web camera which in turn connected to RF transceiver through parallel port whereas the receiver unit is consist of blocks like RF transceiver module, L293 motor driver along with DC geared motor ,5V regulated power supply.

RF TRANSMITTOR

The RF transmitter used in our project is TWS-434A. This RF transmitter transmits data in the frequency range of 433.92 MHz with a range of approximately 400 foot (open area) outdoors. Indoors, the range is approximately 200 foot, and will go through most walls. TWS-434A has features TWS-434A has features which includes small in size, low power consumption i.e. 8mW and operate from 1.5 to 12 Volts DC, excellent for applications requiring short-range RF signal. Data to be send is Amplitude modulation with the carrier RF signal.

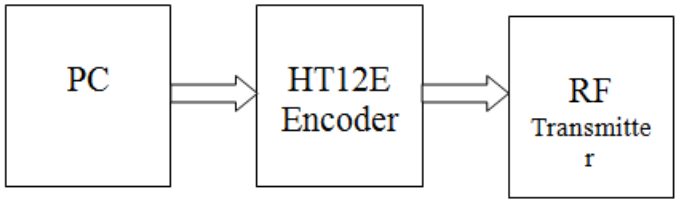

Fig 5 : Block Diagram of Transmitter Side

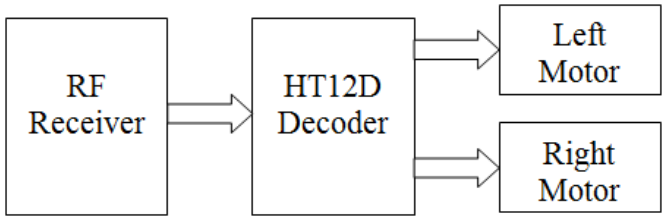

Fig 6: Block Diagram of Receiver Side

RF RECEIVER

The RF receiver receives an RF signal, converts the RF signal to an IF signal, and then converts the IF signal to a base band signal, which it then provides to the base band processor.

The RF receiver used is RWS-434. This RF receiver receives RF signal which is in the frequency of 434.92 MHz and has a sensitivity of 3uV. The RWS-434 receiver operates from 4.5 to 5.5 volts-DC, and has both linear and digital outputs and its tunable to match the frequency of the transmitter unit.

ENCODER

An encoder can be a device used to change a signal (such as a bit stream) or data into a code. Encoder used here is HT 12E. The HT12E encoder is a CMOS IC It is capable of encoding 8 bits of address (A0-A7) and 4-bits of data (AD8-AD11) information. Each address/data input can be set to one of the two logic states, 0 or 1. Grounding the pins is taken as a 0 while a high can be given by giving +5V or leaving the pins open (no connection). Upon reception of transmit enable (TE-active low), the programmed address/data are transmitted together with the header bits via an RF medium.

DECODER

A decoder is a device which does the reverse of an encoder, undoing the encoding so that the original information can be retrieved.. The decoder used here is HT 12D. The HT12D is a decoder IC made especially to pair with the HT 12E encoder. It is a CMOS IC. The decoder is capable of decoding 8 bits of address (A0 - A7) and 4 bits of data (AD8 - AD11) information. For proper operation, a pair of encoder/decoder with the same number of addresses and data format should be chosen. The decoders receive serial addresses and data from programmed encoders that are transmitted by a carrier using an RF or an IR transmission medium. They compare the serial input data three times continuously with their local addresses. If no error or

unmatched codes are found, the input data codes are decoded and then transferred to the output pins. The VT pin also goes high to indicate a valid transmission. The decoders are capable of decoding information that consists of N bits of address and 12_N bits of data. Of this series, the HT 12D is arranged to provide 8 address bits and 4 data bits.

MOTOR DRIVER L293

The L293 is an integrated circuit motor driver that can be used for simultaneous, bidirectional control of two small motors. The L293 is limited to 600 mA, but in reality can only handle much small currents unless you have done some serious heat sinking to keep the case temperature down. Unsure about whether the L293 will work with your motor? Hook up the circuit and run your motor while keeping your finger on the chip. If it gets too hot to touch, you can't use it with your motor. The L293 comes in a standard 16-pin, dual-in line integrated circuit package.

DC GEARED MOTOR

Carbon brush of DC motor for the main role to play for, for referring to the rotating armature winding components from one slip to another slip, the brush in the process of short-circuit current generated by components within Change of direction. For the poor performance at run-time is the electrical spark happened. Level and sparks more than a certain limit will cause the carbon brush and commutator surface damage, with the result that should not continue to run the motor. When the motor for the situation well, sparks larger, an increase of the electrical brush wear. Especially when the commutator surface oxide film is damaged, the wear will be increased significantly.

4 CONCLUSION

The Hand Gesture Controlled Robot System gives an alternative way of controlling robots. Hand Gesture control being a more natural way of controlling devices makes control of robots more efficient and easy. This project presented a gesture controlled wireless robot that does not require any special markers or gloves and can operate in real-time on a commodity PC with low-cost camera. Specifically, the system can track the coordinates of each color on the thumb and nuckel for each hand, assuming that a calibrated camera is viewing the hands from above with the palms facing downward. The algorithm for gesture recognition is implemented in opencv and .net. This project presents a fast, robust and accurate method for hand gestures recognition under unconstrained scenes. The failure of the system to recognize the gesture is mainly due to the very changeable lighting conditions and moving objects (persons) entering the scene, operator's failure to move the hand to the proper posture. It must be emphasize that after a short experience operators get used to the system. Future work will be focused on algorithm improvement, by using a combination of segmentation techniques and robot motion control by tracking the arm movement and its speed.

ACKNOWLEDGMENT

I take this opportunity to express my heart-felt gratitude to my guide, **Prof. Chouthmol L.K.,** for her constant encouragement, wonderful technical guidance and support throughout the course.

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An assessment of the conditions requisite for learning Kiswahili language by learners with hearing impairment in Mumias Primary School for the Deaf in Kakamega County, Kenya

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ABSTRACT: In Kenya, Kiswahili is important, not only as a national and official language in Kenya, but as a compulsory subject in primary and secondary school curricula. There has been an outcry by various stakeholders that learners perform poorly in Kiswahili in both local and national examinations. The focus of this paper is to assess the availability of the conditions requisite for excellence and educational resources used in teaching and learning Kiswahili among the hearing impaired learners. The study was carried out at the Mumias School for the Deaf in Kakamega County, Kenya. The school was purposively selected because all the pupils in the school had hearing impairment. A sample size of six teachers and thirty-two pupils was involved in the study. The study was guided by the behaviourist theory of language acquisition which emphasizes language learning through Stimulus-Response-Reward (S-R-R) chains. It employed qualitative approach as a major research methodology and was carried out in the form of a case study. Quantitative analysis was used to compare KCPE results between Kiswahili and other subjects in the school. The instruments used for data collection were: non-participant observation guide, three interview guides for the head teacher, Kiswahili teachers and learners with HI, document analysis and data sheets. Raw data collected was categorized into themes and data presentation was done using frequency distribution tables, pie charts, histograms line graph and descriptive passages. Interpretation of the study findings was done in the light of the tenets of the study guiding theory of Stimulus-Response-Rewards (S-R-R). The study found that performance in Kiswahili was poor due to several reasons, among them being the conditions at the school were not conducive to effective learning of Kiswahili. It was recommended that teachers should revert to the horse-shoe seating arrangement as this would inevitably shift the passive class atmosphere to one that is more interactive and cordial, allowing peer-peer learning to take place. Moreover, classrooms should be flooded with play things especially in lower classes to facilitate more Kiswahili language experiences. A change in policy that would provide KSL training for examination officials in order to improve examination standards and that teachers train learners with HI on how to tackle examination questions.

KEYWORDS: conditions, learning Kiswahili language, learners, hearing impairment, Mumias Primary School, Deaf, Kakamega County, Kenya.

1 INTRODUCTION

Kiswahili is rated among major languages of the world today (Chiraghdin & Mnyampala, 1977). It is broadcasted widely in the media and taught by many universities worldwide (Chiraghdin & Mnyampala, 1977). The language has continued to receive appraisal both locally and globally. In Eastern Africa, for instance, it is lingua franca and as such facilitates communication among several people of diverse linguistic background. In Kenya, the teaching of Kiswahili dates back to 1909 when the then United Missionary Conference (UMC) decreed vernacular languages and Kiswahili to be used as media of instruction in classes four and five in African schools.

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The conditions requisite for effective teaching of a language such as Kiswahili, especially to learners with hearing impairment, are discussed in this paper under the following categories:

- The learning environment
- Learning experience
- Evaluation
- Teachers' and learners' attitudes towards language learning
- Reinforcement

2 LITERATURE REVIEW

2.1 LEARNING ENVIRONMENT

The classroom arrangement should be adapted to suit learners' special needs in conjunction with the teaching/learning strategy in use. Learners should maintain eye contact with one another and with the teacher for ease of communication. UNESCO (1987) recommends horse-shoe arrangement for classes not exceeding ten. However, in Kenya, twelve is the number signed approved by the Ministry of Education. To facilitate speech reading, the teacher should sit at a low chair to have her face at the same level as the learners' faces. There should be enough light in the room, particularly on the learners as well as the teacher. Such seating arrangement will allow for better inclusion of learners with hearing impairment.

2.2 LEARNING EXPERIENCE

A child with hearing impairment largely lacks experiences that one would expect from children of the same age to have. They lack knowledge and many skills in language issues (UNESCO, 1987). In their early days in school, the teacher should flood the class with language experiences and other forms of communication. Children should be involved in activities like play with toys and other things from daily life. In a class for learners with hearing impairment, the type of activities selected should enhance both receptive and expressive skills of the learners. The activities should be relevant to individual learners' needs. The primary school syllabus for English (Kenya Institute of Education [KIE], 2004) outlines these learning experiences as receptive skills and expressive skills.

Receptive skills

A child with hearing impairment will be expected to develop and refine their listening skills through carrying out observations of poems, signed stories and short passages. Their response to signed comprehensions, participation in role play and understanding instructions, explanations, descriptions, visual materials, proverbs and announcements will go a long way in refining their receptive skills. Learning experiences are laid down with increasing complexity of content as the grade increases but basically each class has their own activities (KIE, 2004).

Expressive skills

Learning experiences for the expressive skills have a wider scope of operation as outlined in the syllabus (KIE, 2004). Learners are engaged in signing as a form of "speaking" in response to what they are involved in. Participation in discussions, debates, interview, asking and answering oral questions or even storytelling, among other activities, can be done through signing. For advanced grades, learners can write down their responses such as letter writing, composition writing, compiling of school magazines and others. Reading of instructions and directions, library books or comprehension passages will also be a learning experience for the learners. The learners can therefore either sign, finger spell, write or read to express themselves. Drawing plays an important role in expression and appreciation of the children's creative ability (Kithure, 2002). Kithure (ibid.) further identifies demonstration, note taking, tracing, modelling, mimicry and pantomime as learning experiences for these learners in addition to what is laid down in the syllabus.

Learning experiences are suggested for each language skill, reading and writing, listening and speaking. For the learners with hearing impairments, these skills are modified into expressive signing, receptive signing, writing and observation; finger spelling supplements signing where signs are not available. Pupils' ability to sign fluently depends on language exposure. Constructive classroom signing and observation should be encouraged. As such, learners should be granted ample opportunities to sign and observe about themselves, express their ideas and opinions, sign stories, discuss events and describe their experiences (KIE, 2004).

2.3 EVALUATION

Evaluation is a general term used to determine any learning process. It is an approach of determining student achievement during implementation of the curriculum in the school (Shiundu & Omulando, 1992). Kissock (1981) asserts that evaluation is the process through which students' performance and program effectiveness are assessed. It presents students, teachers and curriculum developers with feedback on their success in achieving programme objectives. This forms the basis for making sound decisions on which to modify and improve the programme. The central concern of evaluation is determination of outcomes. Evaluation can either be formative or summative. The former is informally carried out by teachers during implementation of the curriculum. The latter is carried out formally, at the end of the course by KNEC which works closely with the DQAS and KIE. Part summative evaluation is, however, done at the end of every year for promotion of learners to higher grades (Kilei, 2003).

In evaluation of student performance, a number of evaluation tools can be applied depending on the purpose for which it is done, whether formal or informal. Shiundu and Omulando (1992) identify several tools for formal evaluation. Continuous Assessment Tests (CATS) can be organized by teachers on a weekly, fortnightly, monthly, mid-termly or termly basis. This is referred to as formative evaluation. Tools used include essays, short answer questions, objective test items or examination of actual product. Informal approaches include interviews, questionnaires and observation in assessment of personal and social adjustment. Summative evaluation for SNE learners is carried out by the KNEC in conjunction with QAS and KIE. Considering the needs of learners with hearing impairments, adaptations carried out on their examinations include offering instructions in sign language, and giving extra time for them.

2.4 TEACHERS'/LEARNERS' ATTITUDES TOWARDS LANGUAGE LEARNING

Teachers' attitude towards both learning and use of skills of simultaneous communication, whether positive or negative will affect performance in developing and using communication skills. Ranklin (1991) notes that the biggest question in the effective use of Manual English or American Sign Language, other than skills, is that of attitude. A teacher of English should first and foremost possess positive attitude towards the learner with hearing impairment, then the teaching of English (KIE, 2004). The right kind of attitude is mandatory in teaching of Kiswahili language as well. A teacher who possesses a positive attitude towards the learner and the subject imparts a similar attitude to them. The contrary is true as well: a teacher possessing a negative attitude towards Kiswahili will impart it to the learners. Both the teacher and the learner need a positive attitude to be able to teach/learn the language well.

2.5 REINFORCEMENT

Reinforcement or rewarding of desirable pupil behaviour is a frequently used teaching skill. When a pupil gives a correct answer to a question, the teacher would respond by saying some encouraging remarks, smiling or nodding while looking at the pupil (Shaffer, 2000). According to Shaffer (ibid.), various aspects of praise, issuance of corrective feedback are positively correlated with pupils' achievement and positive attitudes. Farrant (1980) postulates that rewards should be used to either acknowledge success and effort or as incentives. They should never be so easy to get or else they lose their worth.

Reinforcement techniques (Cannon & Palmiter, 2003) fall into two main categories: verbal and non-verbal. The most common verbal reinforcers are one-word or brief phrase responses such as "good, well done", among others. A verbal reinforcer such as praise, not only changes behaviour but develops confidence and a positive self-image. Jacinta and Regina (1981) concur that praise is always positive reinforcement. The learner is said to associate pleasure and satisfaction with getting a problem right or answering a question correctly followed by praise. This motivates them to try harder in future.

Verbal reinforcement could also compromise a teacher's response to ideas learners express by accepting them, building on them or asking questions based on them (Cannon & Palmiter, 2003). It has been proven in classes where such reinforcement techniques are applied, pupils have more positive attitudes and higher achievement than in classrooms where pupils' ideas are not incorporated in lesson development. Such verbal reinforcement can be a powerful motivation for increasing a pupil's desire to participate.

Non-verbal reinforcement, on the other hand, refers to the physical messages sent by teachers through cues such as eye contact, facial expression and body positions (Cannon & Palmiter, 2003), like frowns and impassivity from the teacher. A smile, a nod of the head and friendly eye contact can be used to encourage participation. Cannon and Palmiter (ibid.) further postulate that rewards if used indiscriminately become inappropriate use of reinforcement. If given too quickly they may interfere with complete development of pupils ideas. It becomes paramount that the teacher reinforces intermittently and

appropriately. Different individuals respond to different kinds of reinforcement. Some pupils, for example, find intensive eye contact rewarding while others find it uncomfortable. In this paper, the challenge was identification of appropriate reinforcement for the learner with hearing impairment. Issuance of the reinforcement should not be done indiscriminately. Special consideration should be made for the attempts made towards learning of Kiswahili by the learner with HI.

2.6 STATEMENT OF THE PROBLEM

From the review of past studies, it is evident that Kiswahili has increasingly become prominent due to its demand and use not only as a national and international language but also as a medium of instruction in lower primary and as a compulsory examinable subject (Shiundu & Omulando, 1992). Since the existing curriculum does not give special preference to children with hearing impairment, it poses many challenges to the teaching/learning of the subject. As such, the study focused on challenges to learning of Kiswahili among children with hearing impairment as was necessitated by the fact that performance in Kiswahili had remained dismal (Kilei, 2003). This paper examines the prerequisite conditions that need to be addressed within the academic curriculum to make it possible for the learners with hearing impairment to compete favourably.

3 MATERIALS AND METHODS

The study was carried out in Mumias School for learners with HI in Kakamega County in western Kenya. This is one of the oldest schools for learners with HI. The school is representative of a homogeneous target population existing as an integral part of the school community. The learners have to face a number of challenges as they contend with the regular school curriculum put in place for all learners. Mumias School for the Deaf is a public mixed boarding primary school. It is also known as St. Martin DE Porres. The school is situated in Mumias Nabongo location in Kakamega County. It was founded by Ursuline Sisters from Holland, way back in 1961, with an enrolment of five pupils only. The figure remained static until in eighties when it started posting a commendable rise.

Mumias was the first school to offer education to learners with hearing impairment locally. Today, it is an international school, admitting pupils from the entire nation of Kenya as well as the neighbour countries such as Uganda, Burundi and Sudan among others. The school follows the 8-4-4 school curriculum marked by the national KCPE examination. At inception, Luhyia language was used as a medium of instruction. The rationale was to integrate children back to the hearing community. Later, with the extension of the catchment area to include pupils from other parts of the country, this tradition was relinquished. Presently, Kenyan Sign Language is used to accommodate learners in the school.

Mumias Primary School for the HI is divided into four sections: the pre-school admits children aged between four and six years. The primary section comprises classes one to eight. The third section is that of children with multiple handicaps, mainly hearing impairment and mental challenges. The vocational unit admits big girls that have academic challenges. They are introduced to skills like dress making, knitting, handicraft, gardening and cookery among others as they await placement at St Angela vocational institute, just adjacent.

The study adopted a qualitative approach, to explore in detail teaching and learning of Kiswahili among children with hearing impairment. In the study the conditions requisite for excellence were independent variables. These were the vehicles through which effectiveness in learning of and academic performance in Kiswahili was gauged. Learning of Kiswahili was the dependent variable.

Mumias School has a teaching staff of thirty-six members: twenty-five females and eleven males. Thirty-five among them are employees of the Teachers' Service Commission and one male is a Peace Corp from the USA. Majority of the teachers have taught in the school for many years. The target population in the study comprised a total of four hundred and two pupils enrolled in Mumias Primary School for children with HI. Out of these, two hundred and twenty-one were boys and one hundred and eighty-one were girls. The results would be generalized to the learners in thirty-four primary schools for learners with HI across Kenya due to the homogeneity of their characteristics.

In the study, purposive sampling was used to select the school, the head teacher, Kiswahili teachers and pupils for focus interview groups and observation classes. Focus interview groups were purposively selected by gender and academic performance in Kiswahili. The sample size for the study comprised one head teacher, five Kiswahili teachers and thirty-two learners with HI in Mumias Primary School for the deaf. There were four focus groups for discussion selected as follows: by gender, eight boys, eight girls, and by academic performance, eight high performers and eight low performers in Kiswahili, bringing the total sample size to thirty-eight (six teachers and thirty-two pupils).

Data collection adopted three methods: observation, interview guide and document analysis. Triangulation of six instruments was employed to increase chances of depth and accuracy of data. Raw data collected was categorized, ordered,

coded and then tabulated. This was done according to themes from which objectives were generated as follows: analyzing academic performance, teaching/learning methods, conditions requisite for excellence and educational resources. Qualitative data collected using observation guides was categorized under the last three themes indicated above.

Data gathered from the head teacher's interview guide was categorized under conditions requisite for excellence in Kiswahili and educational resources. Specific sub-themes under this theme were the learning environment, learning experiences, evaluation modes, attitude and reinforcement. Data gathered from teachers' interviews was categorized under: teaching and learning methods, educational resources and conditions requisite for excellence whereas data from the focus groups discussion was categorized under all the four themes. From the document analysis, data gathered was categorized under analyzing academic performance of Kiswahili by learners with HI. Quantitative data gathered from data sheets was categorized under the first objective: academic performance of Kiswahili by learners with HI. It was later analyzed using a measure of central tendency-the mean score.

After categorization of the raw data, analysis was done in descriptive nature. Data interpretation was done in light of objectives of the study and on the basis of the three tenets of the guiding theory of the study: Stimulus-Response-Reward. The findings of the study were presented descriptively through narrative passages as well as in frequency distribution tables, pie charts and histograms.

In the study, ANOVA was run to statistically assess whether the observation that Kiswahili was poorly performed compared to other subjects in KCPE was indeed a pattern or just a phenomenon that occurred by chance. Since ANOVA showed that the means between the KCPE subjects were indeed statistically significant with Kiswahili having a lower mean than the other subjects, it was concluded that Kiswahili more than any other subject was indeed poorly performed amongst learners who are hearing impaired.

4 RESULTS AND DISCUSSION

Several factors affect an individual's learning process. The classroom environment can have a big effect on the amount of learning that occurs, hence the study evaluated the environmental conditions at the school to ascertain whether they enhanced or inhibited learning, particularly amongst learners with HI. The Kenya Institute of Education (KIE) has established the following to be conditions that need to be optimized for effective learning amongst all learners: learning environment, learning experiences, evaluation, reinforcement, and teachers and pupil's attitudes. Table 1 below demonstrates the learning environment at the school as per pupils' responses.

Table 1: Pupils' responses on "learning environment" and "learning experiences" as Conditions Requisite for Learning

Learning Environment	Preferred conditions	Conditions present at school
Seating Arrangement	Horse-shoe arrangement	Seating in rows
Appropriate lighting	Sufficient lighting	Sufficient lighting
		Finger spelling (32/32)
		Signing (16/32)
		Writing (19/32)
Learning Experiences	Total Communication	Story-telling (22/32)
	IEP	Answering questions (16/32)
		Observing (16/32)
		Discussing (6/32)

As shown in the table above, the conditions at the school fall short of those recommended by the KIE in the following aspects:

4.1 LEARNING ENVIRONMENT

The horse-shoe seating arrangement has been recommended as the best way to organize a classroom because:

i) It fosters acquaintance of pupils with their peers
ii) Gives a new perspective on learning activities by encouraging pupil's to sit in different positions
iii) It encourages participation by allowing eye contact between the teacher and all learners

iv) Allows each pupil to consistently have access and proximity to the teacher, and allows the teacher to move closer to each learner

However, at this school pupils sit in rows, an arrangement that does not allow for pupils or teachers to interact with everyone in the classroom. Particularly, the pupils are not able to follow each other's responses and contributions thus not optimising their learning experience.

4.2 LEARNING EXPERIENCES

The pupils reported on the learning experiences they have in the classroom and it was established that the learning experiences at the school do not involve all aspects of TC (Figure 1).

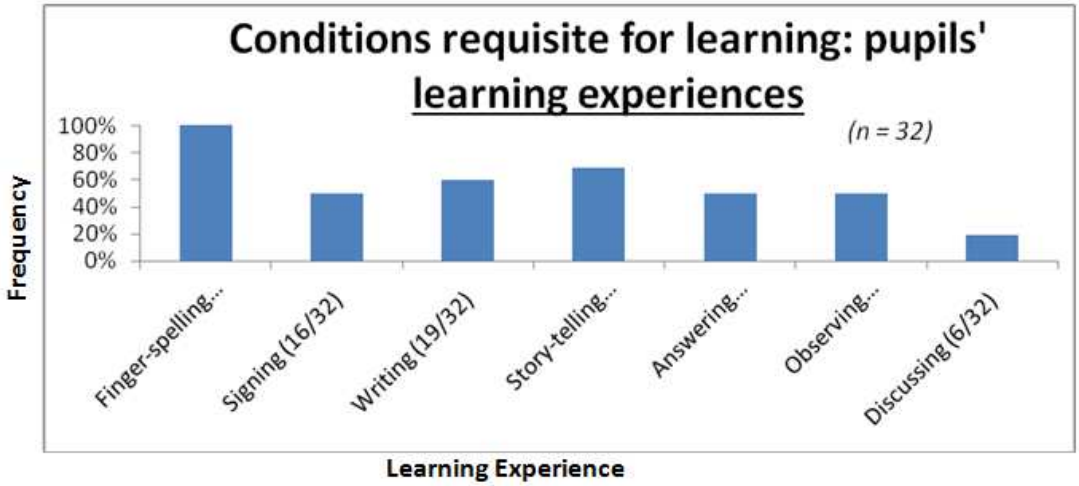

Figure 1: An analysis of conditions requisite for learning shows that pupils prefer learning by finger spelling, writing, and story-telling

Learning experiences should be both receptive and expressive. On the contrary, the author found that the pupils at the school were limited in their expressive capabilities. This stems mainly from two factors:

i) There was a shortage in materials such as toys, playthings, poems and sign stories that learners could use to acquire the necessary expressive skills.

ii) Learners were not exposed to Kiswahili prior to their enrolment into formal schools, an aspect that greatly slowed down their learning compared to their counterparts with no hearing impairments.

The research also analyzed teachers' and pupils' responses on reinforcement, attitude, and evaluation as factors that affect teaching and learning of Kiswahili. The results were as presented in Table 2 (pupils' responses) and Table 3 (teachers' responses')

Table 2: Pupils' responses on other Conditions Requisite for Learning

	Preferred conditions	Conditions present at school
Reinforcement	Verbal and non-verbal, continuous reinforcement	Verbal i.e. compliments (22/32) Non-verbal i.e. tokens, hand claps, body language, facial expressions (10/32)
Attitude	Positive attitude	Positive (10/32)

Table 3: Teachers' responses on conditions requisite for learning

	Preferred conditions	Conditions present at school
Evaluation	Summative and formative evaluation	Oral/signed questions (6/6) Short answer questions (6/6) Essays (1/6) Observation (5/6) Continuous Assessment Tests (6/6)
Reinforcement	Verbal and non-verbal, continuous reinforcement	Verbal i.e. compliments (6/6) Non-verbal i.e. tokens, hand claps, body language, facial expressions (6/6/)
Attitude	Positive attitude/empathy	Empathy/positive (4/6) Sympathy/negative (2/6)

4.3 EVALUATION

The research noted that although teachers performed both formative and summative evaluation as was expected of them (Figure 2), they could not conduct summative evaluation in a manner that allowed for a comprehensive evaluation of the pupils' performance in Kiswahili. This was because the KIE dictated the conditions in which to organize the summative evaluation but these conditions were not tailored to learners with HI. Firstly, learners with HI were allocated thirty extra minutes during examinations but the teachers argued that this time was not sufficient. Secondly, although the examination invigilators were trained in special education and KSL, the supervisors were not necessarily trained in the field. This discrepancy inhibited proper administration and evaluation of examinations taken by learners with HI since the supervisors were not aware of the nuances that govern KSL and communication with HI learners.

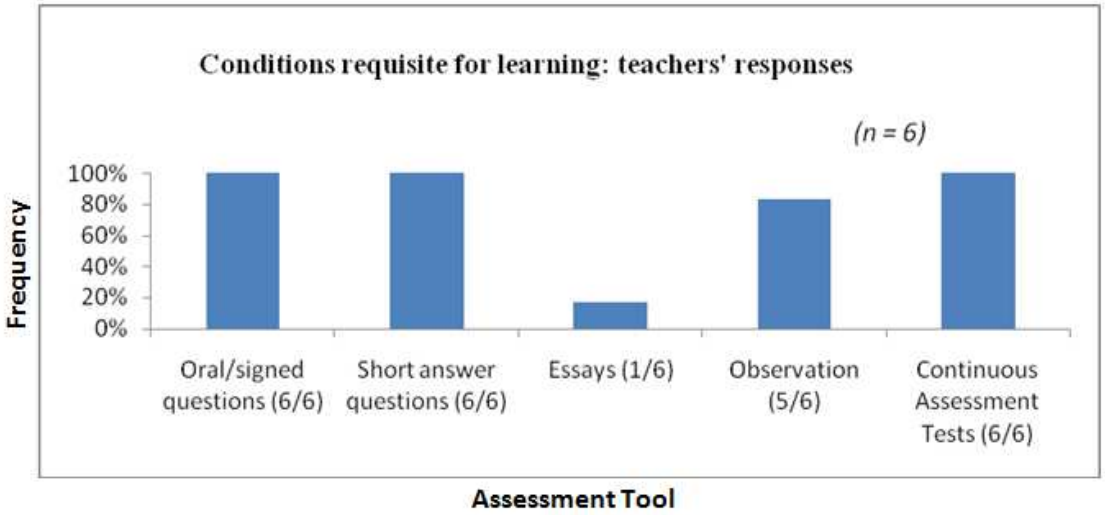

Figure 2: Teachers' responses on conditions requisite for learning show that teachers evaluate pupils formatively (in-class) and summatively (end of term and/or year exams)

4.4 REINFORCEMENT

Reinforcement at the school was done during both formative and summative evaluations. Formative reinforcement occurred in the classroom during the lessons while summative reinforcement occurred at the end of the term and/or year. The research noted that very few pupils reported that they ever received positive reinforcement (in the form of awards) for their performance in Kiswahili (Figure 3). The pupils who received reinforcement were interested in pursuing Kiswahili further as learners and eventually as teachers. As a result of this observation, the research concluded that positive reinforcement is key in getting learners interested in Kiswahili and consequently improving their performance in the language.

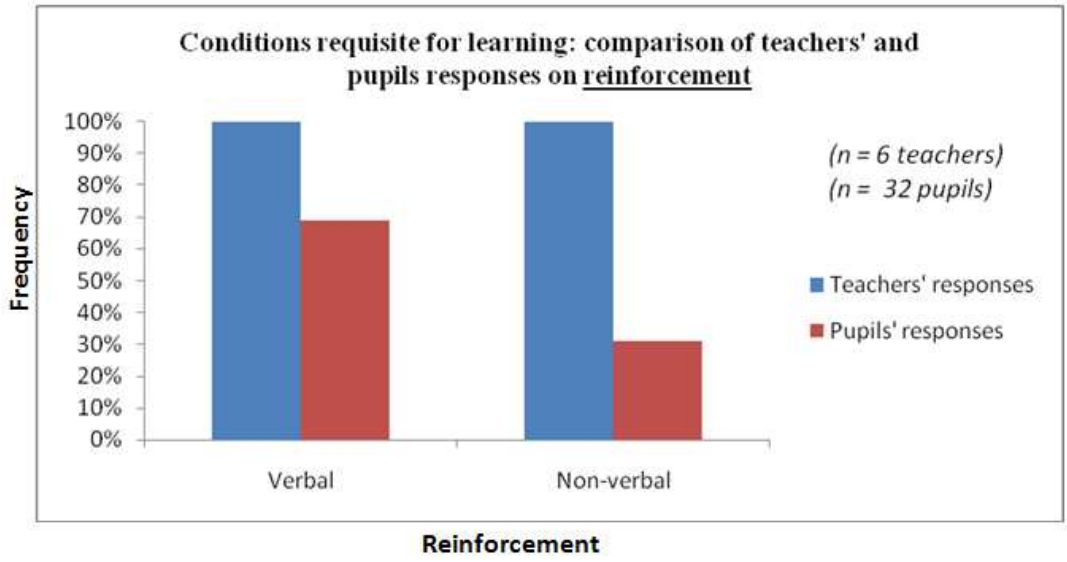

Figure 3: A comparison of teachers' and pupils' responses on reinforcement as a condition that is important to enhance learning of Kiswahili

4.5 ATTITUDE

Majority of the pupils had a negative attitude towards Kiswahili (Figure 4). They believed that it was a difficult language and were more interested in learning Kenyan Sign Language (KSL) because it was their natural language and easier to learn and communicate in it. The few students keen on learning Kiswahili were mainly interested because a proficiency in the language would allow them to get by in their communities. Particularly, an understanding of the language would allow them to read public warnings and signs, communicate with people in market places, and interact with people without HI who do not understand KSL. As such, for these students being proficient in Kiswahili would allow them to become more independent.

Most of the teachers had a positive attitude and empathized with the learners (Figure 4). They encouraged the pupils to learn Kiswahili as the language would become imperative for them to integrate into the community. In addition, two of the teaching staff that had HI were especially interested in having the learners pursue Kiswahili and eventually becoming teachers of Kiswahili themselves as they would become role models to future learners with HI. A few of the teachers mainly sympathized with students and had a negative attitude towards teaching Kiswahili. They argued that the pupils would be over-burdened if the curriculum demanded that they learn English, Kiswahili and KSL. As a result, these teachers were not keen on having their pupils master the Kiswahili language, an aspect that in turn negatively affected pupils' attitudes towards learning Kiswahili.

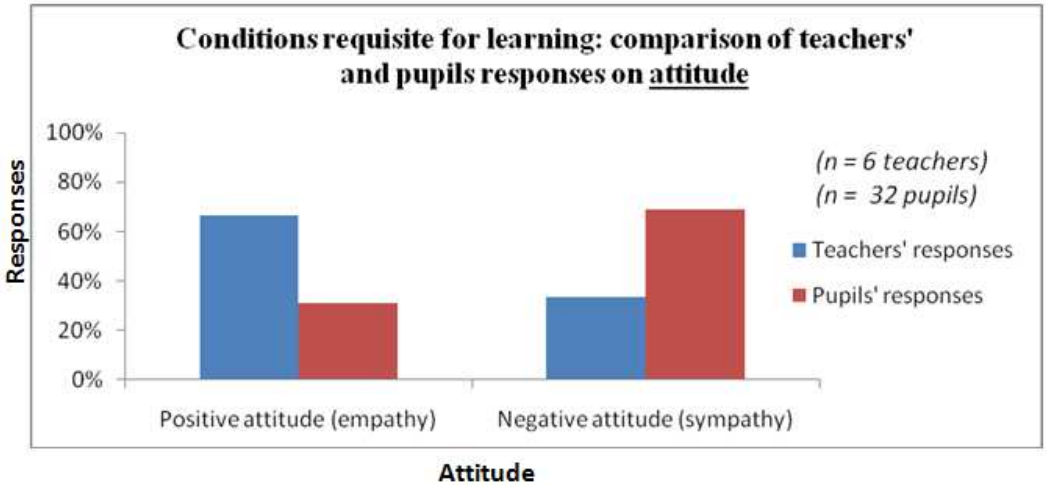

Figure 4: Teachers and pupils attitude towards teaching and learning of Kiswahili

5 CONCLUSION

5.1 LEARNING ENVIRONMENT

It was observed that the learners' seating arrangement in the classroom was the traditional row arrangement as opposed to the recommended horseshoe arrangement. The horse-shoe seating has been recommended as means to facilitate maintenance of eye contact between learners-learner and between teacher-learner, thus enhancing learning from both the teacher and other peers. Contrary to this, the seating arrangement at this school allowed pupils' eye contact with the teacher but not with one another. It was therefore difficult for the learners to follow each other's responses during lessons; consequently, learning amongst peers was greatly inhibited.

5.2 LEARNING EXPERIENCES

The research established that the learners' most preferred expressive activities were finger spelling, storytelling, writing and signing, while observation was the most preferred receptive activity. It was noted that discussions were least popular amongst learners due to their limited Kiswahili vocabulary. This led the research to conclude that not all elements of TC were used to enhance learning of Kiswahili and was a factor that would contribute to the poor performance.

5.3 EVALUATION

Student's performance and programme effectiveness are assessed through evaluation. In line with this, the researcher established that the school was involved in both formative and summative evaluation. Formative evaluation was carried out daily, weekly, fortnightly or monthly by individual teachers in different classes whereas whole school evaluation was done at the end of each term and each year. It was established that the most frequently used evaluation tools were short answer questions, Continuous Assessment Tests, essays and observation. Summative evaluation was carried out annually by KNEC in which evaluation of learner's performance in class eight in KCPE and the curriculum effectiveness were both assessed.

However, three main shortcomings associated with evaluation of learners with HI were the limited time allocated to the examination, a shortage of KSL-trained examination officials, and lack of skills on tackling examination questions as reported by pupils.

5.4 REINFORCEMENT

It was established from the informants as well as by observation that both verbal and non-verbal reinforcement was used in the Kiswahili lessons. Teachers offered compliments or tangible reinforcement such as food whenever positive efforts or correct responses were elicited by learners. Learners would clap hands to those who deserved to be rewarded. Physical messages such as facial expressions, eye contact, nodding of the head in approval and body positions were used as well. It

was reported that at the end of term, tokens like text books, pens and utensils such as glasses were presented to a few learners who merited for them. Those who received reinforcement were interested in pursuing Kiswahili further as learners and eventually as teachers. As a result of this observation, the researcher concludes that positive reinforcement is key in getting learners interested in Kiswahili and consequently improving their performance. This finding concurs with the fact that various aspects of praise and issuance of corrective feedback are positively correlated with pupils' achievement and positive attitude. It is notable that reinforcement is a great determinant of success in the learning process.

5.5 ATTITUDE

Amongst the learner informants, majority (three focus groups) had a negative attitude towards Kiswahili. They conceded that learning Kiswahili was too hard for them no matter how much they tried to learn it. They preferred learning KSL. The groups cited comprehension, long answer questions in examinations and interpretation of English signs into Kiswahili as the most difficult aspects of learning the language. These informants wished Kiswahili scrapped off the curriculum for them to excel in other languages.

One of the focus groups had a positive attitude towards learning Kiswahili. In fact, they showed interest in pursuing Kiswahili to higher levels in order to become teachers, like two of their own teachers that have HI or to be able to interact in the community. This group wished that the curriculum continues to be inclusive of Kiswahili for them to learn more of it.

The teacher informants looked at learning of Kiswahili as two sides of the same coin. They were sympathetic to the learners' burden of learning three languages: English, KSL and Kiswahili at the same time, especially for the prelinguals. They argued that the prelinguals should be exempted from learning of Kiswahili. On the other hand, they were empathetic to the postlinguals and hard-of hearing learners for whom they argued that they needed to learn Kiswahili to be able to integrate into the society, or for job placements in the teaching fraternity or to embrace the national and official language of the nation. This finding affirms the claims that teachers' attitudes towards both learning and the learner, whether positive or negative will affect the learner's performance.

The findings of the study confirmed that learning of Kiswahili needed a positive attitude. Those learners whose attitude was negative towards Kiswahili could not be convinced to learn it for whatever benefits and given an optional language to study, they would readily embrace it. Those learners whose attitude was positive were intrinsically motivated to study the language in addition to other languages.

When teachers sympathised with the learners for their burden of three languages to study, this attitude did not motivate learners to learn Kiswahili. On the other hand when they empathized with them this impacted positively on the learners and encouraged them to learn the language.

RECOMMENDATIONS

To improve the conditions and ensure effective teaching of Kiswahili among the hearing impaired, the following recommendations are made:

Learning environment: Encouraging teachers to revert to the horse-shoe seating arrangement as this would inevitably shift the passive class atmosphere to one that is more interactive and cordial, allowing peer-peer learning to take place.

Learning experiences: The classrooms should be flooded with play things especially in lower classes to facilitate more Kiswahili language experiences.

Evaluation: A change in policy that would provide KSL training for examination officials in order to improve examination standards and that teachers train learners with H.I on how to tackle examination questions.

Reinforcement: Teachers find out ways to incentivize each pupil in order to inspire them to work harder to improve their Kiswahili skills.

Attitude: Teachers adopt an empathetic attitude rather than a sympathetic one such that they can encourage their pupils to learn Kiswahili in order to improve their performance in national examinations and embrace it as a national as well as an official language.

The MOE has made Kiswahili an optional subject at the KCPE level. However, some teachers were noted to argue that learners were over-burdened by being required to learn three languages (English, Kiswahili and KSL). It is highly probable that most schools might even remove Kiswahili from the syllabus altogether. This is problematic since Kiswahili has been declared both a national and an official language. Further research should be done to understand the policy-making process in order

to stir advocacy work that would influence the policy makers to revert the decision that would potentially exclude Kiswahili from the curriculum.

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SECURITY STORAGE SYSTEM FOR CLOUD USER USING OSD WITH A SELF-DESTRUCTING DATA

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ABSTRACT: Cloud computing focuses on maximizing the effectiveness of the sharing of resources. It is not only shared by multiple users but can also dynamically reallocating as per demand. Cloud computing is the notion of outsourcing on-site available services and data storage to an off-site. Personal data stored in the cloud may contain account number, password, notes and other important information that could be used and misused by a miscreant, a competitor or a court of law. These data are cached, copied and archived by Cloud Service Providers (CSPs), often without user authorization and control. To overcome this problem to propose a Self Destruction method is protecting the user data privacy through Shamir Secret sharing algorithm, which can generate a pair of keys. Self Destruction method is associated with Time to Live (TTL) property to specify the life time of the keys. TTL trigger the Self Destruction operation, then the keys becomes destructed or unreadable after a user specified period. User can decrypt after timeout, either the user give correct keys. Shamir algorithm generates new keys to the user. Self Destruction mechanism reduces the overhead during upload and download file in the cloud. The result demonstrates that Self Destruction is practical to use and meet all privacy preserving goals. In this paper, active storage framework provides virtualization environment to run client's application and data is treated as objects to increase the throughput and decrease the latency.

KEYWORDS: Cloud Computing, confidential data privacy, object based active storage, Vanishing data, Authentication, Self-estructing Data, Distributed hash table (DHT).

1 INTRODUCTION

Development of Cloud computing and popularization of mobile Internet, Cloud services are becoming more and more important for people's life. People are more or less requested to submit or post some personal private information to the Cloud by the Internet. When people do this, they subjectively hope service providers will provide security policy to protect their data from leaking, so others people will not invade their privacy. Distributed hash tables (DHTs): DHTs discard data older than a certain age. The key is permanently lost, and the encrypted data is permanently unreadable after data expiration. This system is built upon standard cryptographic techniques and assuredly deletes files to make them unrecoverable to anyone upon revocations of file access policies. A model of load-managed active storage, which strives to integrate computation with storage access in a way that the system can predict the effects of offloading computation to Active storage Units (ASU).

We implemented a proof-of-concept *SeDas* prototype. Through functionality and security properties evaluations of the *SeDas* prototype, the results demonstrate that *SeDas* is practical to use and meets all the privacy-preserving goals described.

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Compared to the system without self-destructing data mechanism, throughput for uploading and downloading with the proposed *SeDas* acceptably decreases by less than 72%, while latency for upload/download operations with self-destructing data mechanism increases by less than 60%.

The problem of vanish discussed above, in our previous work, we proposed a new scheme, to prevent hopping attack, which is one kind of the Sybil attacks , by extending the length range of the key shares to increase the attack cost substantially, and did some improvement on the Shamir secret sharing algorithm implemented in the vanish system. The previous work aimed at some special applications, e.g., database, multimedia, etc., there is no general system level self-destructing data in the literature

There are multiple storage services for a user to store data. Meanwhile, to avoid the problem produced by the centralized "trusted" third party, the responsibility of SeDas is to protect the user key and provide the function of self-destructing data. Fig. 1 shows the brief structure of the user application program realizing storage process. In this structure, the user application node contains two system clients: any third-party data storage system (TPDSS) and Self Destructing data system. The user application program interacts with the server through client, getting data storage service. The way to attain storage service by client interacting with a server depends on the design of TPDSS. We do not need a secondary development for different TPDSS. The process to store data has no change, but encryption is needed before uploading data and the decryption is needed after downloading data.

1.1 SHAMIR SECRET SHARING ALGORITHM

Shamir algorithm are ideal for storing information that is highly sensitive and highly important. A secret sharing method can secure a secret over multiple servers and remain recoverable despite multiple server failure. The dealer may act as several district participants, distributing the shares among the participants. Each share may be stored on a different server, but the dealer can recover the secret even if several servers break down as long as they can recover.

1.2 SELF DESTRUCTION USING TIME TO LIVE PROPERTY

Time to Live is a mechanism that limit the lifespan or lifetime of keys stored in cloud. TTL may be implemented as a counter or timestamp attached to or embedded in the keys. Once the prescribed event occur or timespan has elapsed, keys can be self destructed without any user intervention. In computing application, TTL is used to improve performance of caching or to improve privacy from the leakages.

Our objectives are summarized as follows:

1) We focus on the related key distribution algorithm, Shamir's algorithm. We use these methods to implement a safety destruct with equal divided key.
2) Based on active storage framework, we use an object-based storage interface to store and manage the equally divided key.
3) In this, self-destructing data system supports security erasing files and random encryption keys stored in a hard disk drive (HDD) or solid state drive (SSD), respectively.
4) Through functionality and security properties evaluation of the SeDas prototype, the results demonstrate that SeDas is practical to use and meets all the privacy-preserving goals. The prototype system imposes reasonably low runtime overhead.
5) Protect the privacy of past, archived data against accidental, malicious and legal attacks (e.g. Emails, Trash Bin).
6) Ensure that all copies of certain data become unreadable after a user-specified time, without any specific action on the part of a user.
7) Even if an attacker obtains both a cached copy and the user's cryptographic keys and passwords.

The rest of this paper is organized as follows. We review the related work in Section II. We describe the proposed methodology in Section III, and we conclude this paper in Section IV

2 RELATED WORK

R. Geambasu , T. Kohno , A. Levy and H. M. Levy [1] Proposes a system that meets this challenge through a novel integration of cryptographic techniques with global-scale, P2P, distributed hash tables (DHTs). We implemented a proof-of-concept Vanish prototype to use both the million-plus-node Vuze Bit- Torrent DHT and the restricted-membership OpenDHT.

We evaluate experimentally and analytically the functionality, security, and performance properties of Vanish, demonstrating that it is practical to use and meets the privacy-preserving goals described above.

S. Wolchok , O. S. Hofmann , N. Heninger , E. W. Felten , J. A. Halderman , C. J. Rossbach , B. Waters and E. Witchel [3] Proposes a two Sybil attacks against the current Vanish implementation, which stores its encryption keys in the million-node Vuze Bit Torrent DHT. These attacks work by continuously crawling the DHT and saving each stored value before it ages out. They can efficiently recover keys for more than 99% of Vanish messages

LingfangZeng, Zhan Shi, ShengjieXu, Dan Feng[4]They Discuss the existing state-of-the-art self-destructing data schemes (Vanish) exhibit fragile for hopping attack and sniffing attack in realistic application. Propose a new scheme called SafeVanish

Y. Xie, K.-K. Muniswamy-Reddy, D. Feng, D. D. E. Long, Y. Kang, Z. Niu, and Z. Tan [10] Proposed a system that is aimed to be practically used:

- Small modifications to the existing T10 OSD standard
- Four kinds of critical characteristics in terms of user case
- System demonstration on three real world applications in terms of performance, scalability, language, etc

Y. Tang , P. P. C. Lee , J. C. S. Lui and R. Perlman [11] propose a cloud storage system called FADE, which aims to provide assured deletion for files that are hosted by today's cloud storage services. We present the design of policy-based file assured deletion, in which files are assuredly deleted and made unrecoverable by anyone when their associated file access policies are revoked. We present the essential operations on cryptographic keys so as to achieve policy-based file assured deletion. We implement a prototype of FADE to demonstrate its practicality, and empirically study its performance overhead when it works with Amazon S3. Our experimental results provide insights into the performance-security trade-off when FADE is deployed in practice.

Y. Kang , J. Yang and E. L. Miller [13] provide portability and efficiency by delegating storage management to SCM devices and eliminating duplicate mapping tables on both host and device. Further, this approach allows systems to immediately utilize new SCM technologies with no change to host systems, providing flexibility to system designers without the need to optimize the file system for many different types of SCMs. Moreover, this approach can also provide new functionality such as object-level reliability and object level compression by leveraging the semantics of object-based requests.

3 PROPOSED METHODOLOGY

A. Existing system

Personal data stored in the Cloud may contain account numbers, passwords, notes, and other important information that could be used and misused by a miscreant, a competitor, or a court of law. These data are cached, copied, and archived by Cloud Service Providers (CSPs), often without users' authorization and control. Self-destructing data mainly aims at protecting the user data's privacy. All the data and their copies become destructed or unreadable after a user-specified time, without any user intervention. Besides, the decryption key is destructed after the user-specified time.

Disadvantages:

These data are cached, copied, and archived by Cloud Service Providers (CSPs), often without users' authorization and control. Self-destructing data mainly aims at protecting the user data's privacy. All the data and their copies become destructed or unreadable after a user-specified time, without any user intervention. Besides, the decryption key is destructed after the user-specified time.

B. Proposed system

We present SeDas, a system that meets this challenge through a novel integration of cryptographic techniques with active storage techniques based on T10 OSD standard. We implemented a proof-of-concept SeDas prototype. Through functionality and security properties evaluation of the SeDas prototype, the results demonstrate that SeDas is practical to use and meets all the privacy-preserving goals described above. Compared with the system without self-destructing data mechanism, throughput for uploading and downloading with the proposed SeDas acceptably decreases by less than 72%, while latency for upload/download operations with self-destructing data mechanism increases by less than 60%.

Advantages:

Compared with the system without self-destructing data mechanism, throughput for uploading and downloading with the proposed SeDas acceptably decreases by less than 72%, while latency for upload/download operations with self-destructing data mechanism increases by less than 60%.

c. Module 1: Storage Architecture :

There are three parties based on the active storage framework. i)Metadata server (MDS): MDS is responsible for user management, server management, session management andfile metadata management. ii) Application node: The application node is a client to use storage service of the SeDas.iii) Storage node: Each storage node is an OSD. It contains two core subsystems: key value store subsystem and active storage object (ASO) runtime subsystem. The key value store subsystem that is based on the object storage component is used for managing objects stored in storage node: lookup object, read/write object and so on. The object ID is used as a key. The associated data and attribute are stored as values.

d. Module 3:Active Storage Object:

An active storage object derives from a user object and has a time-to-live (ttl) value property. The ttl value issued to trigger the self-destruct operation. The tll value of a user object is infinite so that a user object will not be deleted until a user deletes it manually.

e. Module 4:Self-Destruct Method Object:

Kernel code can be executed efficiently; however, a service method should be implemented in user space with these following considerations. Many libraries such as libc can be used by code in user space but not in kernel space. Mature tools can be used to develop software in user space. It is much safer to debug code in user space than in kernel space.

f. Module 5:Data Process:

To use the SeDas system, user's applications should implement logic of data process and act as a client node. There are two different logics: uploading and downloading.

- Uploading file process

When a user uploads a file to a storage system and stores his key in this SeDas system, he should specify the file, the key and *ttl* as arguments for the uploading procedure. Fig. presents its pseudo-code. In these codes, we assume data and key has been read from the file. The ENCRYPT procedure uses a common encrypt algorithm or user-defined encrypt algorithm. After uploading data to storage server, key shares generated by *ShamirSecretSharing* algorithm will be used to create active storage object (ASO) in storage node in this system.

- Downloading file process

Any user who has relevant permission can download data stored in the data storage system. The data must be decrypted before use. The whole logic is implemented in code of user's application.

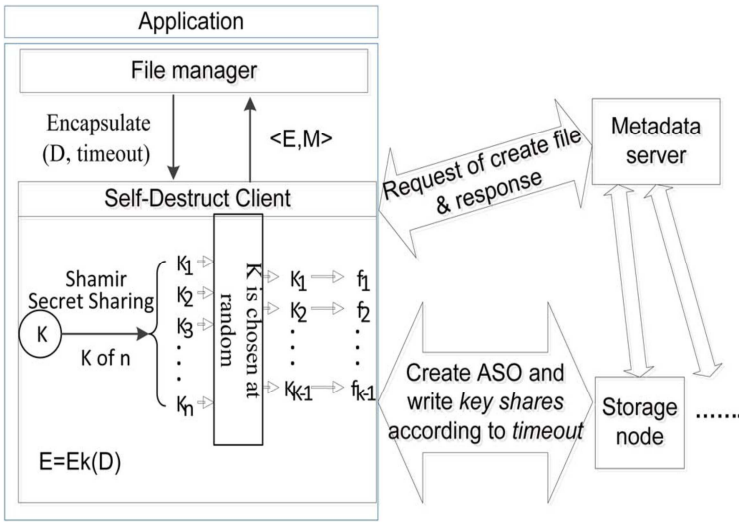

Fig 1. Uploading and Downloading file process

g. Module 6:Data Security Erasing in Disk

Our implementation method is as follows:

- The system prespecifies a directory in a special area to store sensitive files.
- Monitor the file allocation table and acquire and maintain a list of all sensitive documents, the logical block address (LBA).
- LBA list of sensitive documents appear to increase or decrease, The update is sent to the OSD.
- OSD internal synchronization maintains the list of LBA, the LBA data in the list updates.

4 SYSTEM ARCHITECTURE

Shamir algorithm implemented in cloud server to generate a pair of keys to the user. The main components are key generation, encryption and decryption using Message Digest Algorithm. The user can also specify the lifetime of each keys. These keys associated with Time to Live (TTL) property. When the keys can be self destructed after user specified time without any user intervention. The encrypt and decrypt procedure uses a message digest algorithm (MD5) for encryption and decryption. MD5 has been utilized in wide variety of security application, and is also commonly used to check data integrity. Keys are stored in DHT, before download a data in cloud the Shamir algorithm check the keys match with hash table. Then only the given user is authorized to download data in cloud.

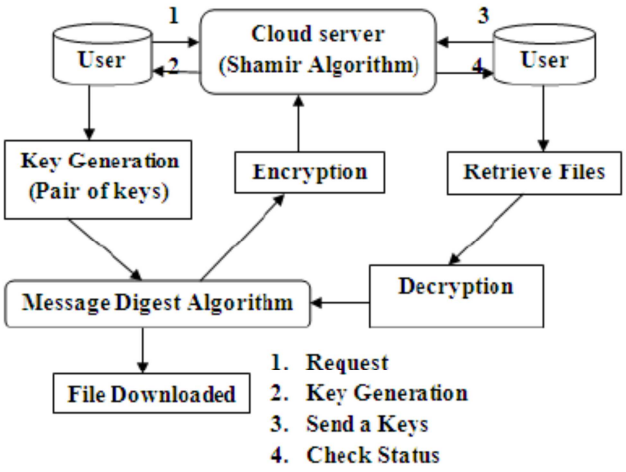

Fig 2. System Model

In Proposed system, sedas method implement automatic self destruction of keys to avoid explicit delete or modification of data in cloud environment by any third party or attackers. It leads several advantages are reduces communication overhead, network delay, generate pair of keys to single file (keys length is 2bytes) , increase processing speed, increase I/O performance and also it will meets all privacy preserving goals.

5 MODULES

User Authentication
Object Storage Devices (OSD)
Secret Key Part
File Uploading
Self Destruction Method
Downloading File
Performance Evaluation

5.1 MODULES DESCRIPTION

User Authentication: - A new user has to first create a profile. This is done by registration. A user id and password are submitted by the user. The user can login successfully only if user id and password are entered correctly. The login is a failure if the incorrect user id or wrong password is entered by the user. This helps in preventing unauthorized access.

Object Storage Devices (OSD):- An OSD is a computer storage device, similar to disk storage but working at higher level. Instead of providing a block oriented a block oriented interface that reads and writes fixed sized block of data. Each object has both data (uninterpreted sequence of bytes) and metadata (an extensible set of attributes describing the object).The OSD is responsible for managing the storage the storage of objects and their metadata. OSD implements a security mechanism that provides the user data privacy. N extensible set of attributes describe objects. Some attributes are implemented directly by the OSD, such as the number of bytes in an object and the modified time of object.

Secret Key Part:- Shamir Secret Sharing is an algorithm in cryptography. It is a form of secret sharing. Where a secret is divided into parts, giving each participant its own unique part. Where some parts or all of them are needed in order to reconstruct the secret. Each of these pieces of information must be kept highly confidential. Secret sharing are ideal for storing information that is high sensitive and highly important and also allow arbitrarily high levels of confidentiality and reliability to be achieved.

File Uploading:- Before upload file in cloud the user perform encryption using pair of keys generated by Shamir algorithm through MD5.When a user upload only a encrypted file in cloud and stores his keys using sedas method, it should specify the file, keys and TTL as the arguments for uploading procedure. When the keys are self destructed after a user specified time.

Self Destruction Method:- Self destruction mainly aims at protecting the user data privacy. All the keys become self destructed or unreadable after user specified time. The result demonstrate that the sedas is practical to use and meet all privacy preserving goals described. Sedas does not affect the normal use of storage system and can also meet the requirement of self destructing data under a survival time by user controllable keys. These are multiple storage services for a user to store data. Meanwhile, to avoid problem produced by the centralized “trusted” third party, the responsibility of sedas is to protect the user keys and provide the function of self destructing data.

Downloading File:- Any user who has relevant permission can download data stored in the cloud. The data must be decrypted before use. If the self destruct operation has nottriggered, the client can get enough key shares to reconstruct the keys successfully. During download process, Shamir algorithm checks the given keys are expired or not. If the keys are not expiring, the user can easily download. Otherwise, Shamir algorithm generates a new pair of keys to the authorized user.

Performance Evaluation:-Compare with the native system without self destructing data mechanism, throughput for uploading and downloading with the proposed sedas acceptably decreased by less than 72%, While latency for upload/download operations with sedas data mechanism increases by less than 60%.

6 RESULT

Here it an evaluation of latency for the files of different sizes. The time taken for uploading and downloading file determines the latency. In this system during file access there is high speed from the first bit to last bit arrival rate of the file. It is evaluated with the file size. Downloaded time is divided according to the file size and makes it to the multiplication of the bytes. To the previous result overhead of sender and receiver is added.

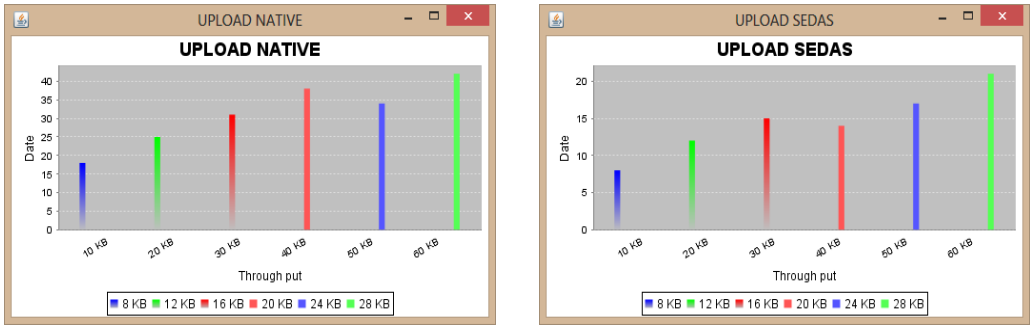

Fig.:3 Comparisons of throughput in the upload operations.

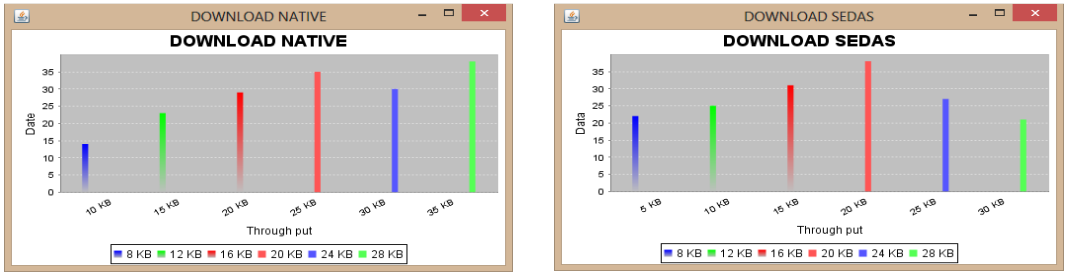

Fig.:4Comparisons of throughput in the download operations.

Fig. shows the throughput results for the different schemes. The throughput decreases because upload/download processes require much more CPU computation and finishing encryption/ decryption processes in the SeDas system, compared with the Native system. From Fig. 13, we can see that SeDas reduces the throughput over the Native system by an average of 59.5% and up to 71.67% for the uploading

From Fig. 17, we can see that SeDas reduces the throughput over the *Native* system by an average of 30.5% and up to 50.75% for the downloading.

Compared with the Native system without self-destructing data mechanism, throughput for uploading and downloading with the proposed SeDas acceptably decreases by less than 72%, while latency for upload/download operations with self-destructing data mechanism increases by less than 60%.

7 CONCLUSION

This paper introduced a new approach for protecting data privacy from attackers who retroactively obtain, through legal or other means, a user's stored data and private decryption keys. .We demonstrated the feasibility of our approach by presenting SeDas, a proof-of-concept prototype based on object-based storage techniques. Its causes sensitive information, such as account numbers, passwords and notes to irreversibly self-destruct, without any action on the user 's part. Our measurement and experimental security analysis sheds insight into the practicability of our approach. Our plan to release the current system will help to provide researchers with further valuable experience to inform future object-based storage system designs for Cloud services.

8 FUTURE WORK

Data and its associated key are destroyed after the expiration time of the key. Data such as file is treated as objects. When a single object is destroyed then any object referenced to that particular object gets free. Thus the reference count decreases. Instead of destroying an object as soon as its reference count falls to zero, it is added to the unreferenced list objects and periodically destroyed from the list.

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Design and Analysis of modified Soft Switching DC-DC Converter with improved voltage regulation for High Frequency applications

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ABSTRACT: In this paper, a modified soft switching DC/DC converter with a full ZVS range with improved output voltage regulation high voltage and high frequency is presented and analyzed. This modified dc-dc converter is designed with two newly proposed half bridge inverter that are situated in parallel among the primary side and phase shifting is made to regulate the output voltage .The novel topology solves the drawbacks of the existing converter .This improved soft switching converter has a major advantage of reduced duty cycle losses and no circulating current. Similarly having reduced output filter. In this proposed converter is provided with proper filter design. The analysis and design is made using mat lab simulation tool.

KEYWORDS: Zero Voltage witching (ZVS), Zero Current Switching, Center Tap Type Rectifier, Phase Shifted PWM Converter.

1 INTRODUCTION

In this paper, the basic soft switching DC/DC converter topology is first presented. This is followed by the modeling of the converter topology, leading to the derivation of a family of converters with improvement and simplification for better functionality and practicality. The resulting family of converters inherits the important advantage of having a reduction in the switch voltage stress. The idea of having soft switching in full bridge DC/DC converter can be traced back in the early years. These soft switching circuits are especially suitable for high power applications (e.g., more than1kw output) because of its high efficiency. In these power levels, the expense of four controlled switches is acceptable. In this system the addition of a small commutating inductor and two low-current clamp diodes essentially eliminates the dynamic losses and the overshoot and the ringing of the rectifier diodes associated with their charge storage and junction capacitance. G. Hua, F. C. Lee, and M. M. Jovanovi´c et al reported an improved full bridge zero voltage switched PWM converter using a saturable inductor core in 1993. The paper discussed about how the saturable inductor which is employed in the full bridge (FB) zero-voltage-switched (ZVS) pulse width -modulated (PWM) converter to enhance its performance. In this proposed system the current and voltage stresses of the switches as well as parasitic oscillations are significantly reduced in this converter topology. The Saturated reactor helps to achieve a wide ZVS range and to reduce circulating current because circulating current increases the losses of the converter. The incorporation of a saturable inductor to the FB-ZVS-PWM converter, a particular member of the ZVS-PWM converters, can minimize all the above drawbacks like achieving wide ZVS range and to reduce circulating current and

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reduces switching losses and also reducing the voltage stress resulting in improvement in the converter performance. The energy stored in a linear inductor is proportional to the square of the inductor current.

Thus the circulating energy in a FB-ZVS-PWM converter is proportional to the square of the load current. For instance, if the converter is designed to achieve ZVS above 20% load, the circulating energy at full load will be 25 times as that needed for discharging the FET capacitances (achieving ZVS for FET's).The situation is somewhat different when the linear resonant inductor is replaced by a saturable inductor. Until now, several soft-switching DC/DC converters have been proposed for the operation of high frequency application. Although the design of these converters has been presented at the operational level for some essential concern such as topologies, analyses, and control have not been thoroughly studied. In this paper, the basic soft switching DC/DC converter topology is first analyzed. This is followed by the modeling of the converter topology, leading to the derivation of a family of converters with improvement and simplification for better functionality and practicality. The resulting family of converters inherits the important advantage of having a reduction in the switch voltage stress.

2 EXISTING CONVERTER TOPOLOGY

The traditional phase-shift full-bridge (PSFB) converter exhibits benefits in medium-to-high-power applications. All primary switches of the converter are turned ON under zero-voltage switching (ZVS) without the help of any auxiliary circuits. The switches' voltage stress is clamped to that of the input voltage. Hence, here high-frequency MOSFETs are suitable as main switches for the converter, which can raise the power density of the converter. However, such a converter has several serious problems: first, the ZVS range of lagging-leg switches is very narrow under the variation of load. For this reason, its conversion efficiency is severely degraded as the load decreases. If the converter is fit for a relatively wide input voltage range due to the design considerations such as the hold-up time requirement, the steady-state duty cycle becomes small and the freewheeling interval lengthens in normal operating conditions. Then, due to this an excessive circulating current appears on the primary side during the freewheeling interval, increasing the primary-side conduction loss and also the turn-off switching loss of the lagging-lag switches. In addition to the small duty cycle has detrimental effects on performance of the converter, such as a large ripple current through the output Inductor *LO*. Especially, in high output voltage applications, a very large inductor *LO* is required to reduce the large ripple current, which results in low power density and increased cost.

In order to overcome the above mentioned problems of the traditional PSFB converter, many studies have been conducted. First, to remove the circulating current and reduce the large output inductor, the frequency-modulated FB converter was presented earlier. The operating range of its switching frequency, however there is change in a wide input voltage range, which leads to difficult in the design, similarly the magnetic components and capacitors also. In this the converter cannot fulfill ZVS in a wide range of load variations. In this proposed system the ZVS range of lagging-leg switches in the traditional PSFB converter can be extended by designing the leakage inductance of the transformer very large or adding an external resonant inductor component with large inductance. However, these approaches will increases duty-cycle loss, which results in high secondary-voltage stress similarly primary-conduction losses also. Another approach is to reduce the magnetizing inductance of the transformer to achieve a wide ZVS range. However, this significantly increases the RMS current stress and conduction losses on the primary side, because of the additional current developed by the magnetizing inductor circulates through all the switches of the converter and transformer at its peak range. In addition, still it has the drawback of a large output inductor in high-output voltage applications. The PSFB converter in the paper uses a saturable reactor on the primary side to achieve a wide ZVS range and to reduce the circulating current. However, too much heat is developed on the saturable reactor core, thus it becomes bulky.

The motive of this paper is to eliminate all the problems of the above mentioned in the existing models which include narrow zero-voltage-switching (ZVS) range, large circulating current, large duty-cycle loss and to design a low output filter for high voltage applications. Similarly to enhance the output voltage and also to reduce switching losses. To reduce the voltage stress is also an important factor.

3 PROPOSED CONVERTER TOPOLOGY

3.1 PHASE SHIFTED PULSEWIDTH MODULATION CONVERTER

The phase shifted pulse width modulation converter is proposed to solve the demerits of the existing converters. This converter provides a soft switching technique along with a full ZVS range and reduced output filter for high voltage and high frequency applications. Some of the major drawbacks that were present in the existing converters are problems related to

duty-cycle loss, full ZVS range, no circulating current, voltage stress and large output filter in high voltage applications. The proposed converter circuit diagram is shown in Fig.3.1.1. The proposed converter is made of two symmetric half-bridge inverters (TSHBIs), with leading-leg and lagging-leg SHBIs, which are located in parallel on the primary side and are driven in a phase-shifting manner to regulate the output voltage of the converter. At the rectifier stage, two full bridge rectifiers sharing two lower-current-rating diodes compared with the main rectifier diodes are employed, because a full-bridge rectifier features low voltage stress in high-voltage applications. The turn's ratio *n* of the proposed converter can be lower than that of the existing converter at the same operating range of duty cycle, which will contribute to the improvement in power loss. The primary RMS current stress in the lagging-leg SHBI in spite of using a small magnetizing inductance of *T*1 is much lower than that of the existing converter design with a small magnetizing inductance, because the average value of the magnetizing current of *T*1 is zero within a half-switching period, and its contribution to the total RMS current at large loads is negligible. Also, it is much lower compared to the existing converter because has a large magnetizing inductance due to the lower turn's ratio. Consequently, in spite of using a small magnetizing inductance of *T*1, the primary conduction losses in the proposed converter become lower than that of the conventional PSFB converter. The ZVS range in the proposed converter is extended using only the magnetizing inductance of the transformer in lagging-leg SHBI, while minimizing the additional conduction loss. In this proposed converter topology, all primary voltages of the transformers are in phase with the primary currents, thus, there is no circulating current. In addition, the area of the reverse current of leading-leg switches as well as its current stress is much smaller than that in the conventional converter, which results in the improvement in the conduction period and turn-off switching losses.

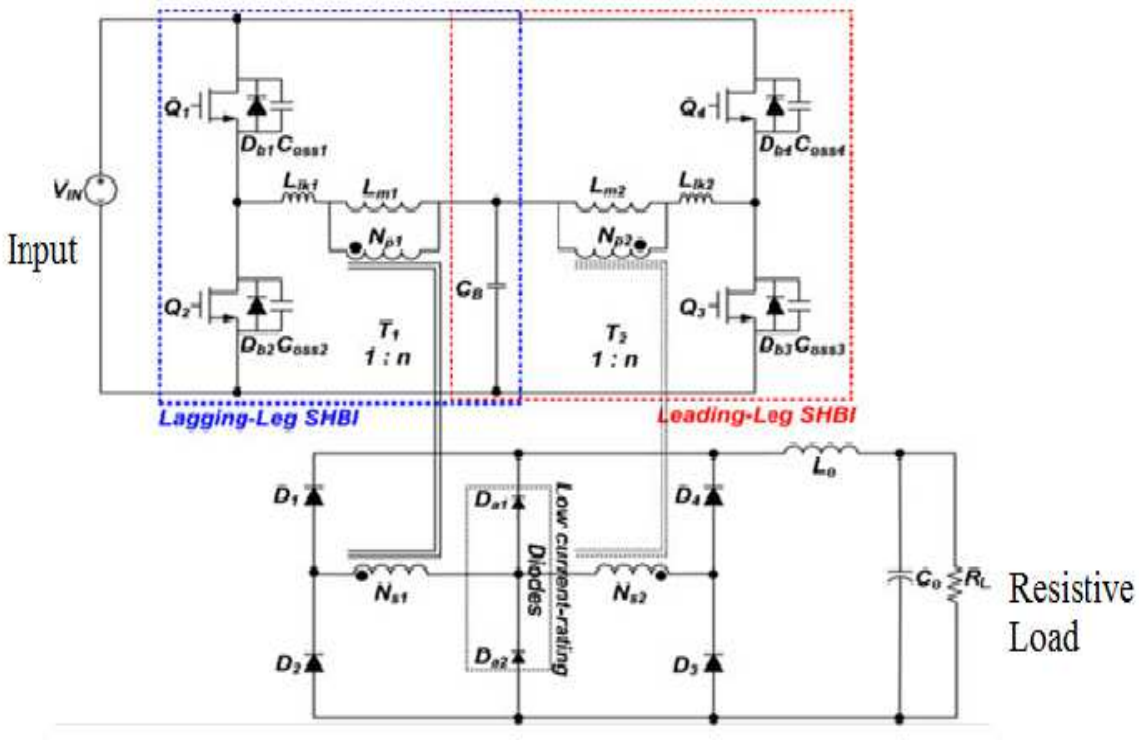


Fig. 3.1.1 Circuit diagram of the modified phase-shifted pulse width modulation converter

The proposed converter system has the following advantages:

- In this system all the switches is turned ON with ZVS under complete load conditions without any additional large resonant inductors or other related circuits, such that the conduction loss caused by the assistant current source extending the ZVS range is minimized due to its reduced conduction path.
- The circulating current in the traditional PSFB converter does not appear in the proposed converter, which contributes to the improvement in the conduction loss.
- The proposed converter has no problems related to an increase of duty-cycle loss. In addition, the conversion ratio is higher than that of existing PSFB converters. These allow that the turn's ratio of the transformers is

designed to be better than that of the counterparts. Thus, the voltage stress across the diode rectifier and the load current reflected to the primary side can be reduced, which leads to the improvement in the conduction loss.

- There is always an input voltage source in the waveform seen by the output *LC* filter. Thus, the value of output inductor is significantly reduced.
- A low profile design becomes a possibility due to the use of two small-sized transformers with low height instead of a large-sized transformer with high height. This results in a slim power supply.

3.2 OPERATING PRINCIPLE OF PROPOSED CONVERTER

The operation principle of the proposed converter in the steady state is studied by using the current and voltage notations and the key operating waveforms of the proposed converter. In this converter all the switches are driven with a constant duty ratio (D = 0.5), ignoring the dead time T dead. The driving signals of the switches in the leading-leg SHBI lead that of the switches in the lagging-leg SHBI. Here, we call the switches in the leading-leg or lagging-leg SHBIs leading-leg or lagging-leg switches, respectively. TSHBIs are operated by adjusting the phase shifted time $T\Phi$ to regulate the output voltage. Each switching period is divided into two half cycles, $t0$–$t8$ and $t8$–$t16$. The circuit showing the current and voltage identifications of the proposed system.

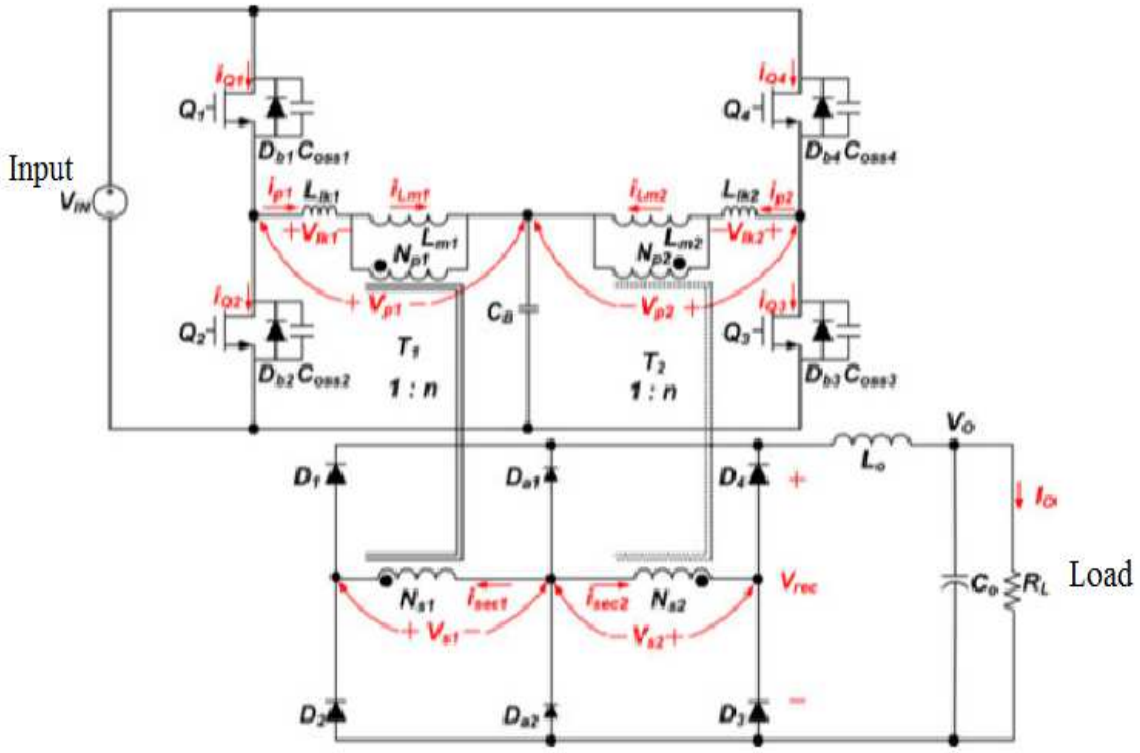


Fig. 3.2.1 Current and voltage indications in the proposed converter

Fig: 3.2.1 shows the current and voltage notations of the proposed converter in the steady state operating condition. The voltage and current flowing through the circuit are indicated using red color indication. The key operating waveforms are also required for the operation of the proposed converter i.e. the voltage and current waveforms across the various components in the proposed phase-shifted pulse width modulation converter. The switching period of the converter is divided into two half cycles, $t0$–$t8$ and $t8$–$t16$. Each half cycle can be subdivided into eight modes of operation.

4 THEORETICAL ANALYSIS AND OUTPUT RESULTS FOR PROPOSED CONVERTER

The performance of the proposed converter is confirmed by the experimental results of a prototype converter realized with the specification of an 80-in plasma display panel (PDP) sustain power module (320–385 V_{dc} input),(205 V_{dc}/5 A output). The prototype converter has to build to check the relevant analysis result which includes

- Input-to-Output Relationship
- Duty-Cycle Loss
- Circulating Current
- Filter Requirement
- Center-Tap-Type Rectifier for Low Voltage Applications

4.1 INPUT TO OUTPUT RELATIONSHIP

Since the durations of modes 2,6 and 8 are very narrow in the proposed converter and hence they can be neglected, then, the rectifier output voltage can be shown as in Figure. Averaging the voltage waveform *V* rec(*t*) in Figure give the dc conversion ratio of the proposed converter as follows:

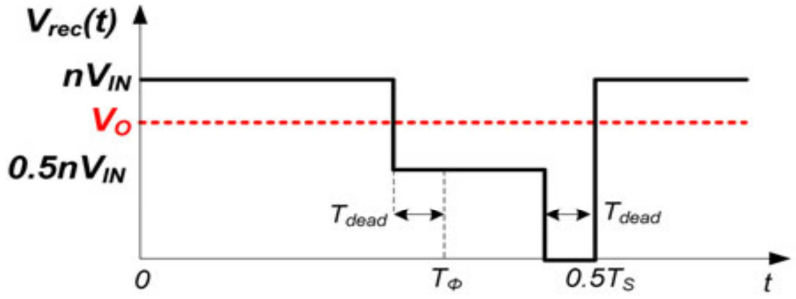


Fig. 5.1.1 Simplified design rectifier output waveform in the proposed converter

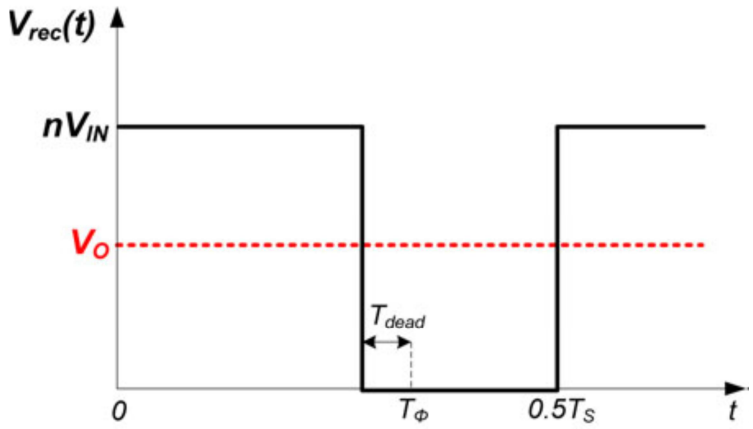


Fig. 5.1.2 Simplified design rectifier output in the existing converter with small leakage (or resonant) inductor

From the figure 5.1.1, it is noted that the gain of the proposed converter is higher than that of the traditional PSFB converter. Therefore, the turn's ratio *n* of the proposed converter can be lower than that of the traditional PSFB converter at the same operating duty cycle, which will contribute to the improvement in power loss.

4.2 DUTY-CYCLE LOSS

In general, it is widely known that utilizing large resonant inductor for extending ZVS range reduces the effective duty-cycle (or increases the duty-cycle loss). To compensate this, the turn's ratio *n* of the transformer is designed to be higher,

thereby increasing the primary-conduction losses and secondary-voltage stress. However, the ZVS range in the proposed converter is extended using only the magnetizing inductance of the transformer in lagging-leg SHBI, while minimizing the additional conduction loss in the converter system. Thus, the present converter has no problems related to the duty-cycle loss.

4.3 CIRCULATING CURRENT

There is the circulating current in the traditional converter, which flows through the transformer and switches although the primary voltage *V* primary (*t*) of the transformer is zero. This will raise the conduction losses. Similarly in this proposed converter, all primary voltages of the transformers are in phase with the primary currents, thus, there is no circulating current. In addition, the area of the reverse current of leading-leg switches as well as its current stress is much smaller than that in the traditional converter, which impacts in the improvement in the conduction and turn-off switching losses of the converter.

4.4 CENTER-TAP-TYPE RECTIFIER FOR PROPOSED CONVERTER

The rectifier structure is a kind of full-bridge rectifier. In general, two types of rectifiers are widely used, i.e., full-bridge rectifiers and center-tap rectifiers. Although a full bridge rectifier employs four diodes, compared to a center-tap rectifier, it offers benefits when it comes to transformer size and voltage stresses on the diodes for high voltage application. In the case of a center-tap rectifier, only two diodes are employed and there is only one diode in the secondary current path which results in less conduction loss for low voltage applications only.

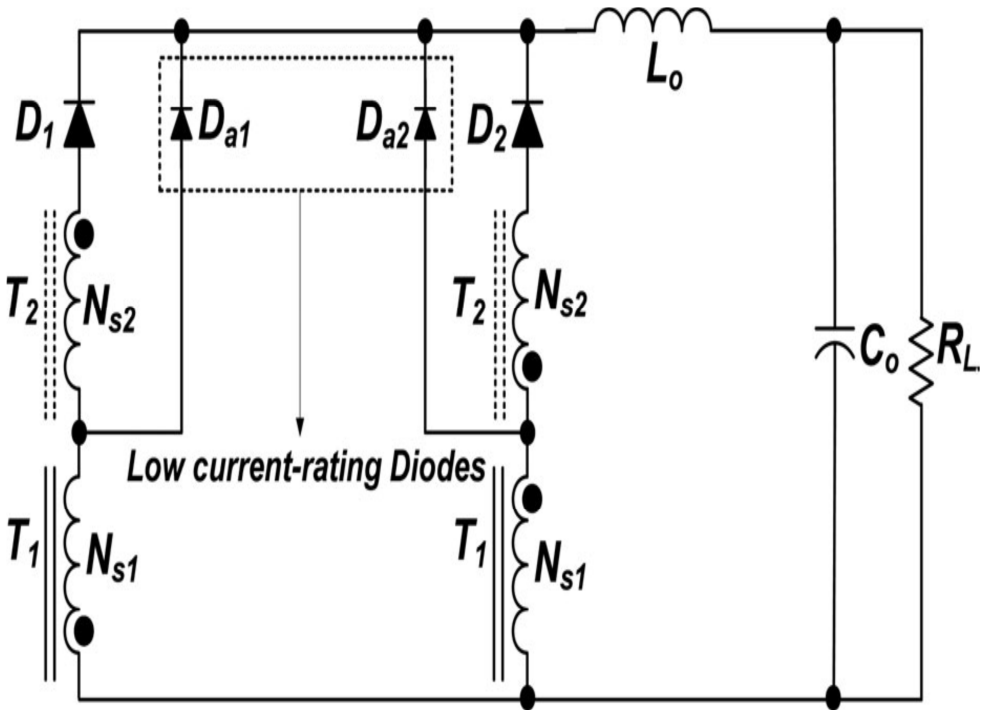


Fig. 5.4.1 Center-tap-type rectifier for the proposed converter design.

A center-tap-type rectifier suitable to the proposed configuration for low voltage applications is presented in the paper. The primary structure is the same and only the secondary structure is changed. Each transformer has two secondary windings and they are connected in series by turns. *D*1 and *D*2 are the main diodes, and *Da*1 and *Da*2 are the auxiliary diodes. The operational principle of the proposed configuration with the center tap rectifier is identical to the full-bridge rectifier.

5 SIMULATION ANALYSIS AND OUTPUT OF THE PROPOSED CONVERTER MODEL

The simulation of the proposed phase-shifted pulse width modulation converter is done using MATLAB to verify the relevant analysis results which include Input to Output relationship, ZVS condition, Duty cycle loss, filter requirements. The performance of the proposed converter is confirmed by the experimental results of a prototype converter realized with the specification of an 80-in plasma display panel (PDP) sustain power module. The basic parts of the proposed phase-shifted pulse width modulation converter consists of two symmetric half-bridge inverters (TSHBIs), leading-leg and lagging-leg SHBIs, which are located in parallel on the primary side of the transformer, two symmetric half-bridge inverters (TSHBIs), leading-leg and lagging-leg SHBIs, which are located in parallel on the primary side of the transformer.

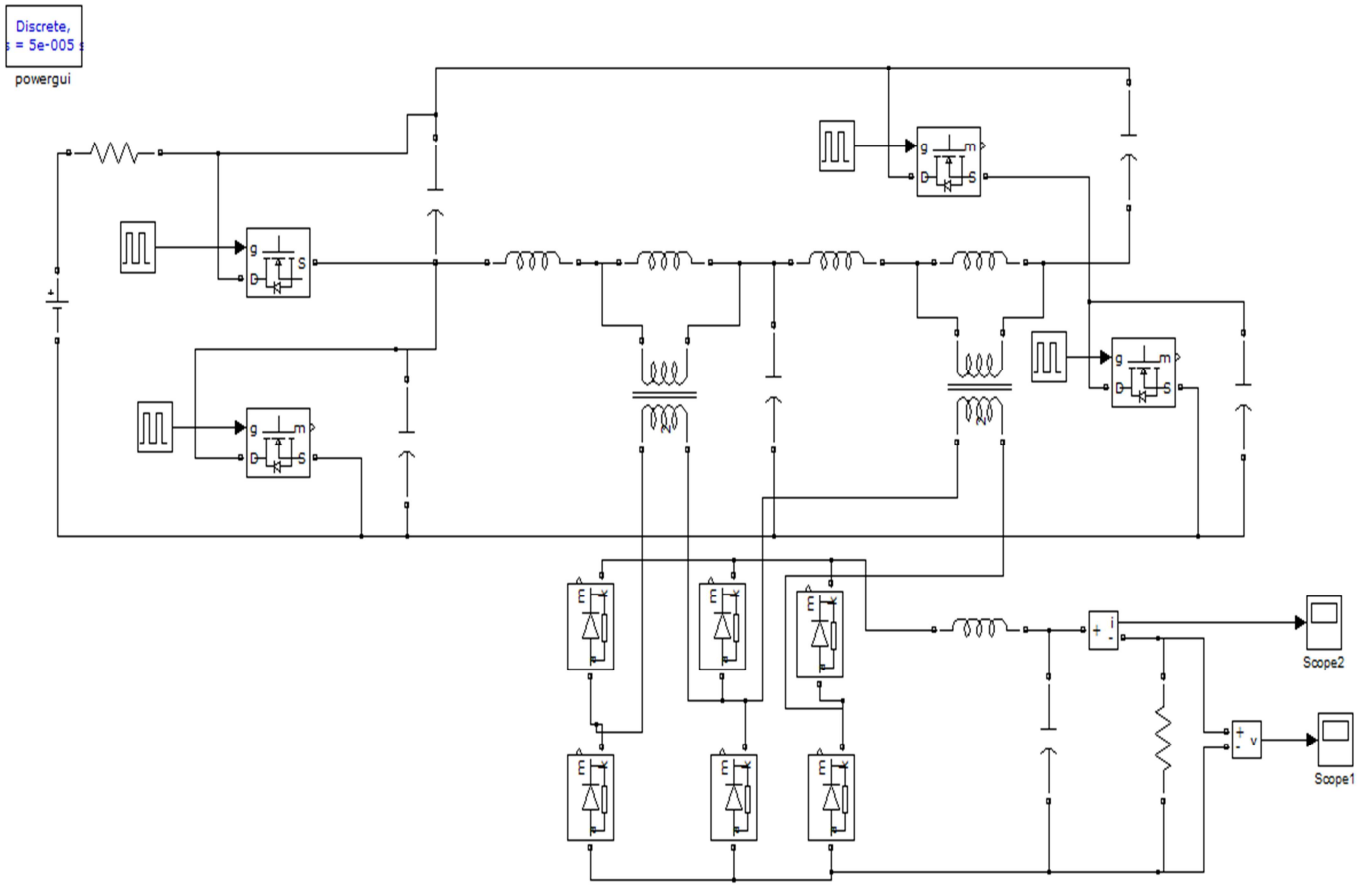
Table 1. Table of components

Main Switches($Q_1 \sim Q_4$)	SPW24N60C3(600V,24A)
Rectifier diodes($D_1 \sim D_4$)	16CTU04(400V,16A)
Auxiliary diodes(D_{a1}, D_{a2})	RURD460(600V,4A)
Main transformers(T_1, T_2)	Core:PQ3535 Turns Ratio:0.667 For T1, For T2, L_m:240µH,L_{lk}:6.08µH L_m:1.2mH, L_{lk}:8.47µH
Blocking capacitor(C_B)	2.2µF/250V
Output inductor(L_o)	125µH, MPP core
Output capacitor(C_o)	47µF/250V

The above given is a table containing the various component list and the specification which is been used for the above circuitry for getting the prototype output voltage and the prototype output current. Using the above specified components in the table the required prototype output can be achieved, the above components are used in the final stage of the DC/DC converter i.e. the rectifier stage for the rectification and filtration of the output. This proposed system is analyzed with nominal input voltage, i.e., 385-420 V and a full load current of 5 A.

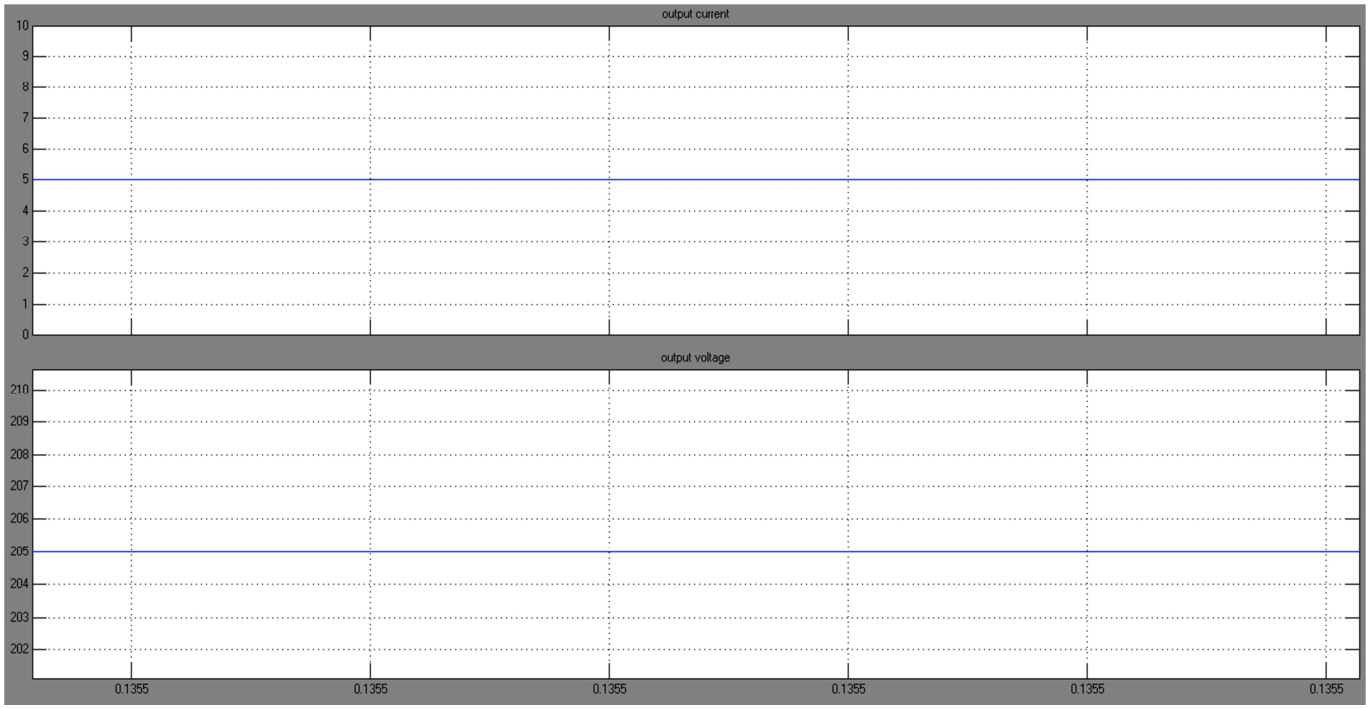
1) Input voltage: (*V*IN = 380–420 V);
2) Output voltage: (*VO* = 205 V);
3) Maximum output current: I_O (max) = 5 A;
4) Switching frequency: f_S = 100 kHz.

The simulation diagram of the proposed modified phase-shifted pulse width modulation converter is done in MATLAB and the prototype output needed for the result analysis is obtained.



Simulation diagram

6 OUTPUT WAVEFORMS



7 CONCLUSION

This paper has presented a modified soft-switching dc/dc converter that can overcome the remedies the of existing PSFB converters, such as narrow zero-voltage-switching (ZVS) range, large circulating current, large duty-cycle loss and a substantial output filter used in high voltage applications. In this presented system, the theoretical analysis has also been provided to show that the proposed converter has the performance over traditional PSFB converters. The regulated output voltage is obtained and also the voltage stress is minimized. Hence the efficiency of this presented converter is increased compared to the conventional converter. The input voltage is obtained as regulated output in this proposed converter.

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Polypropylene Capacitors with High Crystalline Segmented Offer Increased Energy Density

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ABSTRACT: The component of choice for many more DC Filter, energy storage and similar applications for the 21st century is High crystalline segmented metallized polypropylene capacitors are. With the introduction of higher crystalline and higher temperature dielectric, the size of segmented metallized polypropylene capacitors were reduced at least 33 percent while increasing the life expectancy and reducing the costs over previous designs. Higher temperature operation of at least 110°C is also accomplished with this material type. Capacitors are now manufactured using the combined segmented and high crystalline metallized polypropylene technology that allow denser power system packaging and lower manufacturing costs than other capacitor choices.

KEYWORDS: Polypropylene Capacitors, Energy Density.

1 INTRODUCTION

Film capacitors are known to have performance traits superior to other capacitor types. These traits include lower heat dissipation and longer life. For applications requiring large capacitance values in DC applications, aluminum electrolytic capacitors were often chosen over film types because film capacitor volumetric efficiency was not sufficient. Film capacitors are now produced using high crystalline segmented polypropylene that offer energy densities acceptably close to those achieved with aluminum electrolytics.

Most of the size improvements prior to the late 1990's focused on metallization techniques with the greatest improvements in large DC film capacitor banks from segmented polypropylene. This revolution reduced volumes by over 50%. The 21st century brought high crystalline polypropylene with another volumetric improvement of 33% due to increased voltage capabilities. The additive effects of these improvements are large film capacitors in many voltage levels less then one third the size of product produced in the early 1990's.

Polypropylene has become the dominant dielectric for metallized film capacitors. This is due to the large amount of film required to justify any volume manufacturing of a dielectric film and the advantagous dielectric properties of biaxially oriented polypropylene (BOPP) film typically used in capacitors. BOPP has a higher dielectric strength than a major alternative film, PET. This is believed to be because the crystalline phase is aligned in the plane of the film. This puts the electric field in the direction of low conductivity. [1].

The advances in metallization techniques that have been previously adopted included the use of heavy edge metallization. This is where the body is made lighter in metallization to increase voltage capability while the edge remains heavier to maintain current handling capability. Segmented film was subsequently adopted with the major improvements in segmented patterns and deposition processes in the 1990's. Segmented film involves dividing the film capacitor into many

smaller segments in order to reduce the potential for catastrophic failure. A self-healing in one segment is accomplished without causing additional damage to other segments preventing an “avalanche” effect of additional clearing and damage. This increases safety and allows higher voltage stresses.

High crystalline polypropylene or HCPP is a significant improvement in the base polypropylene film. The higher crystallinity leads to higher breakdown voltages and reduced film shrinkage at increased temperatures. The previous generation biaxially oriented polypropylene has had operation to 105°C with a significant de-rating from a 70°C reference, whereas HCPP has operation to 110°C or higher with less de-rating.

2 METALLIZED CAPACITOR PRODUCT

The biaxially oriented polypropylene is typically metallized on one side with aluminum, zinc or an alloy of zinc with a small percentage of aluminum. Higher metallization thicknesses oxidize slower and therefore have less capacitance loss in application where thinner metals cause less damage during the self-healing process. Due to segmented film reducing the damage potential during the self healing process it can allow thicker metallization leading to lower capacitance loss and lower heating in power electronic applications.

Metallized polypropylene is made into a capacitor product starting with a winding procedure. Both round windings on solid cores and flat windings on soft cores that are crushed are employed. Self-clearing characteristics are a strong function of the pressure within the layers of the winding which is more uniform with a round than a flat winding whereas flat winding technology has better volumetric efficiency. Clearly with better equipment for flat winding and proper air evacuation during thermal treatment, flat winding is preferred.

The wound capacitor elements are sprayed with metal to facilitate attachment. This sprayed metal is often called end-spray or schooping. It is essential to long term reliability of a metallized film capacitor that the bond of the sprayed metal to the metallized film remains intact. The stability of the metal bond depends on the winding design, the metal application procedure and that the film shrinkage is not too high after the application of the metal.

The metallized film windings that have been metal sprayed are then packaged to protect them from the environment and allow the user to connect to them. The packaging type depends upon whether the capacitors are oil impregnated or are potted in an insulating resin. Oil impregnation requires a sealed container that adds some cost, size and increased inductance due to connection distances. Sealing with an insulating resin such as a UL approved epoxy or polyurethane can reduce size and lower connection distances. Oil impregnation allows an increase in dielectric operating voltage with the increase dependent upon manufacturing procedures and the type of dielectric film that is used.

3 NEW METALLIZED HCPP CAPACITORS

Biaxially oriented polypropylene (BOPP) is polypropylene film that is stretched in two directions during the manufacturing process. Stretching is carried out at an elevated temperature below the crystalline melting point. Polypropylene is partially crystalline and there are always crystalline and amorphous phases. The degree of crystallization is typically between 50 and 60%. Higher crystalline polypropylene has an average increase in crystallinity of 3-4%.

Dielectric withstand tests of metallized film samples can be performed on sheets of film or in wound capacitor samples for comparitive purposes. Table 1 shows a comparison in dielectric withstand voltages between capacitor samples made with 6 µm thick polypropylene metallized with the same zinc process. A comparison is shown between a specific biaxially oriented polypropylene (PPTS) and HCPP. Breakdown voltage levels were recorded at three different temperatures. It was observed the dielectric withstand voltage was significantly increased with high crystalline polypropylene [2].

Table 1.
AC Breakdown Voltage Versus Temperature
6 µm zinc metallized PPTS and HCPP capacitors

Temperature	PPTS BDV	HCPP BDV
20°C	1200-1500	1720
85°C	1000-1300	1420
100°C	900- 1150	1300

During the manufacture of the film, heat treating is performed to relieve stresses and preshrink the film. The film will also shrink during additional heat treating performed during capacitor manufacturing. The higher temperature properties of high crystalline polypropylene allows the thermal treatment to be performed at increased temperatures. The higher temperature allows getting more air out of the capacitor winding without destroying it with the dual benefit of permitting higher temperature operation.

Studies have been performed by NWL to determine whether segmented HCPP film allows increased dielectric voltages for both capacitors impregnated with vegetable (rapeseed) oil and non-impregnated capacitors that are resin sealed. One study compared 5 micron (µm) thick metallized polypropylene that was not HCPP to an identical prepared product using HCPP. This produced four sample groups of 8 capacitors per group that were approximately 120µF each. The groups being with and without HCPP and with and without oil. The only difference between the HCPP and the non-HCPP samples was the heat treating procedure. The HCPP samples were heat treated at higher temperatures during capacitor manufacture.

The capacitors from the four capacitor groups were all subjected to an accelerated aging study. This was performed at 1000 Vdc and 85°C. The stress on the 5 µm film was therefore 200 V/µm. Figure 1 shows the results of this testing. The non-impregnated regular polypropylene had demonstrated an average capacitance loss of 8% at 1000 hours and was discontinued. The test continued to 1500 hours with the other three groups. All three groups had capacitance values above their starting points at 1500 hours that is a desired result due to electrostatic contraction [3]. It can be observed that the HCPP in vegetable oil had a lower capacitance degradation than the dry resin sealed HCPP group. What is also important is the dry resin sealed HCPP group outperformed the oil impregnated polypropylene capacitors that were not high crystalline film.

The results of this 5µm capacitor study and other studies performed by NWL on various capacitor sizes and HCPP dielectric thicknesses provide many new opportunities in metallized film capacitors. The increase in dielectric stress as has been achieved with HCPP translates into a capacitor volumetric improvement of 30-50%. This improvement is larger with the dry resin sealed capacitor types then the oil impregnated types with respect to the previous products.

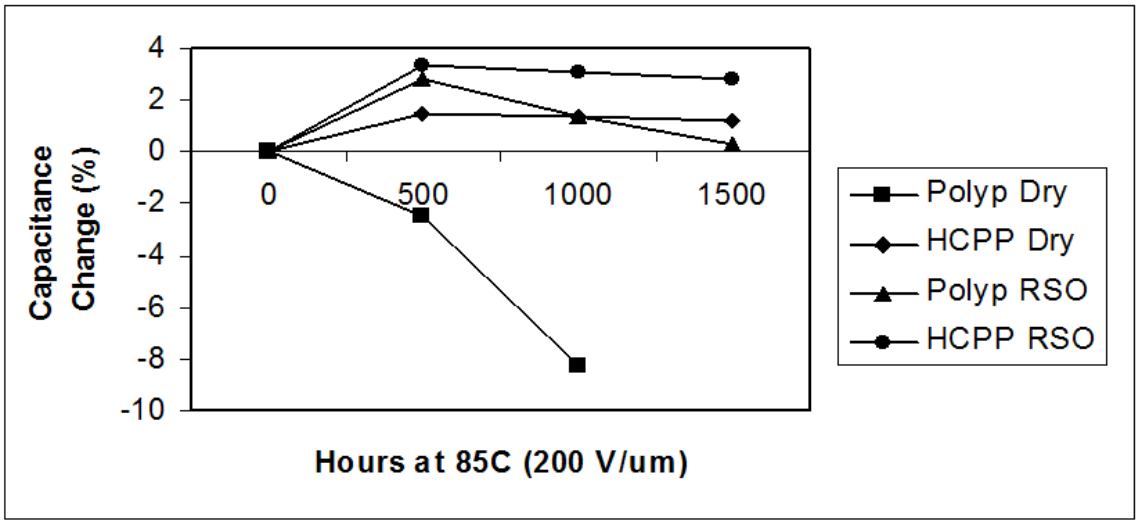

Fig. 1. Performance of Five Micron Segmented Film In Capacitors

Using the segmented HCPP film, NWL has now developed new dry resin sealed packages and reduced size oil filled packages to take advantage of the new material properties. Figure 2 is an example of a dry resin sealed capacitor rated 1500 µF at 1000 Vdc with a ripple current rating of 70 Arms at 55°C. This NWL ER-Series capacitor would replace between 4 and 9 computer grade electrolytic capacitors wired in a series and parallel arrangement. The film capacitor requires no series wiring with the associated balancing resistors and additional bus-work.

The HCPP film high temperature capabilities also allows it to be used in applications where other specialty high cost films were used. These include many requirements that were previously met with polycarbonate film. HCPP film can be used continuously at 110-115°C with intermittent operation at 125°C. Polycarbonate can be used continuously up to 125°C yet often is over-specified due to self-healing characteristics that are not ideal. A segmented HCPP film capacitor operating at 110°C would typically be one half the volume of a metallized polycarbonate capacitor.

Fig. 2. NWL ER-SERIES dry capacitor using segmented HCPP film

One of the previous limitations for metallized polypropylene was that it was only available in thicknesses such as 4μm and above. In the 1990's, 3.5 μm polypropylene was available yet not common. With the improved mechanical properties of HCPP such as greater rigidity, film in the range of 3.0 μm thick is available in industrial quantities. The applications for these thinner materials include high volume products such as hybrid electric automobiles. As the film and capacitor production procedures for these higher volume applications are refined, the comparisons between metallized film and other capacitor technologies will change again.

4 CONCLUSIONS

An important advancement in polymer film capacitors has been introduced. The use of high crystalline segmented polypropylene allows a film capacitor to be used in many more applications to take advantage of long life and lower power losses. These new capacitors are available in packages including oil filled and dry resin sealed. The new dry capacitors using HCPP often have higher capabilities than previous generation oil filled products. Products using high crystalline metallized polypropylene can now operate at higher temperatures with less need for cooling devices and reduced component spacing. New products are now being developed taking into account the improved properties of this film.

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Les intoxications par les produits gazeux au niveau de la province d'Errachidia, région de Meknès-Tafilalet, Maroc

[Gaseous intoxications in Errachidia Province, Meknes-Tafilalet Region, Morocco]

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ABSTRACT: The Poisoning caused by gaseous products still frequent, serious and often unrecognized. It represents a real menace to public health. The prevention is necessary to reduce the severity of this problem. The objective of this study was to describe the epidemiological, clinical and evolutionary characteristics of patients poisoned by gaseous products.
In The present epidemiological study we collected 380 cases of poisoning reported by provincial delegation of Errachidia, during a period from 2004 to 2011. The results showed the average age of the intoxicated was 26 ±16years. The poisonings in this province mainly concerne the adults whose age is between 20 and 74 years (59.04% of cases). The average incidence was 0.85 per 10000 inhabitants. The female patients predominated with 67.10%, the sex ratio (F/M) was 2.04. The frequencies of the highest poisoning were recorded in the urban area with 92%. The poisonings were accidental in 97.1% of the cases. Neuro-intestinal symptoms were the most frequent (36.8%), followed by neurological signs (35.5%) and gastrointestinal (22.1%).

KEYWORDS: Intoxication, Errachidia, gaseous products, Epidemiological Study, carbon monoxide

RESUME: L'intoxication par les produits gazeux reste fréquente, grave et souvent non reconnue. Elle constitue une vraie menace pour la santé publique dont la prévention s'avère nécessaire. L'objectif de ce travail était de décrire les caractéristiques épidémiologiques, cliniques et évolutives des patients intoxiqués par les produits gazeux.
La présente étude épidémiologique a porté sur 380 cas d'intoxications déclarées par la délégation provincial d'Errachidia durant une période allant de 2004 à 2011.Les résultats ont montré que l'âge moyen de la population intoxiquée était de 26±16ans. Les intoxications par les produits gazeux dans cette province concernaient principalement les adultes dont l'âge est compris entre 20 ans et 74 ans et qui représente plus de 59% des cas. L'incidence moyenne était de 0,85 pour 10 000 habitants. Les patients de sexe féminin prédominaient avec 67,10 %, le sexe ratio (F/H) étant de 2,04. Les fréquences des intoxications les plus élevées ont été enregistrées dans le milieu urbain avec 92 %. Les intoxications étaient accidentelles dans 97,1 % des cas. Les signes neuro-digestifs étaient les plus fréquentes (36,8%), suivies par les signes neurologiques (35,5%) et digestifs (22,1%).

MOTS-CLEFS: Intoxication, Errachidia, Produits gazeux, Étude épidémiologique, Monoxyde de carbone

Corresponding Author: Nesma Nekkal

1 INTRODUCTION

Les gaz toxiques proviennent de multiples sources : gaz de combustion, gaz radioactifs, émanations de peinture, colles, etc. L'inhalation de ces produits toxiques est une cause assez fréquente de l'intoxication aiguë, qu'il s'agisse d'une intoxication isolée ou d'un accident collectif [1]. La plupart des intoxications par les produits gazeux sont accidentelles et surviennent en milieu professionnel (défaut de protection, déversement ou relargage inopiné, transport de matières dangereuses) ou domestique (mélange de produits ménagers, accident de bricolage…). L'objectif de ce travail est de dresser le profil épidémiologique et détecter les facteurs de risque des patients intoxiqués par les produits gazeux au niveau de la province d'Erracidia de la région de Meknès Tafilalt, afin de pouvoir cibler les prochaines campagnes de prévention des risques de ces produits au niveau de cette province.

2 DONNÉES ET MÉTHODES

Pour dresser le profil épidémiologique des intoxications par les produits gazeux, une étude rétrospective a été réalisée durant une période de huit ans allant de 2004 à 2011. Elle a porté sur la consultation des cas des intoxications par les produits gazeux, déclarés à la délégation provinciale de la santé d'Errachidia. Cette province est située au Sud- Est du Maroc, dans la région de Meknès-Tafilalt Celle-ci est considérée comme l'une des régions les plus importantes historiquement du Maroc. Elle est bordée par la province de Figuig à l'Est, Beni Mellal et Azilal, Khenifra à l'Ouest, Boulmane au Nord et l'Algérie vers le Sud. Sa superficie est d'environ 60 000 km² et sa population de 556 612 habitants, d'après le Recensement Général de la Population et de l'Habitat (2004) (Haut Commissariat au Plan, 2004).(Figure 1)

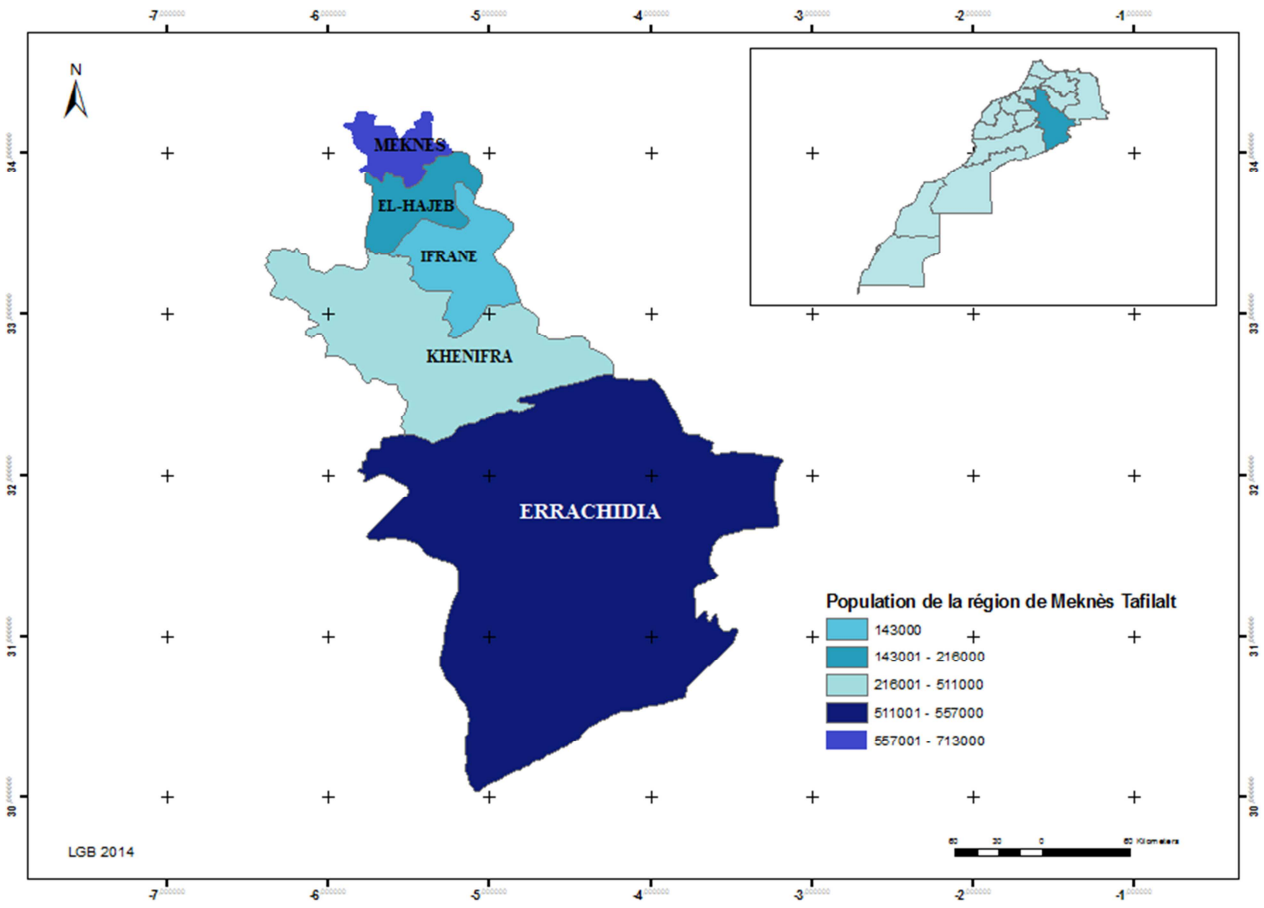

Fig. 1. Situation Géographique et données sur la population de la province d'Errachidia au Maroc.

Notre étude consiste à décrire les caractéristiques socio-démographiques, spatio-temporelles et cliniques des patients intoxiqués par les produits gazeux. Pour déceler les liaisons entre ces variables nous avons utilisé le test khi-deux (χ2) de

contingence et afin de détecter les proximités des variables et de faire apparaître la corrélation entre eux, nous avons utilisé l'Analyse en Composantes. Principales(ACP).

3 RÉSULTATS

380 cas d'intoxications ont été colligés dans la province d'Errachidia, avec une prédominance chez les adultes dont la tranche d'âge est comprise entre 20 et 74 ans soit un pourcentage de 59,04 %. Ils sont suivis par les enfants âgés de 5 à 14 ans, avec un pourcentage de 23,70 %. La prédominance féminine des patients était marquée, les femmes étaient 2,04 fois plus intoxiquées que les hommes, cette différence est très hautement significative avec P=0,0001 ($\chi 2$=44,47 ; P <0,001). (Figure 1).

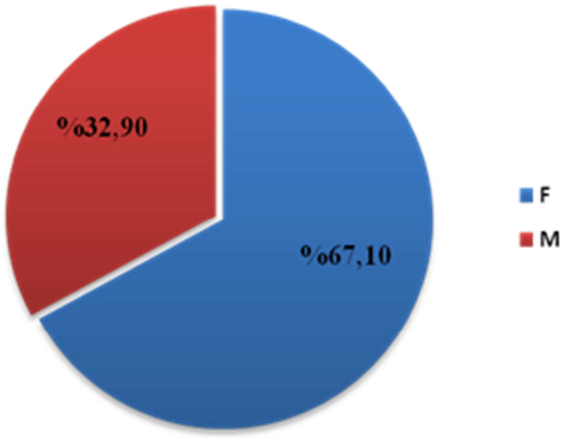

Fig. 2. Répartition des patients intoxiqués par les produits gazeux en fonction du sexe

Au cours des huit années de notre étude (de 2004 à 2012), il en ressort que les intoxications par les produits gazeux surviennent au cours de toute l'année, mais on observe une grande majorité des cas pendant les mois d'hiver (Figure 3), les pics de ce type d'intoxications observés en janvier, février, et décembre correspondent à des périodes froides de l'année, ce qui nous a permis de penser que la cause principale de cette intoxication est due au monoxyde de carbone.

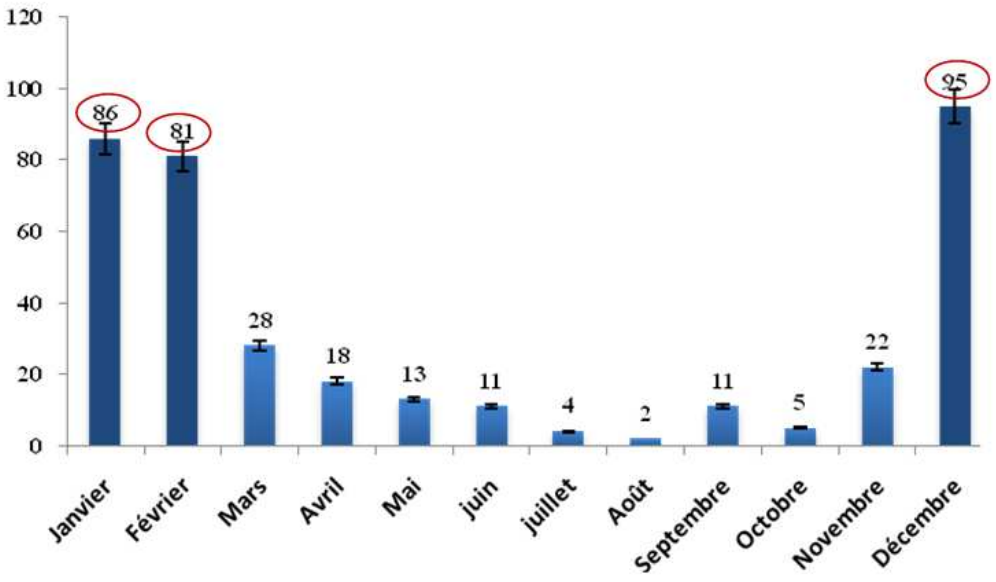

Fig. 3. Répartition des intoxications selon le mois de survenue

Suite à une inhalation des produits gazeux, les intoxications survenues à domicile étaient majoritaires avec un pourcentage de99%. (Figure 4). La majorité des cas provenaient du milieu urbain avec 92%. L'incidence moyenne calculée sur la période d'étude était de 0,85 pour 10 000 habitants.

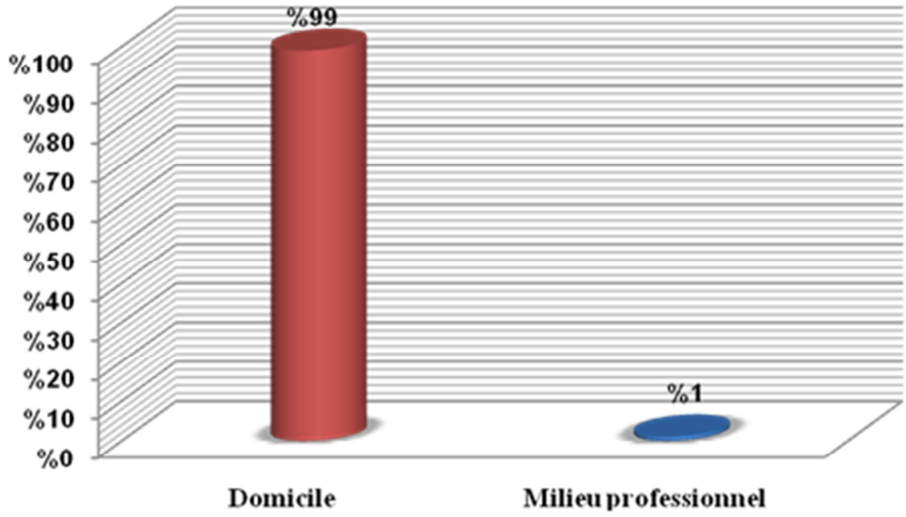

Fig. 4. Répartition des intoxiqués par les produits gazeux en fonction du milieu

L'évolution des taux d'incidence de ce type d'intoxication ne montre pas une régression, en 2007 le taux d'incidence enregistré par la délégation provincial de la santé d'Errachidia atteint 20,32 pour 100 000 habitants alors qu'il était de 0,54 en 2004 (Figure 5).

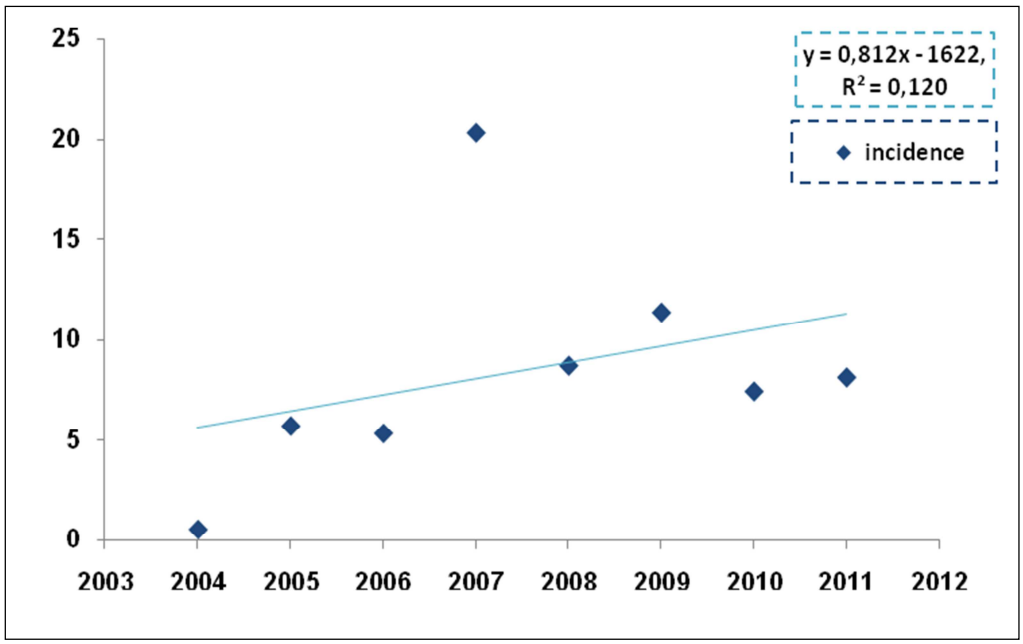

Fig. 5. Evolution de l'incidence au niveau de la province Errachidia

Les intoxications accidentelles ont représenté 97,1%, les tentatives de suicides concernant 0,3% de l'ensemble des cas, alors que 2,6% des cas sont inconnus.

30,3% des patients intoxiqués étaient obnubilés et 65,3% étaient conscient. Les signes neuro-digestifs étaient les plus fréquentes (36,8%), suivies par les signes neurologiques (35,5%) et digestifs (22,1%). D'après les résultats consignés dans le

tableau 1, les valeurs du risque relatif concernant le traitement symptomatique et les signes cliniques ne montrent pas une signification sauf au niveau des signes neurologiques (RR=1.5 IC 95% [1.45-1,70] avec χ2 = 6,24 ; P= 0,012), ce qui nous a permis de dire que le traitement prescrit augmente la fréquence de l'événement.

Tableau1. Le calcul de risque relatif entre les signes cliniques et le traitement

Signes	χ^2	P	RR	[IC 95%]
Signes cliniques Digestifs	1,11	0,29	2,90	0,36-23,00
Signes cliniques neuro-digestifs	0,36	0,55	0,69	0,21-2,31
Signes cliniques neurologiques	6,24	0,012*	1,58	1,46-1,70
Signes cliniques respiratoire et neurologique	0,90	0,76	1,01	0,99-1,02
Signes cliniques Asymptomatique	0,3	0,86	1,003	0,99-1,01
Signes cliniques respiratoire	0,60	0,81	1,005	0,99-1,01
Signes cliniques généraux	0,90	0,76	1,008	0,99-1,02
***Liaison significative (p=0,05) ; **liaison très significative (p=0,01) ; ***Liaison hautement significative (p=0,001). RR : Risque relatif ; IC 95 intervalle de confiance à 95 %.**				

Afin de déceler la corrélation entre l'état clinique, l'origine des patients, le sexe etles tranches d'âgesnous avons procédé à une analyse en composantes principales dont les résultats sont schématisés sur la figure6

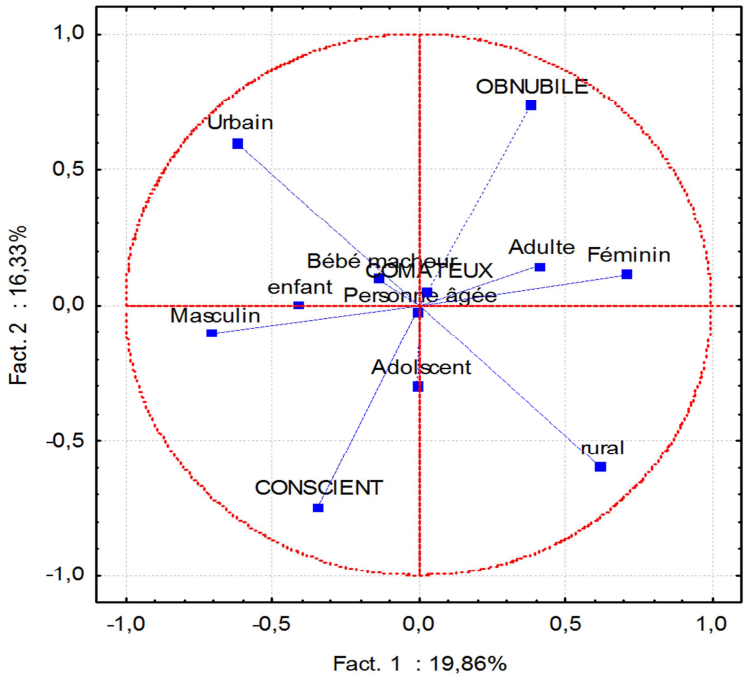

Fig. 6. Projection des groupes d'âges, du sexe, de l'origine et de l'évolution des intoxiqués sur le plan factoriel

L'analyse de composantes principales ACP, montre que les deux premiers axes contribuent par 36,19 % dans la variation totale de l'origine, des groupes d'âge, du sexe, en fonction de l'état des patients.

Selon le premier facteur qui représente 19,86% de la variabilité, on note une association entre les adultes, le sexe féminin, le milieu rural et l'évolution vers l'état d'obnubilé du coté (X+). Du côté opposé(X-), on remarque que les enfants, les adolescents, le sexe masculin et le milieu urbain sont liés à l'état de la conscience. Suivant le deuxième facteur (16,33%), on trouve une liaison entre les adultes, les adolescents et l'état de conscience des patients du coté (Y-).

Ces résultats révèlent, en conséquence, une affinité importante entre les adultes féminins, et l'évolution vers l'état d'obnubilé d'une part, et entre les enfants et les adolescents masculins et l'évolution vers la conscience.

4 DISCUSSION

Malgré le manque important de données sur les patients de la province Errachidia, nous avons décrit certaines caractéristiques épidémiologiques, cliniques et évolutives des 380 cas des intoxications accidentelles et volontaires par les produits gazeux)

Les études épidémiologiques sur ce type d'intoxications restent trop limitées. La majorité des publications se concentrent sur les types de produits provoquant l'intoxication notamment le monoxyde de carbone. Ce produit gazeux constitue un problème de santé publique dans plusieurs pays [2,3]. En France, l'intoxication par le CO est la première cause de mortalité accidentelle, en 2007 l'incidence était de 0,066 ‰ [4].

Au Maroc, 11488 cas d'intoxications au CO ont été enregistrés pendant 17 ans. D'après le Centre Antipoison et Pharmacovigilance du Maroc, les intoxications oxycarbonées sont concentrées dans les régions de Meknès Tafilalt, Tanger Tétouan et Tadla Azilal avec une fréquence de 44% des cas déclarés [5]. Le phénomène des intoxications au CO présente un caractère saisonnier avec une recrudescence hivernale et automnale. Ceci montre la prédominance des causes liées aux moyens de chauffage surtout les chauffages à gaz, le brasero (kanoun) et le chauffe-eau à gaz, ces derniers comportent un risque imminent surtout dans des locaux non aérés [6,7].Nos résultats concordent avec ces données et montrent aussi que c'est le monoxyde de carbone qui est la cause principale des intoxications gazeuses.

En ce qui concerne les intoxications par tous les produits gazeux, dans notre série 380 cas ont été déclarés par la délégation provincial d'Errachidia, les femmes étaient les plus touchées ($\chi 2=44,47$; $P <0,001$) avec 65% des cas survenus à domicile. Ces résultats sont la conséquence des habitudes socio-antropologiques de cette région où la femme reste généralement confinée chez elle. En effet, les femmes sont habituellement loin de la vie de travail, les pressions psychologiques de certains facteurs socio-culturels contraignants dans la population pourraient avoir augmenté les tentatives d'empoisonnement dans ce groupe [8]. D'après les données analysées, les adultes et les enfants sont les plus touchés, avec des fréquences respectivement de 59,04 %. Et 23,70 %.Les signes neuro-digestifs étaient les plus fréquentes (36,8%), suivies par les signes neurologiques (35,5%) et digestifs (22,1%).Ces deux symptômes sont caractéristiques de l'intoxication par le monoxyde de carbone.

Une exposition prolongée à des concentrations faibles de monoxyde de carbone peut également avoir des effets à long terme, en particulier cardiovasculaires et neurocomportementaux [9].

Selon Smith sur son étude concernant le monoxyde de carbone, les intoxications par le CO peuvent occasionner des séquelles, notamment de type neuropsychiatriques : troubles cognitifs, troubles de la personnalité, syndromes parkinsoniens, incontinence, démence et psychoses ont été décrits. La survenue de ce type de troubles a été décrite trois jours à huit mois après l'exposition. La récupération se fait dans l'année dans 50 à 75 % des cas, mais des personnes gardent des séquelles à long terme ; une étude a ainsi relevé des troubles de la mémoire chez 43% des survivants d'intoxications aiguës au CO [10].

5 CONCLUSION

Cette exploitation épidémiologique exhaustive des données, de la province d'Errachidia, recueillies durant les huit années sur les intoxications par les produits gazeux, nous a permis de dégager certains axes de réflexion sur la nécessité d'améliorer le système d'information d'une part afin de pouvoir détecter les facteurs d'exposition sur les populations à risque, et renforcer les compagnes de sensibilisation pour limiter le risque d'intoxication par ce type d'empoisonnement.

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Prevalence of Cytomegalovirus infection among HIV sero-positive patients – Case Study from North India

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ABSTRACT: Cytomegalovirus is one of the opportunistic infections associated with significantly high morbidity and mortality among patients living with immunodeficiency syndrome. Cytomegaloviruses (CMV) are deoxyribonucleic acid (DNA) viruses and are members of the Herpesviridae family CMV are recognized pathogens that cause community-acquired pneumonia (CAP) in compromised hosts. We investigated the prevalence of CMV among seropositive cases of human immunodeficiency virus (HIV) from Northern India. In this study we observed the relationship between CMV infections among the immunocompromised patients. This study carried out in Department of Microbiology, King George's Medical University (KGMU), Lucknow and Dolphin (PG) Institute of Biomedical and Natural Sciences, Dehradun, Uttarakhand, India. Total 250 HIV sero-positive cases were considered in study of CMV infection. HIV status was confirmed by Enzyme linked immunosorbent assay (ELISA) done at antiretroviral (ART) center, KGMU, Lucknow. CMV positivity was evaluated by CMV-IgG and IgM antibodies using ELISA kit. Among 250 HIV positive cases 10.4% were found positive for CMV- IgG where as 8.4% were positive for CMV- IgM however 1.2% were found to be positive for both CMV- IgG and CMV- IgM. Sero-prevalence of CMV IgG and IgM among HIV infected cases were 10.4% and 8.0% respectively. No significant difference was observed among gender and age group in CMV infection among HIV-positive cases.

KEYWORDS: HIV, cytomegalovirus, CMV – IgG and IgM antibodies, ELISA.

1 INTRODUCTION

Cytomegalovirus (CMV) is a large encapsulated double stranded DNA virus. It belongs to the beta – herpes virus group. Most likely it is one of the most common latent infections known to humans [1].

CMV infection is defined as isolation of the CMV virus or detection of viral proteins or nucleic acid in any body fluid or tissue specimen (e.g., plasma, serum, whole blood, peripheral blood leucocytes, CSF, urine, or tissue) [2].

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It is probably one of the most common latent infections known to humans [1]. Normally it is controlled by the cellular immune response and hence characterized as a self- limiting infection in healthy individuals. In contrast, the CMV in Immunosuppressed individuals as in case of HIV infection carries high morbidity and mortality [3]. Clinical disease due to CMV has been observed in up to 40% of the patients with advanced HIV disease [4].

HIV is undoubtedly immune system disorder but ophthalmic disease can occur in up to 50% of HIV patients during the natural history of their infection [5]. However, it is more common in the developing nations and among people with lower socioeconomic background [6].

The ELISA is the most common test available for measuring CMV IgG (past exposure to CMV) and CMV IgM (recent or reactivation of CMV infection) [7]. Although CMV infection among HIV/AIDS patients has been reported in India [1], [8], [9]. But still the surveillance of CMV infection in immunocompromised cases needs to be investigated to meet the future health challenges. The present study has been designed with aim to investigate the prevalence of CMV infection among HIV sero-positive positive patients from North India.

2 MATERIALS AND METHODS

This study was conducted between January 2011, to January 2014, at the Department of Microbiology, King George's Medical University, Lucknow, Uttar Pradesh and Dolphin (PG) Institute of Biomdical and Natural Sciences, Dehradun, Uttarakhand, India.

2.1 STUDY POPULATION

The study population constituted of 250 HIV sero-positive patients both males and females. The age group was between < 10 to > 50 years at the time of interview and were about to be registered for treatment. Their HIV status was confirmed by using ELISA test in ART Center, KGMU, Lucknow UP India.

2.2 DATA COLLECTION

The data was collected through personal interview using structured questionnaire to provide information regarding age, sex, marital status, occupation and patient's history and clinical examination by physicians at the hospital.

2.3 BLOOD COLLECTION AND ANALYSIS

A 5 ml of whole blood was collected from each HIV infected patient by vein puncture into vacutainer. Serum was separated after centrifugation of blood at 3000 rpm for 10-15 minutes and then stored at -20 ºC. The serum was later analyzed for CMV specific IgG and CMV specific IgM. ELISA method. It was supplied by NOVA TEC kit manufactured by Waldstrasse, 23A6 Dietzenbach, 63128, Germany. The assay was performed as per the manufacturer's instructions.

2.4 STATISTICAL ANALYSIS

The data collected was entered into Microsoft Excel and checked for any inconsistency. The descriptive statistics such as percentage calculated. The descriptive statistics such as percentage and mean(±SD), Odds ratio, confidence interval were calculated.

3 RESULT

Out of 250 cases, IgG antibodies against CMV were detected in 26(10.4%) and IgM antibodies against CMV were 21(8.4%). Among these 60.8% were males and 39.2% were females. The most prominent age group in the present study was 31-40 years (39.2%). The mean(±SD) age of the study population was 36.06(±11.34) years with range 7-58 years. The median age of the patients was found to be 38 years (Table-1).

Table 1: Age and sex distribution of study subjects

Age in years	No. (n=250)	Percent (%)
<20	28	11.2
20-30	38	15.2
31-40	98	39.2
41-50	74	29.6
>50	12	4.8
Mean±SD, median, range	36.06 ±11.34, 38, 7-58	
Gender		
Male	152	60.8
Female	98	39.2

Table 2: Percentage of IgG /IgM antibodies in HIV sero-positive patients

N=250	Positive	Negative
IgG	26 (10.4%)	224 (89.6%)
IgM	21 (8.4%)	229 (91.6%)
Both	3 (1.2%)	247 (98.8%)

Table -3: Prevalence of CMV according to Gender and Age

Gender and age	No. of patients	IgG +ve		IgM+ve No. (%)		Both+ve No. (%)	
		No. (%)	OR (95%CI), p-value[1]	No. (%)	OR (95%CI), p-value[1]	No. (%)	OR (95%CI), p-value[1]
Gender							
Male	152	15 (9.9)	0.86 (0.38-1.97), 0.73	13 (8.6)	1.05 (0.41-2.64), 0.91	2 (1.3)	1.29 (0.11-14.45), 0.83
Female	98	11 (11.2)	1.00 (Ref.)	8 (8.2)	1.00 (Ref.)	1 (1.0)	1.00 (Ref.)
Age in years							
<20	28	2 (7.1)	1.00 (Ref.)	5 (17.9)	1.00 (Ref.)	0 (0.0)	1.00 (Ref.)
20-30	38	2 (5.3)	0.72 (0.09-5.46), 0.75	2 (5.3)	0.25 (0.04-1.42), 0.12	1 (2.6)	NA
31-40	98	14 (14.3)	2.16 (0.46-10.16), 0.32	6 (6.1)	0.30 (0.08-1.07), 0.06	0 (0.0)	NA
41-50	74	7 (9.5)	1.35 (0.26-6.97), 0.71	7 (9.5)	0.48 (0.13-1.66), 0.24	1 (1.4)	NA
>50	12	1 (8.3)	1.18 (0.09-14.42), 0.89	1 (8.3)	0.41 (0.04-4.02), 0.45	1 (8.3)	NA

[1]*Derived from binary logistic regression, OR-Odds ratio, CI-Confidence interval, Ref.: Reference category*

The prevalence of IgG positivity was 14% lower among males compared with females (OR=0.86, 95%, CI= 0.38-1.97, p=0.73), although this was statistically not significant. However, the prevalence of IgM positivity was almost similar (p>0.05) among male and females. There was no significant association between age and prevalence of IgG and IgM. The positivity of both IgG and IgM was 1.29 times insignificantly higher among males than females (OR=1.29, 95%CI=0.11-14.45, p=0.83).

4 DISCUSSION

Although tuberculosis was considered as single most common opportunistic infection in Indian patients with AIDS but CMV has also been reported as one of the frequent opportunistic infection in immune compromised individuals as in case of HIV infection.[10],[11],[1].

The infection with CMV is more common in the developing countries like India. The CMV positivity may be considered as marker of extremely severe immunosuppression which may ultimately lead to fatal outcomes in patients [6].

Only a few studies are available on the CMV infection in Indian patients with HIV/ AIDS. In one such report 45% among 125 HIV positive cases were found positive for CMV infection [12].

In present study, prevalence of CMV- IgG (10.4%) and CMV -IgM (8.4%) antibody in HIV positive patients has been observed. This is contrary to earlier report stating 89.4% IgG antibodies and 10.6% IgM antibodies in HIV positive patients [6].

One of the earlier study in North India reported that 32.4% of patients with HIV positive had CMV co-infection and part of the symptoms may be attributed to CMV in India [10]. In another study, 93% were CMV IgG positive CMV infection in HIV patients [13]. Patients had ophthalmic manifestations retinal detachment was reported in 70% in HIV positive patients in India. No significant association of CMV infection with gender and age observed [14].

CMV infection in 16% patients with minor lesions has been revealed which was contributory cause of death in these patients [15]. 59% HIV positive patients indicated histological evidence for CMV infection [16]. Our study shows the increase in CMV IgG sero-positivity with age which agrees with the findings made in a similar study in Iran [17].

Results of one study reports CMV IgM antibody sero-prevalence to be 8.4% and 9% among HIV infected Thai children [18]. Whereas higher than 2.3% recorded in USA [19]. The variation in sero-prevalence of CMV IgM observed may probably be due to epidemiological and methodological differences. Cytomegalovirus is a ubiquitous and infection caused by it has become endemic throughout the world. With its prevalence ranging 40 -100% [19].

One study from USA reports 100% of the sex workers and sexually active homosexual men positive for CMV infection. From England and France maximum prevalence has been reported in homosexual men [20]. The present study indicates the magnitude of the problem associated with active CMV infection among population of HIV infected patients from north India.

In our study presence of IgG antibodies (10.4%) indicates past infection and IgM antibodies (8.4%) indicates reactivation or reinfection of CMV , thus it is suspected that CMV infections are associated with an increased risk among AIDS patients.

The prevalence of IgG positivity was 14% lower among males compared with females (OR=0.86, 95%CI= 0.38-1.97, p=0.73), although this was statistically not significant. However, the prevalence of IgM positivity was almost similar (p>0.05) among male and females. There was no significant association between age and prevalence of IgG and IgM. The positivity of both IgG and IgM was 1.29 times insignificantly higher among males than females (OR=1.29, 95%CI=0.11-14.45, p=0.83).

There is need to further investigate the prevalence of CMV infection among immuno-compromised cases in other part of the country to have a better picture of the extent of this problem in Indian scenario.

5 CONCLUSION

The present study indicates that CMV infection among HIV positive cases although is statistically not significant, but the case study reveals the need of further investigation from different parts of the country to highlight the severity of the problem. It will help in better management of the HIV cases with early diagnosis of CMV antibodies in the patients.

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Intestinal parasitism in Moroccan children: comparative quantitative study of the Faust's and Ritchie's coprologic methods

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ABSTRACT: A study of intestinal parasites in school children in urban and rural areas of Tetouan (Morocco) was conducted. Before it was performed a comparative quantitative study of Faust's and Ritchie's techniques in order to optimize intestinal parasites diagnosis and to determine the techniques effectiveness. The Ritchie's technique resulted the most effective for the detection of both protozoan and helminthes, especially under conditions of low parasite burdens. The prevalence of intestinal parasites was 65% and 71% in rural and urban areas respectively. Overall, the prevalence of protozoa that was found was higher than the one detected for helminths. The most frequent of the intestinal parasites was the protozoa *Blastocystis hominis* and the most frequent pathogenic protozoa were *Giardia lamblia* followed by *Cyclospora cayetanensis*. Among the helminths *Trichuris trichiura*, *Hymenolepis nana*, *H. diminuta, Enterobius vermicularis*, *Taenia saginata*, *Ascaris lumbricoides* and *Fasciola hepatica.*
Giardia lamblia showed notable differences between boys and girls in urban areas. To compare the prevalence of parasites in children with the same sex in different areas the differences were only found in boys infected by *B. hominis*, *G. lamblia* and *E. nana*.
Multiple parasitism appeared in 29% of the samples presenting two, three or four parasites.

KEYWORDS: Faust, Ritchie, quantitative, enteroparasite, prevalence, control

1 INTRODUCTION

Intestinal parasitism can be considered indicative of the socioeconomic status and sanitation levels of a population. The death triangle of poor hygiene, inadequate sanitation and lack of access to safe drinking water claims children's lives each day, mostly in developing countries [1]. Inadequate water supply and sanitation are largely responsible for millions of estimated cases of diarrheal disease and deaths in developing countries every year [2].

Children constitute the sector most affected by intestinal parasites. Concerning the morbidity that this causes, the World Health Assembly, in Resolution 54.19 of 2001 [3], indicated that at least 75% of school-age children living in high-risk areas for geohelminths and *Schistosoma* would need access to regular chemotherapy during the year 2010. WHO have therefore, for some years, been providing incentives to improve sanitation such as the Projects of Healthy Schools [4].

Intestinal parasites can cause a wide range of symptoms including diarrhea, loss of appetite, joint pain, mucus in stools, fever, listlessness, foul-smelling stools, stomach cramps, coughing and vomiting.

The diagnosis of intestinal parasitic infections is based primarily on microscopic analysis of fecal samples, including direct observation, concentration and permanent staining smears. Concentration techniques are essential since the amount of

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parasitic forms in fecal samples is often very low and can give as negative positive samples, which consequence would be the maintenance of the transmission of these parasites. There are many concentration techniques described, however it these techniques have limitations, particularly regarding to their sensitivity. Two of the most common techniques for its low cost and effectiveness to recover both cysts as eggs and larvae are Ritchie's and Faust's [5], [6], [7]. The choice of the concentration technique is important for rigorous epidemiological studies that allow to establish appropriate control programs.

Although intestinal parasites are common in the Moroccan population, there are few references in this regard. The first published study specifically on children dates back to 1955 and, as in most studies, showed a higher prevalence of the protozoan *Giardia lamblia* of 10% [8].

Parasites such as *Chilomastix mesnilii*, *Pentatrichomonas hominis* and *Enteromonas* are also frequent within the adult and child population in the province of Fez [9], [8]. Further studies in this province indicated a simple parasitization index (SPI) of intestinal parasites of 0.46 in 1974 [10] and 0.0938 in 1989 [11].

In all studies undertaken in Fez, protozoa are more frequent than intestinal helminths as in Tangier and Rabat [12], [13]. In Rabat, which studies show has a lower SPI than that of Fez [10], studies of the intestinal parasites more frequently found in hospitalized children showed *Entamoeba histolytica*, *Giardia intestinalis* and *Entamoeba coli* among the protozoa, and *Enterobius* and *Hymenolepis nana* among the helminths [14], [15].

Furthermore in children, Garcia-Fernández et al. conducted a study in 1984 [16] in Ceuta on intestinal parasites of school children, predominantly Muslim in low socio-economic areas in which *Trichuris trichiura*, *Entamoeba coli*, *Giardia intestinalis*, *Iodamoeba butschlii*, *Endolimax nana*, *Hymenolepis nana*, *Ascaris lumbricoides* and *Enterobius vermicularis* were prevalent.

These are also the predominant intestinal parasites in Tetouan, Larache and Tangier [17]. *G. lamblia* is prominent among protozoans, which in all studies predominate over the helminths, while *E. vermicularis* is prominent among helminths.

The intestinal parasitization of urban and rural populations has been compared in the provinces of Taounate, Beni Mellal and Tizinit. Two-thirds of the rural population and 50% of the urban population were affected. The amoebae were the most common parasites, followed by flagellates and helminths [18].

The analysis in 2001 in Tetouan, Rabat and Marrakech, of 1003 fecal samples of people from all ages in both rural and urban areas, showed that the parasitization was greater in rural areas, in males, and in children aged 6-15 years. The most common parasite was *Trichuris trichiura* with a prevalence of 21% (Houmad El Fatni, unpublished results, Doctoral thesis, University of Granada).

More recent studies in children in Tiflet (Morocco) demonstrate that intestinal parasites have a very high incidence with a prevalence of pathogenic protozoa of 25.8%, highlighting *B. hominis*, *E. vermicularis* and *H. nana* [19]. These children were aged 7-15 years old and of them those between 10 and 12 years old were more parasitized (84.1%).

A retrospective study of enteroparasites published in 2009 [20] reviewed the diagnosed intestinal parasitism in the Provincial Hospital Center (Kenitra, Morocco) for the years 1996-2005, and showed an overall prevalence of 14.15%. Amoeba were frequently observed (47.04%) followed by flagellates such as *G. lamblia* (22.71%). Helminths were less common, with a predominance of *Ascaris lumbricoides* (11.87%), *T. trichiura* (5.64%), *H. nana* (2.68%) and *E. vermicularis* (2.08%).

It is clear that one way of infection with of children intestinal parasites is via food, vegetables and fruits irrigated with wastewater. Health risks of raw sewage have been extensively studied which enabled the presence, of abundant eggs in water to be demonstrated of *A. lumbricoides*, *T. trichiura*, *E. vermicularis*, *H. nana* and *Taenia saginata* as well as cysts of *E. histolytica* and *G. intestinalis.* It has also been shown that 50.8% of children living in areas where wastewater is used in irrigation are parasitized, compared to 8.2% in areas where this practice is not utilized [21], [22], [23], [24], [25].

The most recent work on intestinal parasites in children in Morocco has been in the city of Sale, finding a prevalence of 61.7% in children aged 12-14. The protozoa were found more frequently than the helminths with 57.7% and 26% respectively, and 36.6 % of children were multi-parasitized [26].

The Spanish Agency for Intemational Cooperation (Agencia Española de Cooperación Internacional) have been financing since 2009 a project of prevention, control, and treatment of intestinal parasites in Tetouan, to lower the prevalence of parasitic infections among children.

With this aim, in the present study the techniques of Ritchie [27] and Faust [28] were quantitatively compared to select the more sensitive coprologic diagnostic technique. After, an epidemiological study of the intestinal parasitisms in children,

of rural and urban areas of the province of Tetouan, was performed in order to treat sick children and develop monitoring programs against the most frequent pathogen enteroparasites.

2 MATERIALS AND METHODS

This study was carried out in four schools in the province of Tetouan, which is located in the North of Morocco. It has an area of 3242 km^2 and has a population of approximately 700,000 inhabitants. The province has a mountainous landscape and is crossed by numerous rivers. It has a Mediterranean climate with variable temperatures, with a maximum of 32°C in summer and 5°C in winter.

In this work, we studied the frequency of intestinal parasites in children from four schools in both rural and urban areas, in order to treat sick children and establish prevention and control programs against intestinal parasites.

Samples, 546, were collected from the schools 18 Noviembre and Ahmed El Bakal, situated in urban areas, and Jamaate Ben Karich and Azla, situated in rural areas. Samples were collected from November 2009 until the beginning of the year 2011. In all cases these were public schools attended by children of different social classes.

In urban areas, 276 samples were collected from the two schools located in the mountainous area from various socio-economic levels. There were large differences in the dwellings of the population; on the one hand some lived in houses made from adobe with no access to sewerage and drinking water from wells, while on the other hand others lived in large modern buildings. Pets and other domestic animals coexist with people.

In the rural areas, 270 samples were collected from the two schools. In this case the location of schools is different; the college of Jamaate Ben Karich is located in the mountainous area and the college of Azla is located on the coast. Both schools were attended by children with various socio-economic levels; some live in houses of adobe and may or may not have potable water and sewage. Pets and domestic animals live outside the houses in the immediate surroundings.

Data of age, sex and state of health of the family were obtained from a questionnaire interview. Following the interview a small container for a stool sample was given to each child. After the fecal samples were collected, the children were weighed and measured to complete the questionnaire.

Samples were preserved in 10 ml of potassium dichromate at 2.5% and kept at 4ºC until macroscopic and microscopic observation.

Macroscopic inspection determined the consistency and mucosity, as well as the blood and fat contents of the samples. After examination under a binocular microscope, and under a light microscope using lugol in some cases, samples were stained with Zielh-Neelsen and Giemsa.

Since some samples had low number of parasites it was decided to compare quantitatively the Faust's [28] and Ritchie's [27] techniques and see which one offers better results for coproparasitological diagnosis, in order to select the best of them for further epidemiological studies.

A hundred of samples were subjected to Faust and Ritchie concentration techniques. For both concentration techniques, fecal suspensions were filtered through gauze and the material on the filter was diluted with 10 ml of sterile water. This suspension was centrifuged at 500 x *g* for 2 min in conical propylene tubes, followed by supernatant decantation. Sterile water was then added to reach 10 ml of total volume and the process was repeated until a clear supernatant was obtained. Each sample was examined at 40x magnification for the presence of eggs, larvae, trophozoites or cysts and some samples were stained with Ziehl-Neelsen and Giemsa. For the Faust's technique the final pellet was resuspended in 10 ml of $ZnSO_4 \cdot 7 H_2O$ (703 g/l, 33%, specific gravity 1.118) for flotation. The tube was inverted six times and the fluid removed with a pipette to fill both chambers of Neubauer and to quantify the cysts, oocysts, and eggs 10 min after loading the slide [29]. Using the McMaster slide identified only helminth eggs.

For Ritchie's technique the final pellet was resuspended in 10 ml of 10% formaldehyde solution, mixed and finally stand for 10 min. After, 5 ml of ether were added, the tubes were capped with rubber stoppers and shaken vigorously for 30 seconds. Then the mix was spinned down for 2 minutes at 1500 rpm and an aliquot of the pellet were placed in both chambers of Newbaur and McMaster for examination at 40x and 100x in order to quantify the number of parasites per ml and/or per gram of fecal sample.

Although the results showed clearly the greater effectiveness of the Ritchie technique, the statistical test of Mann-Whitney (Wilcoxon) was applied to compare means.

As Ritchie came out to be the most effective technique, the rest of the samples (446) were analized by this technique.

A comparative study of enteroparasitosis has been made for zone (urban/rural) and sex. Statistical analysis was done to study the prevalence of each parasite. It has been realized a study to compare proportions between the rates of infestation in urban and rural areas and between sexes through a hypothesis test. Multiparasitism was studies too.

3 RESULTS

We analyzed 546 fecal samples of school children from the province of Tetouan. In urban areas, 276 samples were collected; in the college of 18 Noviembre, 108 samples were analyzed, (56 from girls and 52 from boys), and from the college of Ahmed Bakal, 168 samples were analyzed, (93 from girls and 75 from boys). From rural areas, 270 samples were collected; 118 samples, (66 from girls and 52 from boys), from the college of Jamaate Ben Karich, and 152 samples, (70 from girls and 82 from boys), from the college of Azla.

A hundred of these samples were used for a comparative quantitative study of the Ritchie's and Faust's techniques. Results showed that Ritchie's technique was more sensitive than the Faust's. Ritchie's allowed to recover more parasitic forms, almost the double, 2062 x 10^4/ml by Neubauer and 2082 eggs/g by McMaster and by Faust's 1014 x 10^4/ml by Neubauer and 1025 eggs/g by McMaster (Table I). This fact was also demonstrated by analyzing individually the 2 techniques for each parasite, which is especially important in pathogens such as *Giardia lamblia* (where 1027 cysts were recovered by Ritchie's and and 503 cysts by Faust's technique), *Hymenolepis spp*. (35/47 by Ritchie versus 12/20 by Faust) and *Cyclospora cayetanensis* (10 by Ritchie versus 7 by Faust) as is showed in Table 1. By the contrast test of Mann-Whitney (W) the midrange of the results was 93.4167 for the Ritchie technique and 63.5833 for Faust technique, where W = 1878.5 with a p-value = 0.0000185924. These statistical results confirmed with confidence level of 95% that the method of Ritchie was significantly better than the Faust technique in the recovery of enteroparasites.

As Ritchie came out to be the most effective technique, the rest of the samples (446) were analized by this technique.

The general prevalence of intestinal parasitism was found to be 68%, slightly higher in the urban areas (71%) than in the rural areas (65%). Although the prevalence of intestinal parasites was similar between boys and girls, 68% and 69% respectively, in urban areas the prevalence was 66.1% in boys and 76.5% in girls, while in rural areas it was 70% in boys and 61.5% in girls.

The protozoa detected were *Giardia lamblia, Entamoeba coli/histolytica, Cyclospora cayetanensis, Isospora belli, Iodamoeba buschlii, Endolimax nana, Chilomastix mesnili,* and *Cryptosporidium spp*. *Blastocystis hominis* was the most frequent. The helminths were *Trichuris trichiura, Hymenolepis nana, H. diminuta, Enterobius vermicularis, Taenia saginata, Ascaris lumbricoides* and *Fasciola hepatica.* Table II shows the general prevalence of each parasite and the prevalence for both urban and rural zones. *E. nana* only was observed in rural areas. Similar prevalences of the parasites were observed between both areas. Table IIIa shows the prevalence of each parasite in boys and girls of urban and rural zones and the study to compare proportions between the rates of infestation of boys and girls in these areas through a hypothesis test. Only *Giardia lamblia* showed notable differences between boys and girls in urban areas. To compare the prevalence of parasites in children with the same sex in different areas the result were shown in Table IIIb. In this case, the differences were only found in boys when they were infected by *B. hominis*, *G. lamblia* and *E. nana*.

Multiple parasitic infections were common (Table IV), with 276 children presenting intestinal parasitosis, and 80 (29%) of these with two, three, or four intestinal parasites. The most frequent cases of multiple parasitism were *B. hominis* and *G. lamblia*, and *B. hominis* and *C. cayetanensis*. Notably, pathogenic enteroparasites as *G. lamblia* and *C. cayetanensis* were associated in samples with three or four.

4 DISCUSSION

The prevalence of enteroparasitoses is linked to both poor hygiene and inadequate sources of drinking water [2]. Also, intestinal parasites have become a public health concern in developed countries because of the increase in the number of inmunocompromised subjects. Physicians in developed and developing countries are now requesting frequent stool examinations for intestinal parasites, or they are recommending at least one stool examination per year, especially for immunocompromised patients [30]. Parasitologic techniques provide true diagnoses since the causative agent is demonstrated directly and have low cost differing from other more sophisticated techniques. The epidemiological studies that lead to the establishment of prevention and control programs against intestinal parasites in developing countries requires economic and sensitive techniques. Several studies have demonstrated that Ritchie and Faust are the better techniques for recuperation of parasites of fecal samples and their low cost are the most useful consideration in developing

countries even comparing both techniques with the TF-Test, which have a higher sensitivity than these traditional techniques [6], [7].

In this study, Ritchie's and Faust's techniques were compared quantitatively in order to select the one that allows greater recovery of parasites. Our global results showed a marked difference between the two techniques. Recovery of parasites (Table I) was more than double in the Ritchie technique than in Faust (2062 x 10^4/ml or 2082/gr versus 1014 x 10^4/ml or 1025/gr), this fact let that some enteroparasites were identified by the technique of Ritchie in negative samples by the technique of Faust. This happened with 20% of the samples. Also we analyzed each parasite by both techniques (Table I) and never were recovered more parasitic forms by Faust technique that by Ritchie, and in the majority of cases the parasites recovered were double or more by Ritchie than by Faust. This is especially important in the case of enteropathogens as *G. lamblia* (1027 x 10^4/ml versus 503 x 10^4/ml), *C. cayetanensis* (10 x 10^4/ml versus 6 x 10^4/ml), *Hymenolepis spp*. (35 x 10^4/ml or 4735 x 10^4 versus 12 x 10^4/ml or 20/gr) or *Taenia spp*. (4 x 10^4 / ml or 635 x 10^4 or 6/gr versus 2 x 10^4/ ml or 3/gr). In the case of *B. hominis,* that actually is considered as well as a pathogen, [31], [32] occurred equally (956 x 10^4/ml versus 478 x 10^4/ml). This confirms the results of previous work [6] where it was refuted that *B. hominis* could not be identified by Ritchie. Other parasites like *E. coli* or *D. dentriticum* not even diagnosed by Faust technique.

Many laboratories have developed modifications in the traditional Ritchie's method [33], [34], [35] in order to avoid toxicological effects but none is more efficient than the original.

For all this, an epidemiological study of esteroparasites in Moroccan children was done using Ritchie's technique. This study shows that intestinal parasitic infections are a public health problem in Morocco, because the general prevalence of enteroparasites was found to be 68%. This is somewhat higher than the prevalence found in previous years ranging from 14 - 57%, with the higher values corresponding to children [17], [18], [26], [20]. This indicates that the socioeconomic and sanitary conditions have not changed significantly during these years or have perhaps worsened, as practically the same parasitic diseases occur in urban and rural areas.

Table 2 shows that the most prevalent parasite was *Blastocystis hominis* (56.04%). *B. hominis* has long been described as a nonpathogenic protozoan parasite until recently when claims were made that it may be a cause of intestinal disorders [31], [32]. Its frequency in children and adults in developing countries has been widely proven [31], [36], [37]. The presence of five or more *B. hominis* forms per high-powered field is reported by most laboratories, leaving the clinical significance and the decision to treat to the consulting physician based on clinical evidence [38]. In these cases we recommended treating with co-trimoxazole or metronidazole.

Among pathogenic protozoa, *G. lamblia* was the most prevalent (16.6%). This prevalence is somewhat lower than that found in the most recent published works [24], [39] in which it appears in 22.71% of fecal samples analyzed. This difference may be due to the fact that these samples were from hospital (from symptomatic persons), while in our study we examined samples of theoretically healthy children. *G. lamblia* (Table II) appeared almost at the same percentage in children from urban areas (17%) as from rural areas (16.2%). This may be due to the zoonotic nature of this parasite, as living with pets is common in the neighborhoods studied, both in the urban and in the rural areas. For *G. lamblia*, zoonotic transmission has been described [40], [30]. By adopting appropriate descriptive and molecular epidemiological studies, particularly in defined endemic foci and where close coexistence between susceptible humans, livestock and companion animals exists, the zoonotic potential of this parasite should be able to be elucidated [41], [42], [43], [44]. Within the *G. lamblia* species complex, there are currently eight described assemblages [45]. The majority of these assemblages are host-specific. However, two, assemblages A and B, are considered zoonotic and are the only assemblages commonly accepted as being infectious to humans [43]. Therefore, one, or both, will be responsible for the infection of children, and are also transmitted between them. The prevalence in the urban area was higher in boys (22.1%) than in girls (11.02%) while there were no major differences between the two sexes in the rural areas (Table IIIa). This also happened with helminths such as *H. nana* and *H. diminuta*, and may be due to better personal hygiene in girls. When prevalence of parasites was compared in boys of different areas, (Table IIIb), significant differences appeared for *B. hominis, G. lamblia and E. nana*, with higher prevalence in boys of urban areas than in boys in rural. This may be because rural and urban schools hygienic conditions were similar and some parasites are endemic in Tetuoan.

Cyclospora cayetanensis presented a prevalence of 6.6%, lower than that of *G. lamblia* (Table II). The cyclosporiosis is an antroponosis whereby no animal transmission occurs, with the main transmission routes instead being food and water. In our study there were few differences between prevalences values of urban and rural areas, as is the case with the majority of diagnosed parasites. This may be because the standard of living in studied urban areas is not homogeneous and buildings with drinking water alternate with houses where water is supplied from wells, in the majority of cases, left open or not properly closed. Similar results were therefore obtained in other studies carried out also in Morocco [18]. It should also be noted that the parental educational pattern was similar in both groups. Both mother and father of rural and urban group

were poorly educated, which may be a factor in the prevalence of human intestinal parasitic infection in developing countries [46].

The prevalence of helminths was significantly lower than that of protozoa (Table II), as in other studies in Morocco [18], [19], [20], [26]. Thus the most common were *Hymenolepis nana* and *H. diminuta* with a prevalence of only 1.28%.

The few differences in the prevalence of intestinal parasites in rural and urban areas (Table II) could also be indicative of the sensitivity of the Ritchie's technique chosen. But it could also been seen that children in urban areas were mostly asymptomatic and they presented quantitatively lower number of parasites in their feces while in rural areas 60% the children had diarrheal stools and other symptoms associated with parasitic infections; their feces also carried a higher number of cysts, eggs and trofozoites.

Multiple parasitic infections were common 29% of these with two, three, or four intestinal parasites (Table 4). The most frequent association was *B. hominis + G. lamblia* (43 samples) *and B. hominis and C. cayetanesis* (10 samples). These children had severe diarrhea as well as those who had *B. hominis*, *G. lamblia* and *C. cayetanensis* (4 samples), and were treated immediately. This also indicates the extent of the problem of intestinal parasites in Morocco and its severity in children. This type of study therefore highlights the importance of prevention and control programs as intestinal infection is one of the major causes of childhood malnutrition, anemia, stunted physical and mental growth, psycho-social problems with high morbidity in children, and remains a major cause of high infant and child mortality [46].

Table I. Comparison of enteroparasites recovered by Ritchie's and Faust's technique in faecal samples of Moroccan children.

Parasites	Ritchie	Faust
	N/Mc	N/Mc
Giardia lamblia	1027	503
Blastocystis hominis	956	478
Hymenolepis spp.	35/47	12/20
Cyclospora cayetanensis	10	7
Chilomastix mesnili	9	2
Entamoeba coli	8	0
Ascaris lumbricoides	5/8	5/6
Taenia spp.	4/6	2/3
Endolimax nana	3	3
Iodamoeba bustchlii	3	1
Enterobius vermicularis	1/3	1/2
Dicrocoelium dendriticum	1/2	0/0
	2062/2082	**1014/1025**

N: *number of parasites counted with Neubauer chamber x 10^4 /ml*
Mc: *number of parasites counted with McMaster chamber / g*

By the contrast test of Mann-Whitney (W) the midrange of the results was 93.4167 for the Ritchie technique and 63.5833 for Faust technique.
W = 1878.5
p-value = 0.0000185924.

Table II. Prevalence (%) of intestinal parasites in children of urban and rural zones of Tetouan.

Parasites	Urban (nº=276)		Rural (nº=270)		Total (nº=546)		p-value *
	Nº	%	Nº	%	Nº	%	
Blastocystis hominis	160	58	146	54.07	306	56.04	0,3549
Giardia lamblia	47	17.02	44	16.2	91	16.6	0,7969
Chilomastix mesnili	3	1.08	5	1.85	8	1.46	0,4534
Isospora belli	0	0	1	0.37	1	0.18	0,3118
Cyclospora	20	7.2	16	5.9	36	6.6	0,5395
Cryptosporidium	1	0.36	0	0	1	0.18	0,3237
Entamoeba coli	8	2.9	4	1.48	12	2.1	0,2578
Entamoeba histolytica	2	0.72	0	0	2	0.36	0,1625
Endolimax nana	0	0	4	1.48	4	0.73	0,0425**
Iodamoeba bustchlii	1	0.36	1	0.37	2	0.36	0,9845
Ascaris lumbricoides	1	0.36	0	0	1	0.18	0,3237
Trichuris trichiura	4	1.45	2	0.74	6	1.1	0,4246
Enterobius vermicularis	2	0.72	0	0	2	0.36	0,1625
Taenia saginata	0	0	1	0.37	1	0.18	0,3118
Hymenolepis nana	4	1.45	3	1.11	7	1.28	0,7236
Hymenolepis diminuta	4	1.45	3	1.11	7	1.28	0,7236
Fasciola hepatica	1	0.36	0	0	1	0.18	0,3237

***Nº:** number of samples*

** Study to compare proportions between the rates of infestation in urban and rural areas through a hypothesis test. The level of significance was set at p<0.05.*

*** The data shows significant evidences to not accept the proportions equality between the rural and urban areas.*

Table IIIa: Prevalence of intestinal parasites in children of urban and rural zones on Tetouan by sexes

Parasites	Urban					Rural						
	Girls (Nº=127)		Boys (Nº=149)		p-value*	Girls (Nº=140)		Boys (Nº=130)		p-value*	Total (Nº=546)	
	Nº	%	Nº	%		Nº	%	Nº	%		Nº	%
Blastocystis hominis	69	53.3	91	61.07	0,1931	79	56.4	67	51.5	0,4195	306	56.04
Giardia lamblia	14	11.02	33	22.1	0,0146**	24	17.1	20	15.3	0,6886	91	16.6
Chilomastix mesnili	1	0.7	2	1.3	0,6216	2	1.4	3	2.3	0,5818	8	1.46
Isospora belli	0	0	0	0	-	0	0	1	0.76	0,3014	1	0.18
Cyclospora	11	8.6	9	6.1	0,4247	9	6.4	7	5.3	0,7008	36	6.6
Cryptosporidium	0	0	1	0.67	0,3554	0	0	0	0	-	1	0.18
Entamoeba coli	4	3.1	4	2.03	0,5721	2	1.4	2	1.5	0,9452	12	2.1
Entamoeba histolytica	0	0	2	1.3	0,1972	0	0	0	0	-	2	0.36
Endolimax nana	0	0	0	0	-	2	1.4	2	1.5	0,9452	4	0.73
Iodamoeba butschlii	1	0.78	0	0	0,2801	1	0.71	0	0	0,3358	2	0.36
Ascaris lumbricoides	0	0	1	0.67	0,3554	0	0	0	0	-	1	0.18
Trichuris trichiura	2	1.57	2	1.34	0,8732	1	0.71	1	0.76	0,9616	6	1.1
Enterobius vermicularis	1	0.78	1	0.67	0,9142	0	0	0	0	-	2	0.36
Taenia saginata	0	0	0	0	-	1	0.71	0	0	0,3358	1	0.18
Hymenolepis nana	1	0.78	3	2.01	0,3933	2	1.4	1	0.76	0,6131	7	1.28
Hymenolepis diminuta	1	0.78	3	2.01	0,3933	2	1.4	1	0.76	0,6131	7	1.28
Fasciola hepatica	0	0	1	0.67	0,3554	0	0	0	0	-	1	0.18

Nº:*number of samples*

** Study to compare proportions between the rates of infestation of men and women in urban and rural areas through a hypothesis test. The level of significance was set at p<0.05.*

***The data shows significant evidences to not accept the proportions equality between two sexes in urban areas.*

Table IIIb: Prevalence of intestinal parasites in children of urban and rural zones on Tetouan by sexes

Parasites	Girls					Boys						
	Urban (Nº=127)		Rural (Nº=140)		p-value*	Urban (Nº=149)		Rural (Nº=130)		p-value*	Total (Nº=546)	
	Nº	%	Nº	%		Nº	%	Nº	%		Nº	%
Blastocystis hominis	69	53.3	79	56.4	0.6112	91	61.07	67	51.5	0.1076**	306	56.04
Giardia lamblia	14	11.02	24	17.1	0.1553	33	22.1	20	15.3	0.1481**	91	16.6
Chilomastix mesnili	1	0.7	2	1.4	0.5782	2	1.3	3	2.3	0.5270	8	1.46
Isospora belli	0	0	0	0	-	0	0	1	0.76	0.2864	1	0.18
Cyclospora	11	8.6	9	6.4	0.4941	9	6.1	7	5.3	0.7742	36	6.6
Cryptosporidium	0	0	0	0	-	1	0.67	0	0	0.3498	1	0.18
Entamoeba coli	4	3.1	2	1.4	0.3452	4	2.03	2	1.5	0.7386	12	2.1
Entamoeba histolytica	0	0	0	0	-	2	1.3	0	0	0.1921	2	0.36
Endolimax nana	0	0	2	1.4	0.1808	0	0	2	1.5	0.1335**	4	0.73
Iodamoeba butschlii	1	0.78	1	0.71	0.9470	0	0	0	0	-	2	0.36
Ascaris lumbricoides	0	0	0	0	-	1	0.67	0	0	0.3498	1	0.18
Trichuris trichiura	2	1.57	1	0.71	0.5047	2	1.34	1	0.76	0.6385	6	1.1
Enterobius vermicularis	1	0.78	0	0	0.2951	1	0.67	0	0	0.3498	2	0.36
Taenia saginata	0	0	1	0.71	0.3414	0	0	0	0	-	1	0.18
Hymenolepis nana	1	0.78	2	1.4	0.6284	3	2.01	1	0.76	0.3799	7	1.28
Hymenolepis diminuta	1	0.78	2	1.4	0.6284	3	2.01	1	0.76	0.3799	7	1.28
Fasciola hepatica	0	0	0	0	-	1	0.67	0	0	0.3498	1	0.18

Nº:*number of samples*

** Study to compare proportions between the rates of infestation in urban and rural areas for boys and girls through a hypothesis test. The level of significance was set at p<0.05.*

***The data shows significant evidences to not accept the proportions equality between boys of different areas.*

Table IV:The most frequent multiple infections by intestinal parasites in children of Tetouan

	Number of cases
2 parasites	
Blastocystis hominis + Giardia lamblia	43
Blastocystis hominis + Cyclospora cayetanensis	10
Blastocystis hominis + Chilomastix mesnili	3
Blastocystis hominis + Endolimax nana	1
Blastocystis hominis + Entamoeba coli	1
Giardia lamblia + Entamoeba coli	1
Chilomastix mesnilii + Endolimax nana	1
Iodamoeba butschlii + Cyclospora cayetanensis	1
Isospora belli + Cyclospora cayetanensis	1
Blastocytis hominis + Enterobius vermicularis	1
Giardia lamblia + Enterobius vermicularis	1
Blastocystis homines + Tania saginata	1
Blastocystis hominis+ Trichiuris trichiura	1
Cyclospora cayetanesis + Trichuris trichura	1
Giardia lambia + Hymenolepis nana	1
Blastocystis hominis + Hymenolepis dimunita	1
Hymenolepis nana + Hymenolepis dimunita	1
3 parasites	
B. hominis + G. lamblia + C. cayetanensis	4
B. hominis + H. nana + H. diminuta	4
B. hominis + G. lamblia + E. coli	2
B. hominis + E. coli + C. cayetanensis	1
B. hominis + G. lamblia + E. nana	1
B. hominis + E. nana + C. mesnili	1
B. hominis + E. coli + E. histolytica	1
B. hominis + E. coli + C. mesnili	1
B. hominis + C. cayetanensis + Iodamoeba bustchlii	1
C. mesnili+C. cayetanensis +B. hominis	1
4 parasites	
B. hominis + G. lamblia + C. cayetanensis + E. coli	1
B. hominis+ G. lamblia + C. cayetanensis + T. trichura	1

5 CONCLUSION

This study shows that intestinal parasitic infections are actually a public health problem in Morocco, because the general prevalence of enteroparasites was found to be 68%. The most frequent of the intestinal parasites was *Blastocystis hominis* (56%) and the most frequent pathogenic protozoa were *Giardia lamblia* (16.6%) followed by *Cyclospora cayetanensis* (6.6%).

We recommended the Ritchie's technique for enteroparasites diagnostic, of both protozoan and helminthes, especially under conditions of low parasite burdens, which is important in pathogens.

ACKNOWLEDGEMENTS

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Effects of Diethyl Ether Fumigation in DI Diesel Engine Using Bio Ethanol Blended Diesel

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ABSTRACT: In this present paper the performance and emission characteristics of single cylinder DI diesel is subjected to addition of diethyl ether by fumigation into the inlet manifold with bio ethanol blended diesel as pilot fuel were discussed. The optimum percentage of bio ethanol blended diesel was chosen by the previous research work carried out by the author. The results are indicated that when fumigated diethyl ether percentages increases, the performances of the engine increases by 30%, 29% and 43% respectively for 10%, 20% and 30%. The smoke density is decreased by 17%, 31% and 32% compared with pure diesel. The emission of Nox and CO were increased at high level loads, the HC emissions were increased for lower loads but small deviations were recorded for higher level loads when the diethyl ether percentages increases.

KEYWORDS: Diethyl Ether (DEE), Fumigation, Performance, Emission and Bio Ethanol Blend.

1 INTRODUCTION

Most of the recent researches are focused in the field of alternative fuels to minimize the depletion of fossil fuel usage as well as to decrease atmospheric pollution due to the automobile emissions. Various research works were conducted on bio ethanol and found that it is a promising alternative fuel CI engines. These alcohols can be produced at large scale from the bio solid wastes, vegetable waste and other bio products like sugarcanes, maize, gaze etc..In this study bio Ethanol has taken for partial replacement to fossil fuel. The problem associated with bio ethanol is that the miscibility with diesel is possible in small percentages [2-4]. From the earlier studies the ethanol blend with diesel produces the decreased brake thermal efficiency while compare with neat diesel due to the lower calorific value of ethanol [1]. The ethanol fuel having low cetane number compare with diesel results in the property of ignition delay and lowers the heat release rate [3].

The potential of Diethyl ether have explained clearly by authors [5-7] that high cetane number fuel increases the process of vaporization of fuels in the combustion chamber results decrease in smoke opacity and increase in NOx emission. From the literature survey [8-10], the various types of duel fuel injection methods, the fumigation of secondary fuel into the intake manifold method has been adopted for this study due to eliminate the design modifications of test engine. The fumigation of secondary fuel and varying the injection timing are the best methods of introduction of alcohol fuel in large quantity in IC engines as per the literature survey [8]. The use of diethyl ether to reduce smoke and NOx emissions simultaneously with diesel and biodiesel fueled single cylinder DI diesel engines. Use of DEE addition to diesel fuel and biodiesel increases the BTE in a general trend. BTE rises 5.5% and 9.2% DEE-Diesel blends respectively [9]. The addition of 5% DEE with B25 revealed that reduction in smoke, CO emissions were slightly lower, NOx and HC increases slightly at full load conditions and BSFC was lower compare with bio diesel and ethanol bio diesel [10]. The fumigation of alcohols reveals the increased percentages of emissions. To avoid all these, the high cetane number and calorific value fuel diethyl ether (as a product from ethanol by dehydration) has been chosen as a secondary fuel for this study. In this present study the Diethyl ether has been injected through the inlet manifold of the engine at various percentages with respect to the mass flow rate of air.

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2 TEST FUELS

In this present study Bio ethanol was blended with diesel at various percentages and subjected into stability test and the optimum percentage of bio ethanol has been chosen from previous experimental research work results. The E15 (15% of bio ethanol + 85% diesel) was chosen as pilot fuel for this present research work. The 99.9% anhydrous pure diethyl ether has been chosen as secondary fuel and injected into the inlet manifold at various percentages (10%, 20% and 30%) with respect to the calculated mass flow rate of air. The test fuels named as diesel, E15, E15D10, E15D20 and E15D30 respectively. The properties of test fuels were shown in table 1.

Table 1: Properties of Test Fuels.

Properties	*Diesel*	*Bio Ethanol*	*E15*	*DEE*
Density- Kg/m^3	833	772	821.3	713.4
Specific gravity	0.831	0.769	0.813	0.712
Kinematic Viscosity cSt (mm^2/s) @ 40° C	3.0	1.2	2.8	0.23
Cetane number	49	6	41	127
Flash point °C	64	13	59	-40
Auto ignition temperature °C	315	235	306	160
Low calorific value(KJ/KG)	42500	24500	40125	33890
Oxygen content – wt%	0	34.8	--	21.6
Carbon content – wt%	87	52.18	--	64.9
Hydrogen content – wt%	13	13.04	--	13.5

3 EXPERIMENTAL WORK

The experiment is conducted on Kirlosker TV-1 engine. The specifications of the engine are tabulated in table 2.The engine ran at constant speed at 1500 rpm for different load conditions. For applying loads the engine was coupled to an eddy current dynamo meter and the smoke density was measured using an AVL smoke meter. Oxides of nitrogen emissions were measured using AVL Di-gas analyzer. The exhaust gas temperature was measured by the thermocouple connected with digital indicator and specifications of all measuring instruments are given in table 3.

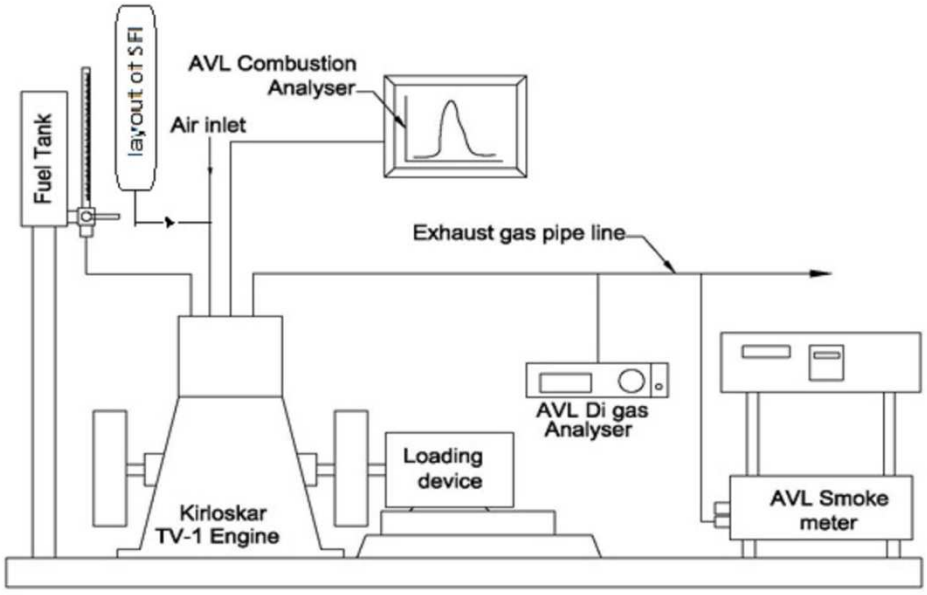

Figure 1: Layout of Experimental Setup with Secondary Fuel injection (SFC).

The separate secondary fuel injection system is developed for diethyl ether injections at 10%, 20% and 30% in inlet manifold with respect to mass flow rate of inlet air. The mass flow rate of air is calculated for each load conditions of test engine. The injection of diethyl ether into the inlet manifold is done by low pressure injector which is connected to pressure

gauge to maintain the injection pressure. The other end of pressure gauge is connected with fuel pump placed in the diethyl ether fuel tank. The secondary fuel injection system consist a return value to adjust the injection pressure. The power supply to the injectors is connected through a digital counter which is getting continuous signals from the proximity sensor placed in fly wheel of the engine. The interval of injection timing is done by the counts which made from the rpm of test engine.

Table 2: Specifications of test engine.

Engine type	Single cylinder,4stroke,DI
Bore	87.5 mm
Stroke	110 mm
Comp. ratio	17.5 : 1
Rated power	5.2 KW
Rated speed	1500 rpm
Fuel type	Diesel
Cooling System	Water
Injection pressure	220 kgf/cm^2
Ignition Timing	23° C Before TDC (rated)

Table 3: Specifications of Instruments used.

TYPE	Measuring Range
AVL-Smoke meter	0 – 99.99 opacity in %
AVL-DIGAS Analyzer	HC / ppm 0 - 20000 CO / % 0 – 10, NOx/ ppm 0 – 4000, CO2 / % 0 – 20.

The experimental setup are shown in figure number 1.The experiment is conducted on sole diesel, E15, E15+10%dee, E15+20%dee and E15+30%dee to find out the optimum fumigative percentage of Diethyl ether into the inlet manifold. The engine was allowed to run with sole diesel fuel at a constant speed for nearly 30 minutes to attain the steady state condition at the lowest possible load. The engine was run twice and average values were taken.

4 Result And Discussion

4.1 Performance Characteristics

The specific fuel consumptions for test fuels at each load in terms of brake power are shown in figure 2 and percentage variations of SFC for each test fuel at full load condition are shown in figure 3. The SFC for E15 is slightly high while compare with pure diesel. When injected percentage of DEE increases specific fuel consumption of the test engine increases. This is due to calorific value of ethanol is less compare with diesel, when DEE injected percentage increases the net calorific value increases result in decreased specific fuel consumption. The specific fuel consumption is 45% less while 30% injection of DEE into inlet manifold compare with pure diesel.

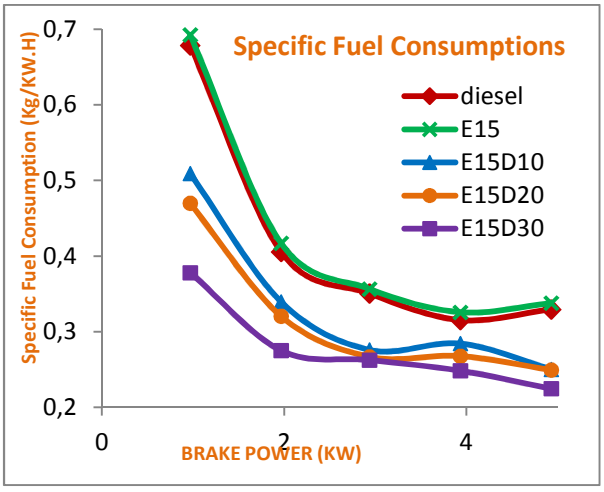

Fig 2: Brake power Vs SFC.

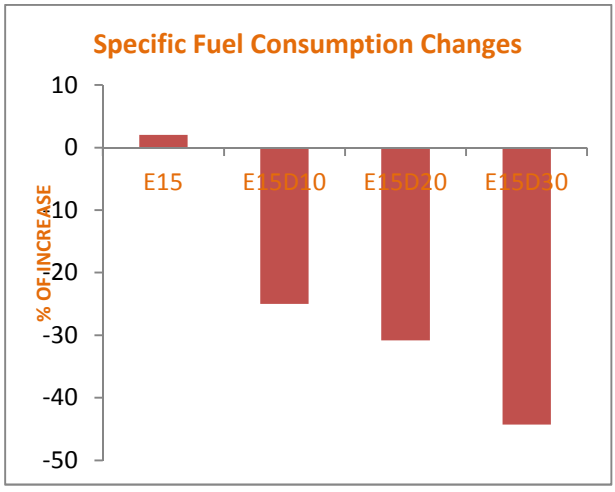

Fig 3: Percentage Variations of SFC

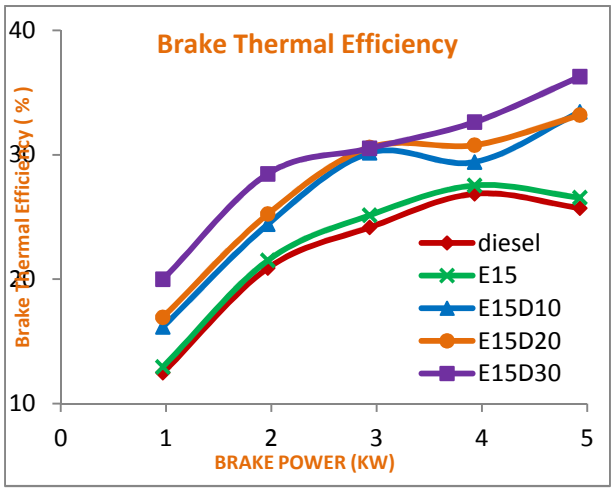

Fig 4: Brake power Vs BTE

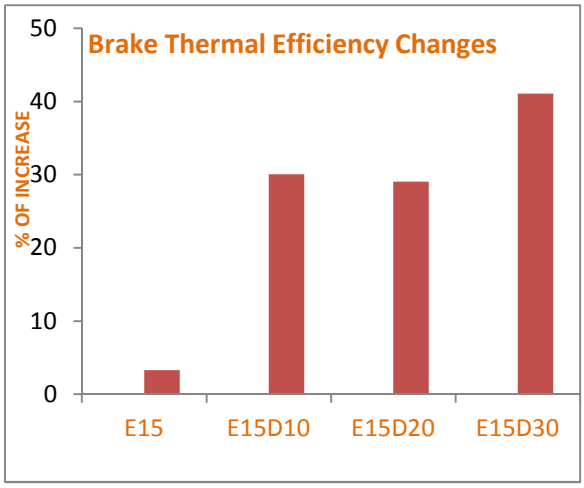

Fig 5: Percentage Variations of BTE.

The brake thermal efficiency for all test fuels at each brake power are shown in figure 4 and percentage variations of BTE for each fuel at full load condition are shown in figure 5. The brake thermal efficiency has improved for all test fuels while compare with pure diesel. The maximum brake thermal efficiency has achieved for 30% injection of DEE. For 10% and 20% injection shows 30 percentage increases in brake thermal efficiency at full load conditions while compare with pure diesel and E15. The specific fuel consumption inversely proportional to the brake thermal efficiency, hence the net calorific value and oxygen available in ethanol and DEE plays a major role in brake thermal efficiency increases.

4.2 EMISSION CHARACTERISTICS

The CO emissions for test fuels at each load in terms of brake power are shown in figure 6 and percentage variations of CO emission for each test fuel at full load condition are shown in figure 7. The CO emission for E15 is slightly high while compare with pure diesel. The increased injected percentage of DEE increases CO emissions of the test engine marginally. This is due to excess oxygen available in diethyl ether enhance the inlet air condition. The CO emissions were increased by 37%, 90% and 100% at full load conditions respectively for 10, 20 and 30 percent diethyl ether injections.

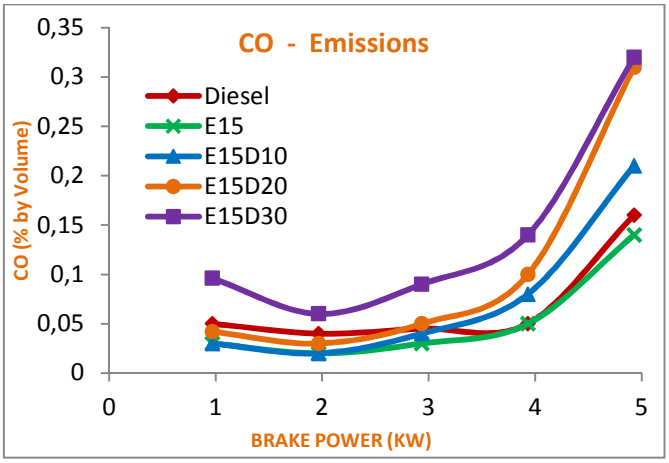

Fig 6: Brake power Vs CO Emissions.

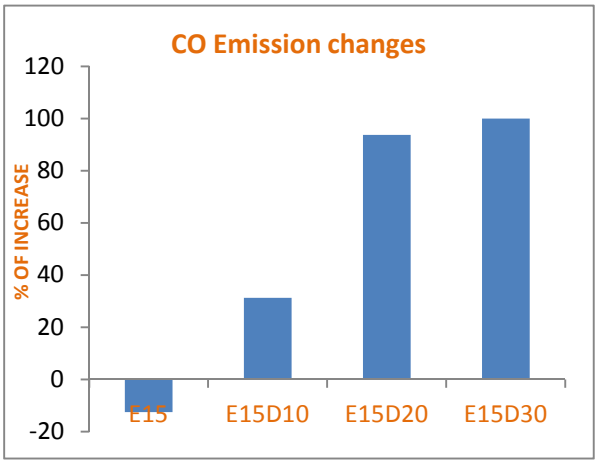

Fig 7: % Variations of CO Emissions.

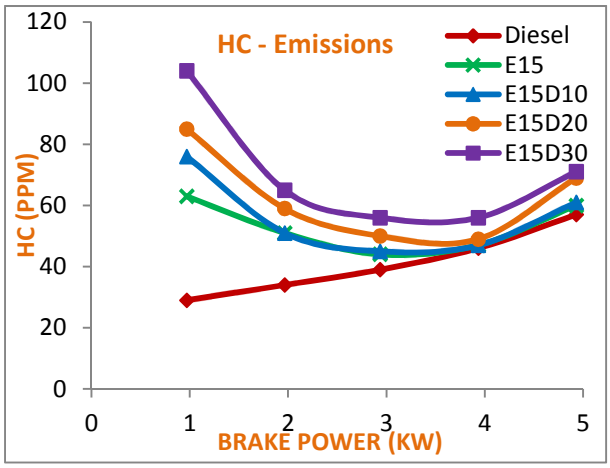

Fig 8: Brake power Vs HC Emissions

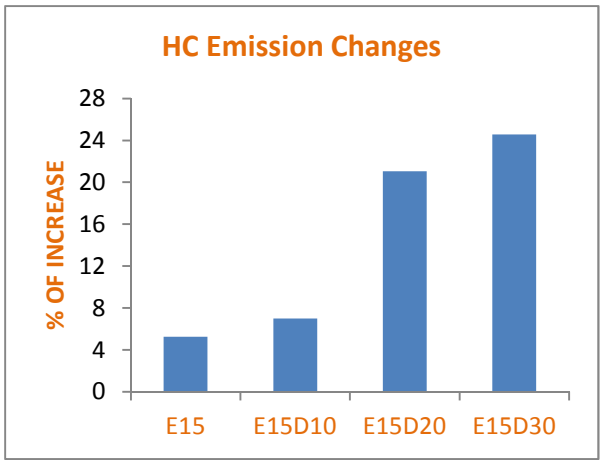

Fig 9: % Variations of HC Emissions.

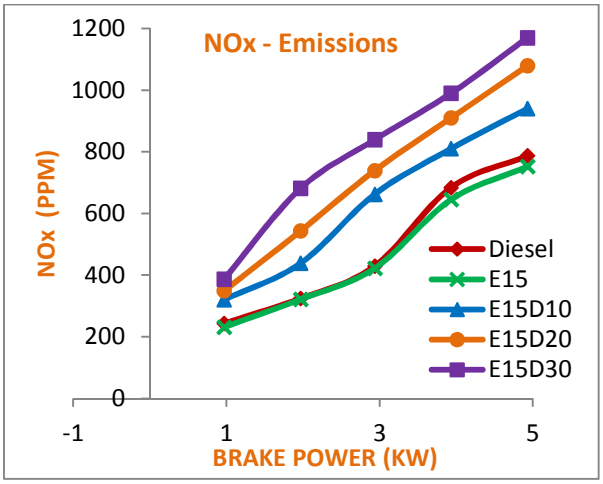

Fig 10: Brake power Vs NOx Emissions.

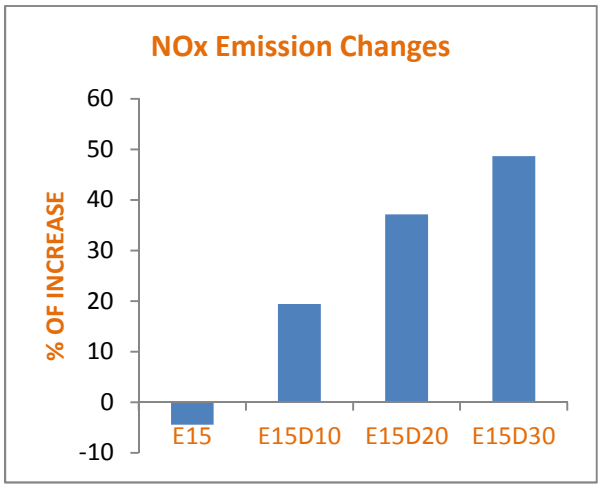

Fig 11: % variations of NOx Emissions.

The HC emissions for each test fuel with respect to load were shown in figure 8 and the percentage variations at full load condition for each fuel are shown in figure 9. The HC emissions are increased for E15 by 5%. The addition of DEE at 10 and 20 percent by injection at full load condition resulted in increase of HC emissions by 8% and 22% respectively. However HC emissions are increased marginally at initial and mid level loads due to higher heat of evaporation of ethanol into diesel cause slower the process of fuel evaporation leads the unburned hydrocarbon increases at initial loads. When the lower heat of evaporation fuel DEE injected induces the process earlier than diesel results in decreases of HC at high level loads.

The NOx emission are shown in figure 10 and the variations in percentages with respect to full load for all test fuels are shown in figure 11. The ethanol blended diesel E15 shows slightly decrease in oxides of nitrogen, when the injection percentages of DEE increases the NOx emissions are increasing drastically. This is mainly due to oxygen available in DEE increases the cylinder temperature while combustion takes place that leads to the formation of oxides of nitrogen and that is evidently proved in heat release rate and exhaust temperature of test engine. The highest 48% increase in NOx emission were recorded at 30% of DEE injection while compare with sole diesel.

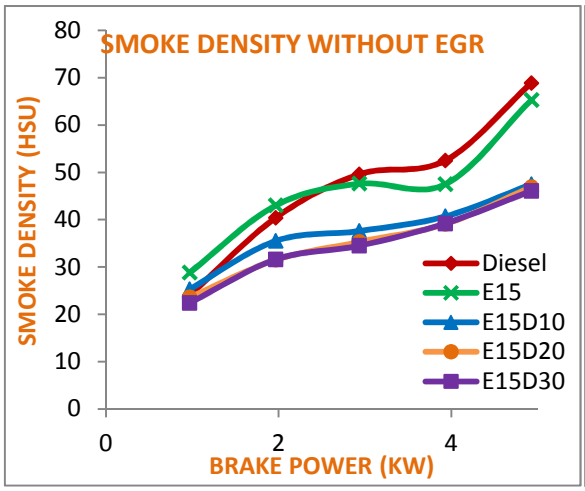

Fig 12: Brake power Vs Smoke Density.

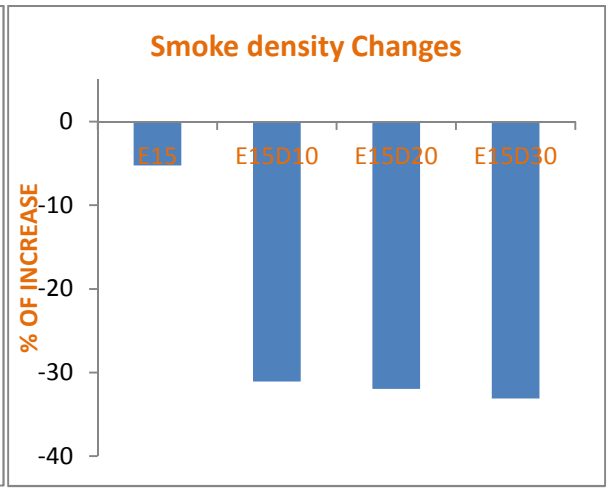

Fig 13: % Variations of Smoke Density.

The smoke density for all test fuels at each load are shown in figure 12 and the variations in percentages at full load condition for all test fuels are shown in figure 13. The smoke density decreased for all test fuels while compare with diesel. The maximum decreased percentage 32 is achieved for 30% injection of DEE. This is due to the oxygen enrichment of ethanol and DEE improves reactions in diffusion phase of combustion reflects in reduction in smoke density.

5 CONCLUSION

From the above experimental investigation,

- It has been concluded that the injection of diethyl ether into inlet manifold is limited up to 30%, beyond that heavy knocks were observed at full load conditions. The 30 percentage addition of DEE improves the performance and 10 percentage addition of DEE maintains and decreases the emissions than diesel (except NOx emission).
- From the above test fuel results, the higher brake thermal efficiency is recorded for 30% injection of DEE. The improved brake thermal efficiency is 43% compared with diesel.
- The smoke emissions are decreased for all percentages of injected DEE. The maximum reduction percentage is 32 for 30% of injection while compare with diesel and E15.
- The HC emissions are marginally increased for initial and mid level loads. However it increases slightly for higher level loads. The maximum increase of HC emission in full load condition is 28% with respect to diesel for 30% injection.
- The CO emissions are increased marginally. The highest CO emission variation by 90% with respect to diesel is recorded for 30% injection of DEE. The NOx emission is increased by 48% while compare with diesel for 30 percentage addition of diethyl ether.

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Phytoaccumulation Potentials of *Tamarindus Indica*

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ABSTRACT: The concentrations of chromium, cadmium, copper, lead, zinc and manganese in *Tamarindus indica* plants growing on automobile contaminated sites (Dass Park and Mechanic village within Bauchi Metropolis were determined, in order to find out the phytoaccumulation potential of the plant for these metals. The weighted means of the various metals in the plant under investigation were observed to be higher than those obtained in the control site. The weighted mean of the metals in Dass Park was as follows: Cu (97.67mg/kg)> Zn (75.70mg/kg) > Mn (60.33 mg/kg) > (Pb 40.53 mg/kg) > Cr (3.52 mg/kg)> Cd (0.72 mg/kg). In Mechanic Village, a similar order was observed, with Cu (111.62 mg/kg)> Zn (64.93 mg/kg)> Mn (51.80 mg/kg)> Pb (48.77 mg/kg)> Cr (5.62 mg/kg)> Cd (2.34 mg/kg). The average concentration factors (CF) of the six elements in the *Tamarindus indica* studied at both contaminated sites were in the order: Cu (1.28)> Zn (0.38)> Mn (0.31)> Pb (0.27)> Cr (0.08)>Cd (0.06). Cadmium (Cd) has the highest translocation ratio, while Zn was observed to be the least. All the metals except Cd and Zn tend to accumulate mostly on the barks and roots of *Tamarindus indica* and this would therefore decrease their transfer probabilities to secondary consumers.

KEYWORDS: contamination, phytoremediation, heavy metals, large plants, mechanic workshop.

1 INTRODUCTION

Automotive maintenance facilities are considered to generate significant loads of hydrocarbons, trace metals and other pollutants, which can affect the quality of storm water runoff [1]. The extensive trace metal pollution of soil within and around Mechanic workshops implies that water bodies (surface and groundwater) within and away from the vicinity of the workshop may equally be polluted with trace metals due to continuous interactions between soil and water[2]. Heavy metal contamination of soil is now viewed world-wide as a global problem because metal pollutants are toxic, persistent and non-degradable in the environment [3], [4], [5], [6]. The removal of this persistent pollutant is therefore necessary but very difficult. The remediation of large volumes of such soil by conventional physicochemical technologies previously developed for small, heavily contaminated sites would be very expensive[7], [8].

A plant based technique called phytoremediation has been developed to ensure that the contaminants from the soil, sludge, sediments and waters are managed in an environmentally, yet cost effective way [9], [10], [11]. As in [7], many small herbs have been proven to accumulate heavy metal ions, the burden of harvesting and disposing these one season plants poses greater difficulties in applying phytoremediation. Hence, large plants with long period of life, soil covering and transpiration potentials could be the best choice for phytoremediation.

Generally, the use of phytoremediation is limited to sites with lower contaminant concentrations and contamination in shallow soils, streams, and groundwater. However, researchers are finding out that using trees (rather than smaller plants) allows them to treat deeper contamination. To effectively redeem contaminated automobile sites, the underground water and contaminants should therefore be within tree root depth, which is 10-20 feet below ground surface [12].

The aim of this research is to investigate the potential of *Tamarindus indica* plants (growing on two automobile sites) to accumulate cadmium, chromium, copper, lead, manganese and zinc.

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2 MATERIALS AND METHODS

Dass Park and Mechanic village are two very importance automobile repair and maintenance sites within Bauchi metropolis, with more than fifteen years of operation. Dass Park is located along Dass road while Mechanic village is situated along Jos road. Geographically, Bauchi state lies between latitudes 9^0 30 N and 12^0 34' and longitude 8^0 5' E and 11^0 00' E of the Greenwich meridian. It occupies a total area of 549,259.01 sq. kilometres representing about 5.3% of the land mass of Nigeria. The state spans two vegetation zones namely Sudan and Sahel Savannah. Effective rains start in mid may or sometimes around early June and ends in late October. The dry season starts in October and ends in May. The average annual rainfall is between 1000mm and 1300mm.

2.1 SAMPLING AND ANALYSIS

Soil samples were randomly collected at ten (10) different drainage collection points along the direction of drainage in the respective mechanic villages at soil depth of 0 – 30cm using a soil auger. The samples were stored in polyethene bags. All the samples were collected between August and September, 2010. The samples from the two locations were homogenised to make a composite sample. A background sample or the control was similarly collected 500 m away from each mechanic village, against the direction of drainage. The soil samples from each of the study sites were conned and quartered several times before the required samples for analysis were obtained. The samples were then air dried, crushed in a mortar and sieved through a 2mm sieve. Three (3) replicate samples of 2.0g of the air-dried, ground and sieved sample were accurately weighed and digested in a 1:1 mixture of concentrated nitric acid and perchloric acid, by heating the mixture and the sample on a water bath in a fume cupboard. The mixture was heated to dryness; the residue was re-dissolved in 5cm3 of 2M HCl and filtered into plastic bottles [9], [10]. The digested samples were then subjected to analysis of the six metals using the Atomic Absorption Spectrophotometer (A Analyst 400, Perkin Elmer, U.S.A).

The leaves, barks and roots were collected from three randomly selected *Tamarindus indica* plants and stored in paper bags. Root tissues were sampled from what was considered to be the surface roots of these plants. The plant samples were washed thoroughly with running tap water to remove the soil particles from the leaves, barks and roots. The samples were then cut into smaller pieces and oven- dried at 60^oC for three (3) days. The dried samples will be ground to powder and stored in labelled polythene bags [10], [13]. Three replicate samples (the leaves, bark and roots) and six different samples of the whole plant *(T. indica*) were digested with a mixture of conc. nitric acid and perchloric acid. 1.0g of the ground dried plant samples were placed in a small beaker and 10ml of the conc. HNO_3 was added to the beaker and allowed to stand overnight. The contents were heated on a hot plate in a hood until the production of red NO_2 fumes has ceased. The beaker was cooled and 3.5ml of 70% $HClO_4$ will be added. The mixture was then heated and allowed to evaporate to a small volume. Digested samples were diluted to 50ml with distilled water [14]. Each sample extract were then placed in plastic bottles, before subjecting them to analysis of the six metals using the Atomic Absorption Spectrophotometer (A Analyst 400, Perkin Elmer, U.S.A).

3 RESULTS AND DISCUSSION

Table 1 shows the concentration of heavy metals in *Tamarindus indica* plants tissues and the weighted mean concentration in the various study sites. The transfer ratios of the heavy metals from the root to the leaves and the bark are given in **Table 3.**

Table 1. Accumulation of Average Heavy Metals in Tamarindus indica (mg/kg)

Metal	DASS PARK				MECHANIC VILLAGE				CONTROL SITE				Normal range in plants
	Leaves	Bark	Root	Weighted mean	Leave	Bark	Root	weighted mean	Leave	Bark	Root	Weighted mean	
Cd	1.73^{A} ±0.22	0.31^{B} ±0.04	0.11^{C} ±0.06	**0.72**	3.53^{A} ±0.14	3.15^{B} ±1.35	0.35^{C} ±0.06	**2.34**	ND	ND	ND	ND	$0.1\text{-}2.4^{D}$
Cr	0.22^{A} ±0.03	7.16^{B} ±0.04	3.17^{C} ±0.06	**3.52**	0.22^{A} ±0.02	10.30^{B} ± 0.71	6.33^{C} ±0.28	**5.62**	0.017 ±0.08	0.510 ±0.08	0.150 ±0.13	**0.23**	$0.03\text{-}14^{E}$
Cu	27.80^{A} ±6.08	133.20^{B} ±10.90	132.00^{B} ±13.00	**97.67**	31.10^{A} ±5.21	163.71^{B} ±17.70	140.10^{C} ±12.32	**111.62**	10.23 ±3.62	37.65 ±5.21	15.85 ±3.07	**21.34**	$5 – 20^{E}$
Pb	16.07^{A} ±0.97	45.47^{B} ±0.68	60.07^{C} ±8.12	**40.53**	29.97^{A} ±1.33	57.57^{B} ±2.98	58.75^{B} ±3.19	**48.77**	7.433 ±0.80	21.47 ±1.40	41.22 ±3.66	**23.34**	$0.2\text{ -}20^{E}$
Mn	31.10^{A} ±0.82	72.97^{B} ±1.79	76.88^{B} ±2.64	**60.33**	37.12^{A} ±3.19	47.53^{B} ±1.80	0.730^{C} ±0.75	**51.80**	8.533 ±1.60	30.83 ±0.61	47.32 ±3.73	**28.89**	$20\text{-}1000^{D}$
Zn	76.35^{A} ±1.13	69.27^{B} ±0.69	81.43^{A} ±4.88	**75.70**	53.92^{A} ±6.88	50.38^{A} ±4.20	90.53^{B} ±54.80	**64.93**	41.48 ±5.33	44.85 ±04.23	53.38 ±4.80	**46.57**	$1\text{-}400^{E}$

(D and E were obtained from [15] and [10] respectively, ND – Not detected, Values ($^{A, B, C}$) within a row for each part of the plant, with different superscripts are significantly different (p< 0.05).

3.1 ACCUMULATION OF METALS IN *TAMARINDUS INDICA* ON THE CONTAMINATED SITES

The result in Table 1 shows that the weighted means of the metals in the whole plant in Dass Park (DP) is in the order: Cu (97.67mg/kg)>Zn(75.70mg/kg)>Mn(60.33mg/kg) >Pb(40.53mg/kg) >Cr(3.52mg/kg)>Cd(0.72mg/kg), while in the Mechanic Village (MV), the weighted mean is in the order: Cu (111.62mg/kg) >Zn(64.93mg/kg) >Mn(51.80mg/kg) >Pb (48.77mg/kg) >Cr(5.62mg/kg)>Cd(2.34mg/kg). The order of the accumulation of the metals in this tree in the study sites, were observed to be similar.

The values of the metals accumulated in the plant in the contaminated and control sites were within the normal range in plants except Cu and Pb, reflecting the high level of enrichment of these metals (Cu and Pb) in these sites. The little increase in the concentration of Cu and Pb, especially, the control site could be attributed to the fact that soils from urban area (including farm lands) could be 5-10 times as high in Cu due to combustion of wood products, fossil fuels and waste incineration with the area. Also, Pb in urban soils could be derived from abraided tyres materials, coal, plastics, insecticides and car batteries, paints and wash off from gutters containing wind borne dust. Also Pb in leaf materials can be due to foliar uptake [15].

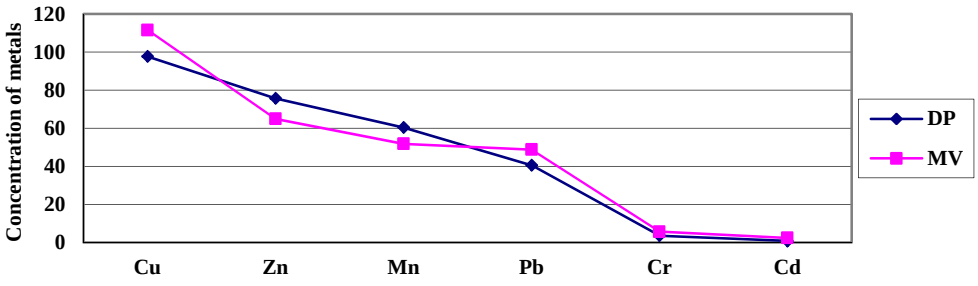

Fig.1 Accumulation trend of the Metals in T. indica on Automobile

Fig. 1 shows that in the contaminated sites, a decreasing trend of accumulation of the metals from Cu to Cd for the plant was observed. In both contaminated sites, it was observed that the order of metal concentration showed that Cd_{leave}>>Cd_{bark}> Cd_{root}, while Cr_{bark}>Cr_{root}>>Cr_{leave}. In DP, Cu_{root}= Cu_{bark}> Cu_{leave} while Cu_{bark}>Cu_{root}>Cu_{leave} in MV. In DP, Pb_{root} > Pb_{bark} > Pb_{leaves}, while in MV, Pb_{root} = Pb_{bark} > Pb_{leaves}

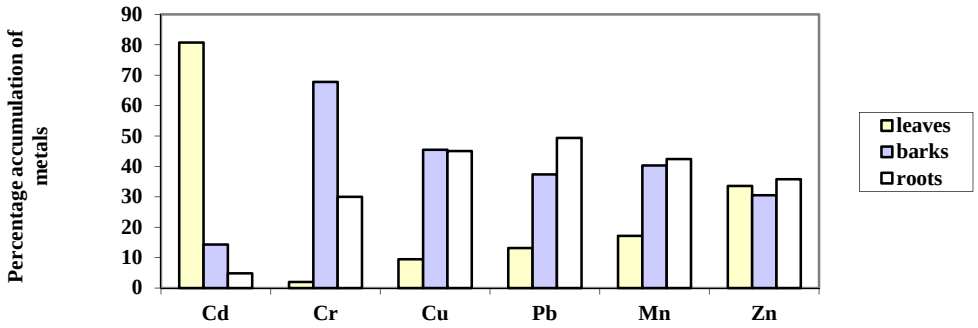

Fig.2. Percentage accumulation of metals by each plant component of T. indica in Dass site

Fig. 2 shows that in DP, 80% of the Cd absorbed by this plant is stored in the leaves, while in Fig. 3; the Cd accumulation was more than 50% in the leaves in MV.

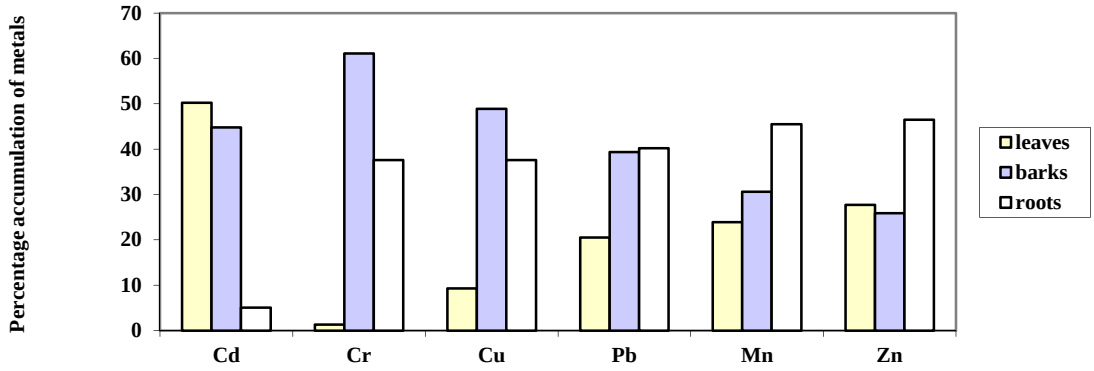

Fig. 3. Percentage accumulation of metals by each plant component of T. indica in Mechanic village

The distribution pattern of heavy metal in this tree indicated that all the metals except Cd and Zn, accumulated in the barks, followed by the root tissues. This shows that the tree has the capacity to be extremely tolerant to these metals. It has been noted that in trees, the heavy metals concentration in the bark is generally found to be higher than in the wood of the stem [16].

3.2 TRANSLOCATION OF HEAVY METALS IN *TAMARINDUS INDICA*

Translocation ratio (TR) of metal is the ratio of the concentration of heavy metal in the aerial parts of a plant to the concentration of the heavy metal in the root $[HM]_{aerial}/[HM]_{root}$. Translocation ratio gives a picture of the mobility of metals from the aerial parts of the plant [13]. In table **2**, the average translocation ratio from the root to leave for this tree was in the order: Cd>Pb>Mn>Cu>Cr>Zn. In the bark, the order changed to Zn<Mn<Pb<Cu<Cr<Cd. [15] and [16] noted that generally Cr, Cu and Pb are translocated to a lesser extent to the plants top compared to Mn and Zn. Cr accumulation in the leaf is quiet low or almost negligible when compared to stem and roots [17]. This could explain the low level of Cr in the leaves of this plant. In this study, no significant difference was observed between the translocation ratio of Cr/Cu and that of Zn from root to leaves while for Pb; the TR was also not significantly different when compared to Mn. In the bark each metal exhibited different extent of translocation ratio.The differences between these results and those reported by other studies may be because the rate and extent of movement of metal ions within plants do not only depend on the metal concern, but also on the plant organs and age of plant [16]. In this plant, Cd was observed to have the highest translocation ratio, showing that Cd is more mobile in plants (Table 2).

Table 2. Average translocation ratio of detected metals and concentration factor of Tamarindus indica in the study sites

Metal	Average Translocation Ratio (TR)		Average Concentration Factor (CF)
	leaves	Bark	
Cd	13.67±0.06	5.92±0.32	0.06±0.06
Cr	0.48±0.01	1.94±0.45	0.08±0.03
Cu	0.48±0.08	1.09±0.11	1.28±0.63
Pb	0.68±0.07	0.87±0.16	0.27±0.05
Mn	0.54±0.07	0.81±0.20	0.31±0.04
Zn	0.31±0.07	0.70±0.21	0.38±0.01

3.3 ABILITY OF *T. INDICA* TO ABSORB METAL IN THE CONTAMINATED SITES

The concentration factor (CF), is the ratio of metal in the plant to the concentration of metal in the soil. It gives an idea of the ability of a plant to accumulate metals absorbed from the soil and reveals the accumulation pattern in the plants [13]. The average concentration factor (CF) for *T. indica* indicates that the order increased thus: Cd<Cr<Pb<Mn<Zn<Cu (**Table 2**). Except for Cu (CF= 1.28), the CF for all the other metals exceeded 0.1 but were lower than 0.5, though their CF values show moderate accumulation except Cd (CF=0.06) and Cr (CF=0.08). The average CF values for Cu, Pb and Zn obtained in this study were observed to be higher than those reported by some other researchers, while they reported a higher CF value for Cd [18]. From these results, it is obvious that *T. indica* exhibited the capacity to absorb high amount of Cu and moderate amount of Zn.

3.4 PEARSON BIVARIATE CORRELATION COEFFICIENT FOR METALS IN *T. INDICA* (WHOLE PLANT)

Table 3 shows that Cd negatively correlated with Cu (r= -0.819; p<0.85). A strong relationship exists between Pb and Mn (r= 0.892; p<0.05). This indicates that an increase in the concentration of Cd in this plant can lead to a decrease in Cu and vice versa. Likewise, increase in Pb would result in an increase in Mn.

3.5 HEAVY METAL CONCENTRATION IN THE STUDY SITES

The heavy metal concentrations in the two mechanic workshops were well over those of the control site (**Table 4**). Although the metal concentrations in this present study were lower than those reported by [2], except for Cd and Cr, the present results obtained for Cd, Cr, and Pb are similar to those reported for automobile workshops in Akure [19]. The order of abundance of the metals in Dass park and Control site were Zn>Mn>Pb>Cu>Cr>Cd while in the Mechanic village (M.V), the order changed to Mn>Zn>Pb>Cu>Cd>Cr. The order in the M.V was similar to results obtained by [2] and [19].The values obtained in the contaminated and control sites in this study are within the normal range in soils except for Cd. The enrichment of Cd and Cu in both automobile sites were significantly different, while Cr, Pb, Mn and Zn were not. The accumulation of Cd and Cu were higher in the Mechanic Village.

Table 3. Pearson Bivariate Correlation Coefficient for Metals in T indica (whole plant)

		Cd	Cr	Cu	Pb	Mn	Zn
Cd	R	1					
	P						
Cr	R	.255	1				
	P	.626					
Cu	R	.819(*)	-.479	1			
	P	.046	.336				
Pb	R	-.642	.030	.305	1		
	P	.170	.955	.556			
Mn	R	-.342	-.075	.188	.892(*)	1	
	P	.507	.887	.721	.017		
Zn	R	-.144	-.621	.170	-.448	-.606	**1**
	P	.785	.189	.748	.373	.202	

(Correlation is significant at the 0.05 level)*

Table 4. Heavy Metal Enrichment (mg/kg) of Soils in the Automobile contaminated sites and Control site

Metal	Cd	Cr	Cu	Pb	Mn	Zn
Dass Park	16.90 [a]	62.03[a]	73.60[a]	168.6[a]	177.50[a]	197.40[a]
	±3.35	±2.63	±11.30	±3.27	±2.29	±2.29
Mechanic Village	31.35[b]	55.50[a]	90.20[b]	160.30[a]	184.41[a]	175.72[a]
	±5.33	±5.47	±9.25	±10.50	±12.00	±14.60
Control site	1.52	9.47	24.35	37.57	44.77	72.70
	±0.57	±0.83	±3.60	±3.89	±9.42	±13.60
Normal range in soil	0.01-2[ж]	5-1500 [жж]	2-250 [жж]	2-300 [жж]	20-10,000[ж]	1-900 [жж]

([ж] Alloway, 1996, [жж] Oyelola et al., 2009), Values within a column with different superscripts are significantly different (p< 0.05).

4 CONCLUSION

The study shows that *Tamarindus indica* can highly accumulate Cu and Pb, while moderately accumulating Mn and Zn (on the average) compared to the other metals. This could be useful for the bio-recovery of these metals, especially Cu and Pb. Considering the kind of activities taking place in mechanic workshops, large plants should be planted in and around these workshops to help in the litigation of heavy metals released into the environment from these workshops, prevent erosion and provide shade in these sites.

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Traditional Medicinal Plants and Healers of Nalamalla Forest

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ABSTRACT: Since the ages plant has been playing a major role in the field of science. Especially the believes of tribes on some plants proved scientifically. These tribes got this medicinal knowledge of plants as a tradition. This study has made in Nalla mala forest, there are more than 6 tribal people living in different parts of the forest like palutla, Nekkanti Nadathadika, Chinthala gudams etc. I met the so called Dora, (Doctor) and collected 80% of medicinal plants. I also met another tribe chenchu leader who gave me another 20% of medicinal plants and their use I collated nearly 25 plants and 30 of their families. These, medicinal plants are very popular in near by towns. Most of the town people visit these gudams for medicines.

KEYWORDS: Traditional Medicinal Plants, and healers' in Nalamala Forest

INTRODUCTION

Guntur district, an area of 430 sq. km is situated in the North coast of Andhra Pradesh, bounded on the south prakasham district and Kadapa district. Nalamala forest consists of 6 tribal clusters split into different parts of the forest, gudam names palutla village, Nekkanti Nadathadika, Chinthala gudams.The tribal live in these villages, with all own socio-culture. The main occupation of the tribes is gathering food and hunting, besides they grow some plants in their backyards.

Early some people worked on this project, and have been carried several researches on medicinal plants. But my research is purely based on the collection of flowers, plants herbs seeds and nuts which are very important part of the tribal healers.

Traditional medical practices are an important of the health care system .It is attracting the international scientist, to vast study of the medicinal plants. It is also drawing the attention of medicinal practitioners around the world. The present study reveals the foklorie use of 25 plant species belonging to 30 families of the plants. The plant species are used to cure one or two diseases. The dosage is prescribed based on age and type of severity of illness.

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MAP OF NALLAMALLA FOREST

MATERIALS AND METHODS

Study: Nalamala is a dense forest which spreads in three district of Andhra Pradesh the collected data includes plant, herb, seed, flowers,with local names, parts of the plant flower, seed, and nuts are used for different diseases. The herbs and plants are collected with the help of Gudam leader who is said to be the herbs doctor. This man got this usage of this plants from his parents as a tradition. The scientific name of these plants and herbs were identified. The present study is on 25 numbers of plants species belong to 30 families. These plants are given under with their local name, dieses dosages and part which is used and their uses.

Abrus Precatorius (Guruvinda Ginjalu)

Azadirachta Indicia (neem)

Dattura metal

Ocimum Tenui Florum(Tulasi)

Centella Asitica (sarswati plant)

Riccinascommunis(Amudam)

Anona squamosa (sita phalam)

Tamarindus Indica (chinta chetu)

Tribulus Terrestris (palleru

MEDICINAL PLANTS TABLE

S.No	Scientific Name	Local Name	Use of the Part	Medicinal Use
1	Ocimumtenifloram	Tulasi	Leaves, Juice of Leaves	Cough and Cold
2	Riccinus communis	Amudam	Leaves	Control Body pain
3	Dattura Metal	Umetta	Leaf and Bark	Skin Allergy
4	Centella aciatica	Saraswthi	Leaves mixed with honey	Improve memory power
5	Nona squmosa	Seetapalam	Leaves. Grained the leaf and applied to the tumor	Tumours cane be controlled
6	Lowsina	Gorinta	Leaves	Jaundice
7	Bombox ceiba	Burugu chekka	Bark, grind the bark and mixed with water	Body heat regulations
8	Casifistula	Ralakya	Fruit	Fids legs scrams
9	Lleucasaspera	Thumikuru	Root	Asthmatic problem
10	Bryophyllum	Ranapala	Leaves	Wounds healing
11	Sphaeranthus indicus Linn	Bodsaram	Leaf	Sexual stimulation, Body pains and Diabetes
12	Litseasebifera	Narre mamedi	Bark	Abdominal pain
13	Tectonegrandis	Teaku	Flower	Urine flow
14	Holoptaliaintegricelia	Namelinara	Bark	Abdominal pain
15	Dolichas biflorous	Balackuluvu	Seed	Piles

16	Myristica fragarans houtt	Japathri	Nutmeg	Sleeping disorders
17	Euphorbia hirta Linn	Dhugdhika	Leaves	Asthma cough
18	Phyllanthus amarus schum	Nelausiri	Leaves,fruits,roots	Jaundice
19	Abrus precatorius linn	Guruvindha	Leaves,seeds,root	Leaves and root is given orally for cold and cough; seed powder is used to induce abortion.
20	Azartica Indicia	Veepa chettu	Bark, leaf	Bark to kill warms, leaf use to measles.
21	Tamarindus Indica	Chenta chettu	Pulp, fruit	vomiting
22	Mangifera Indica	Mamedi chettu	Leaf	Burn leaf ash applied on burns
23	Syzygium cumini	Neredu chettu	Fruit,seed,leaf,bark	Reduce cogh, healing, improve digestion
24	Argemone Mexicana linn	pechikusuma	Whole plant	Skin diseases, external wounds ulcers
25	Tribulus Terrestris	palleru	Whole plant	Reproductive support, enhanced fertility, and regular menstrual cycles.

CONCLUSION

The present study has been conducted to understand the medicinal plant resource in the Nalamala forest of Andhra Pradesh, as well it explores the traditional knowledge of conventions and old believes of chenchu people of this forest area. This medicinal plant information is to be taken in to large scale cultivation and to conserve these medicinal plants which provide a lot of use for the coming generations.

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Les réservoirs de stockage d'eau traditionnel: caractéristiques, popularité et problèmes

[Traditional storage tanks of water: characteristics, popularity and problems]

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ABSTRACT: In recent years water stress is increased due to the scarcity of water. Water resources are characterized by a very high sensitivity to climatic vagaries, an irregularity in time and a bad spatial distribution and a vulnerability to drought and pollution. In most developing countries, there is often an infrastructure lack of drinking water supplies, especially in rural areas. The populations of these areas resort on archaic methods in order to have a continuous source of water for their own use. In Morocco, the traditional water storage tanks are a particular water supply system, known as « *matfia* ». In fact, it considered as one of the major drinking water supplies in rural areas, to ensure a resource more at least sufficient especially during drought. These tanks are fed from rainwater and/ or directly from surface water of rivers, and this water is generally consumed by the surrounding population without any treatment. The uncontrolled water storage in such reservoirs leads to a deterioration of their quality.

KEYWORDS: water resources, rural areas, traditional reservoir, water storage, *matfia*, quality.

RÉSUMÉ: Au cours des dernières années le stress hydrique devient accru en raison de la rareté de l'eau. Les ressources d'eau sont caractérisées par une très forte sensibilité aux aléas climatiques, par une irrégularité temporelle et une mauvaise répartition spatiale et par une vulnérabilité à la sécheresse et à la pollution. Dans la plupart des pays en voie de développement, il y a très souvent un manque d'infrastructures d'alimentation en eau potable, notamment dans les zones rurales. Les populations de ces zones ont recours à des méthodes archaïques afin d'avoir une source continue en eau à leur propre usage. Au Maroc, les réservoirs traditionnels de stockage d'eau sont des systèmes particuliers d'approvisionnement en eau dans les zones rurales, dits : « *matfia* », en vue de garantir une ressource plus au moins suffisante surtout en période de sécheresse. Ces réservoirs sont alimentés par l'eau de pluie et/ ou directement à partir des eaux de rivière et l'eau est utilisée sans traitement comme par les populations environnantes. Le stockage non contrôlé des eaux dans ce genre de réservoirs entraine une dégradation de leur qualité.

MOTS-CLEFS: ressources d'eau, zone rurale, réservoir traditionnel, stockage d'eau, *matfia*, qualité.

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1 INTRODUCTION

L'obtention d'eau suffisante est une lutte quotidienne qui demande beaucoup de temps et d'énergie, particulièrement pour les femmes et les enfants [1]. L'étendue de ce problème ne fait que croître du fait de la croissance de la population, des conflits armés, de l'urbanisation et des effets prévus des changements climatiques [2], [3], [4]. En effet, un rapport de l'OMS traitant la situation de 2008, note que si 30 % de la population de la région africaine vit en milieu rural, 16% seulement y est desservie par des réseaux de distribution d'eau publique et le reste de la population a recours à des installations individuelles. Actuellement, On peut affirmer qu'une amélioration sensible est enregistrée pour le milieu urbain, alors que les populations rurales souvent majoritaires dans les pays en développement, connaissent une situation moins brillante dans leur approvisionnement en eau potable [5].

Le stockage des eaux de surface et pluviales peut être une solution alternative intéressante au manque d'eau [6], [7]. Avec la collecte et le stockage des eaux, la dépendance vis-à-vis des sources d'eau peu fiables, telles que les marigots à ciel ouvert, est réduite.

Au Maroc, l'utilisation des réservoirs d'eau de pluie domestiques est une pratique bien établie et relativement commune, en particulier dans les zones rurales et éloignées. Des milliers de familles dans les zones rurales comptent surtout sur les réservoirs d'eau de pluie pour l'eau de consommation. Cependant, dans une nouvelle perspective visant la résolution de la problématique du manque d'eau surtout dans la zone Sud, le gouvernement marocain mène actuellement des études ayant comme objectif la réalisation de bassin de rétention des eaux pluviales. En effet, à Marrakech, un bassin de stockage de l'eau pluviale d'une capacité de 20 000 m^3 s'étalant sur une superficie de 4 000 m^2 a été récemment construit.

2 POPULARITÉ DES RÉSERVOIRS D'EAU : UN PROCÉDÉ CONTRE LA PÉNURIE

La collecte des eaux surtout de pluie est pratiquée depuis des siècles ; c'est une technologie simple et à faible coût [8]. Les eaux de pluie sont recueillies à partir des toits ou des surfaces de captage et sont stockées dans différents systèmes de stockage [9]. De par sa nature décentralisée, la collecte et le stockage des eaux permet aux populations de gérer leur propre eau au niveau du ménage et de la communauté [10]. La collecte des eaux de pluie peut être une solution plus qu'adéquate pour répondre à une grande partie des besoins en eau [11]. Elle fournit également une bonne alternative pendant les périodes de sécheresse et lorsque le niveau de l'eau baisse et que les puits s'assèchent [12], [13]. Toutefois, les précipitations étant incontrôlables, il est de toute importance, surtout dans les conditions climatiques des régions arides ou semi arides, d'utiliser le plus efficacement possible les quantités limitées d'eau de pluie [14], [15]. L'eau collectée est un complément de valeur qui serait sinon perdu du fait de l'écoulement de surface ou de l'évaporation [16], [17].

La récupération de l'eau de pluie est considérée comme une pratique traditionnelle dans certains pays. Leur usage domestique est un sujet populaire chez les chercheurs qui visent à identifier les questions clés qui doivent être abordées pour promouvoir dans le monde entier le retour à l'évolution historique de l'utilisation de réservoirs d'eau de pluie [18]. La référence [19] fait indication à la première conférence sur l'utilisation des systèmes d'eau de pluie pour l'alimentation en eau domestique à Honolulu, Hawaii en 1982 où 50 universitaires et praticiens étaient présents. Ce fut le début d'une série de conférences internationales sur la collecte des eaux pluviales ou de surface où des milliers de participants étaient présents à partir d'une section transversale très large éventail de pays, les professions et les organismes de défense des droits [18].

En outre, la référence [20] a déclaré que dans de nombreuses régions d'Australie, la pluie était la seule source d'eau utilisée simultanément à des fins domestiques ou autres. Il a également observé que les habitants du Queensland étaient enclins à utiliser l'eau de pluie en parallèle avec de l'eau du réseau. Ils ont également utilisé l'eau de pluie à des fins de consommation. A l'instar d'autres techniques décentralisées, le stockage d'eau réapparaît aujourd'hui en milieu urbain sous une nouvelle forme plus sophistiquée en faisant appel à des technologies et des savoirs élaborés qui permettent de la qualifier de rétro-innovation[21], au sens proposé par [22]. Progressivement, les installations de récupération et d'utilisation de l'eau de pluie constituent un système d'approvisionnement en eau parallèle, complémentaire plus qu'alternatif au réseau d'eau potable centralisé [23].

Dans ce sens, la collecte des eaux pluviales et/ ou de surface est un excellent outil qui, avec une utilisation correcte, pourrait considérablement réduire la pression continuelle sur les bassins versants [9], [15], [24]. Afin d'utiliser les ressources et soutenir les pratiques agricoles, diverses technologies ont été mises en œuvre pour exploiter l'eau de pluie. Les techniques actuellement employées sont les fosses d'infiltration, les billons, et l'utilisation de canaux de collecte des eaux de ruissellement [25].

La collecte des eaux est une pratique ancienne qui remonte à plus de 3000 ans. Dans le monde entier, la popularité de collecte des eaux pluviales est croissante [24], [26], [27], [28].

3 LES DIFFÉRENTS TYPES DE SYSTÈMES DE STOCKAGE

3.1 LES SYSTEMES DE STOCKAGE DES EAUX DE PLUIE

La référence [29] rapportent en 2002, que **les « magden » en Algérie, « matfya » dans le Rif ou « lavogne » en France** sont des mares creusées à ciel ouvert de quelques dizaines de m^3 qui stockent le ruissellement d'une piste ou d'un court impluvium (caillouteux ou encroûté et tassé), pour assurer l'abreuvement du bétail. Avec une mare de 80 m^3, il fut possible dans la région de l'oued Mina en Algérie d'entretenir 40 moutons et une famille et d'irriguer un petit jardin fruitier dans des collines marneuses recevant 300 mm de pluie par an. Le plus gros problème est de réduire l'apport de sédiments et de maintenir la qualité des eaux en tenant le bétail hors de la mare.

Les citernes cimentées ; Les romains et les arabes ont construit un bon nombre de citernes enfouies dans le sol, captant les eaux du toit (Mazets de Montpellier) ou d'un impluvium rocheux (citerne Telman près de Gabès en Tunisie). La référence [30] a étudié 51 citernes enfouies (aljibes) dans la province d'Almeria (Espagne). Ce système est encore viable de nos jours pourvu que la citerne et le volume ruisselé soit suffisant pour remplir la citerne (>60 m3).

Réservoir en ferrociment ; Le réservoir en ferrociment est un des types de stockage construits au-dessus du sol, dont la technologie est vieille de 30 ans ou plus. La combinaison du mortier avec de l'acier vise à donner un cadre solide qui supporte le poids de l'eau ainsi que les effets de dilatation ou de rétraction dus aux changements des conditions climatiques. Les réservoirs en ferrociment dans le cadre du Programme RAIN pour l'Afrique de l'Ouest ont une capacité allant de 10 000 à 14 000 litres et sont, pour la plupart, construits au niveau des ménages.

Réservoir en pierres taillées ; Ce type de réservoir permet d'avoir une capacité de stockage à près de 60 m^3 ou plus. Ce type de réservoir est fait de grosses pierres et de ciment. Ceci lui donne un cadre solide, et est dans la plupart des cas relativement facile à construire. Ces réservoirs stockent les eaux écoulées du toit et sont principalement construits près des infrastructures communautaires telles que les écoles ou les centres de santé.

Le réservoir souterrain ; La principale partie de ce réservoir est construite dans le sol. Un mur d'environ 90 cm de hauteur muni d'une couverture est visible en surface. Ces réservoirs peuvent être soit de forme circulaire, soit de forme rectangulaire et peuvent stocker jusqu'à 60000 litres d'eau de pluie.

3.2 LES SYSTEMES DE STOCKAGE DES EAUX DU RUISSELLEMENT DANS LA VALLEE

Construction de terrasses étroites dans l'oued ; Dans les zones semi-arides où il est difficile de cultiver les versants, des haies vives sont implantées en bordure de l'oued pour ralentir la vitesse du courant, capter les eaux et leur charge en sédiments pour construire progressivement un jardin de saison sèche alimentant une « séguia » (canal courant le long de la colline pour irriguer une terrasse en aval). Ces haies sont constituées de cannes de Provence, divers peupliers, saules, frênes, tamaris, eucalyptus et lauriers roses, carex et joncs.

Les jessours ; Dans les zones arides du sud de la Tunisie, des digues en terre sont construites en série dans les vallées pour capter le ruissellement et sa charge solide en vue de construire une suite de terrasses plantées progressivement en arbres fruitiers (palmiers, figuiers et oliviers), en céréales et légumineuses [31].

Limans ; il s'agit d'une digue barrant une tête de vallée dans le Néguev pour intercepter les rares crues. La culture est organisée en amont dès que l'infiltration du ruissellement est complète [32].

Des barrages collinaires sont construits pour récolter le ruissellement qui sera redistribué pour l'irrigation de petites terrasses en aval, ou pompée sur les bords [33].

3.3 CONCEPTION DES RESERVOIRS DE STOCKAGE

Le réservoir de stockage de l'eau représente généralement le plus gros investissement d'un système domestique de collecte des eaux. Il faut donc bien réfléchir à sa conception pour assurer une capacité de stockage optimale et une solidité structurelle tout en maintenant les coûts à un niveau le plus bas possible [34]. Pour le stockage de l'eau à très petite échelle, dans les pays en voie de développement, on utilise des cuvettes et des seaux en plastique, des jerrycans, des pots en terre ou en céramique, de vieux barils de pétrole ou des récipients alimentaires vides.

Pour stocker de plus grandes quantités d'eau, il faut disposer d'un réservoir posé sur le sol ou enterré. Sa taille peut varier d'un mètre cube (1 000 litres) à des centaines de mètres cubes pour les grands réservoirs. Pour les systèmes domestiques au niveau des ménages, la taille varie de 10 à 30 mètres cubes et pour les systèmes au niveau des communautés ou des écoles,

elle est de 50 à 100 m^3, en fonction naturellement du cycle des précipitations locales tout au long de l'année [35]. Les réservoirs ronds sont généralement plus solides et nécessitent moins de matériau que les réservoirs carrés, pour la même capacité de stockage.

4 LES RÉSERVOIRS DE STOCKAGE D'EAU AU MAROC : ALTERNATIVE CARACTÉRISTIQUE DU MILIEU RURAL

Depuis son indépendance, le Maroc a multiplié la production d'eau potable annuelle par dix, passant de 80 millions de m^3 en 1956 à près de 800 millions de m^3 actuellement. Toutefois, une large disparité persiste encore entre les secteurs urbain et rural dans ce domaine.

La population totale du Royaume du Maroc représentait lors du dernier recensement général en 2012 : 32,5 millions d'habitants dont 41,4% vivants en milieu rural [36]. Ce dernier taux n'a cessé de décroître, puisqu'il représentait 70 % en 1960, 65 % en 1971 pour tendre vers 36% en 2030. Cette baisse accompagnant généralement le développement des nations est aussi synonyme au Maroc d'un fort exode rural vers les villes, avec des retombées négatives qui en découlent. Par conséquent, la population rurale du Maroc croissant au rythme annuel de 1,06 % était répartie en 2000 entre 1,86 millions de ménages de plus grande taille en 2009 regroupant 11,7 millions d'habitants.

Les eaux de surface au Maroc constituent donc un apport non négligeable pour le développement durable de l'agriculture, de l'élevage et de l'industrie dans le pays. Elles permettent également en temps de pluviométrie normale, la réalimentation de certaines nappes aquifères et surtout la préservation de l'équilibre de l'écosystème. En plus, elles sont susceptibles d'être utilisées comme eaux potables et eaux d'irrigation. C'est le cas des rivières de l'Atlas qui jouent un rôle très important comme source principale d'eau de stockage pour la population locale.

4.1 DIFFICULTÉS DES ZONES RURALES

4.1.1 DISPERSION DE L'HABITAT

Au Maroc, la population rurale est répartie sur près de 32 000 douars de moins de 500 habitants. Dans certaines régions, les douars eux-mêmes sont «éclatés» en plusieurs groupes d'habitations pouvant aller jusqu'à une dispersion totale de l'habitat. Dans ces conditions, tout système public de desserte en eau courante ne pourrait être réalisé qu'au prix de grands investissements et de frais de fonctionnement et de maintenance élevés.

4.1.2 DIFFICULTES DE GESTION ET DE MAINTENANCE

Des fréquentes inadaptations des équipements, le manque d'organisation et de structures, en mesure d'assurer convenablement les tâches de gestion et de maintenance sont à l'origine de difficultés notoires. Il faut aussi rappeler et souligner que le concept de gratuité de l'eau qui différencie fondamentalement le monde rural du monde urbain est encore trop souvent un frein, au niveau individuel, à la prise en charge de la gestion et de la maintenance de la gestion des équipements dès lors que leur niveau technologique l'impose.

4.1.3 REPARTITION INEGALE DES RESSOURCES EN EAU

Du fait que 85 % des ressources en eau du pays se trouvent sur 1/3 de son territoire, la desserte en eau des populations rurales des régions déficitaires nécessiterait le recours à des transferts d'eau sur de longues distances et par conséquent la réalisation de projets onéreux et difficilement gérables par les collectivités locales.

Par ailleurs, les régions sans extension suffisante de nappes souterraines ne comptent que sur des sources parfois temporaires, même si les précipitations annuelles sont relativement abondantes, comme dans le Rif par exemple.

4.1.4 DIFFICULTÉS ORGANISATIONNELLES

La multiplicité des intervenants et l'insuffisance de coordination ne favorisent pas un développement rationnel du secteur. Le plus souvent cela se traduit par une faible valorisation des actions entreprises et même une déperdition des efforts consentis.

4.1.5 FAIBLESSE DES INVESTISSEMENTS

La dépense per capita lors du plan 1981-1995 pour l'eau potable est de l'ordre de 100 DH/an pour un citadin alors qu'elle est au moins 10 fois plus faible pour un habitant rural.

Face à ces difficultés, la majorité de populations rurales stockent des eaux de pluie et/ou de surface dans des réservoirs nommés par ces populations «*matfia*», dont ils utilisent ces eaux pour différents usage.

4.2 RESERVOIRS DE STOCKAGE D'EAU OU « *MATFIA* » ; UNE RESSOURCE ANTIQUE

4.2.1 DÉFINITION DE MOTS « *MATFIA* »

Selon le dictionnaire Le français au Maroc **« *MATFIA, MATFYA ou METFIA*.** L'eau : une eau de *matfia* rouge poussière…On la fait bouillir, on la rend potable à notre gout. (L'Opinion, 14/04/92) ». Un réservoir, naturel ou construit par l'homme, contient de l'eau et possède des berges (*bund*) en terre (Fig.1). Les rivières, l'eau de pluie des bassins hydrographiques ou l'eau de pluie qui s'accumule dans les aires à battre (Fig.2), s'écoulent dans le réservoir. Les aires à battre sont des surfaces empierrées ou en terre battue (en arabe, on utilise le mot *nader* ou encore *anrar* (en amazigh)), il pouvant prendre une forme circulaire mais il peut être aussi rectangulaire. C'est un endroit ou les paysans locaux séparent et traitent leur cultures ; ils séparent les semences céréales (blé, orge, avoine…) de leurs pailles traditionnellement (par l'âne). Les aires à battre sont établies, le plus souvent, à proximité des habitations dans un endroit où elles sont bien exposées au vent. En plus, ces aires à battre jouent un rôle important dans la collecte des eaux pluviales dues à leur forme bien aménagée. En conséquence la population les connecte à leur réservoir de stockage pour l'alimenter.

Fig.1 : Chaîne de citernes sur un versant de l'Anti-Atlas occidental (photo d'HUMBERT 2009).

Fig. 2: Alimentation des matfias par l'eau pluviale qui tombe sur les aires à battre dans l'Anti-Atlas occidental (photo d'HUMBERT 2009).

Les réservoirs simples, d'une superficie inférieure à 40 m^3, sont alimentés par les précipitations et ont une faible capacité de stockage. Les réservoirs complexes sont alimentés par l'eau des rivières et l'écoulement des eaux de pluie à travers des barrages de diversion, des canaux d'alimentation et les flux de surface. Ils peuvent être reliés en cascades où l'eau d'un réservoir supérieur se déverse dans un réservoir inférieur.

4.2.2 CONFIGURATION DES RÉSERVOIRS

Selon la référence [37], il y avait de nombreuses façons par lesquelles les réservoirs d'eau pourraient être configurés (tôles ondulées, béton). Le matériau et la conception des murs d'une citerne doivent lui permettre de résister à la pression extérieure du sol et des eaux souterraines lorsque la citerne est vide. Les racines des arbres risquent aussi de l'endommager. Il est donc de toute importance de bien choisir l'emplacement de la citerne. En l'installant en partie au-dessus du niveau du sol et largement au-dessus du niveau de la nappe phréatique, on évitera les problèmes causés par une montée de l'eau de la nappe phréatique et le passage de camions, qui risqueraient d'endommager la construction souterraine. Des matériaux locaux comme le bois, le bambou et l'osier pourraient remplacer l'acier pour renforcer les citernes en béton. Une citerne souterraine doit être munie d'un dispositif permettant de puiser l'eau : une pompe ou un seau et une corde. Pour éviter toute contamination de l'eau stockée, le dispositif doit être sain et il faut l'entretenir et le nettoyer régulièrement [38].

Il y a deux catégories de réservoirs : les réservoirs de surface et ceux qui sont enterrés (citernes), les premiers étant plus souvent utilisés pour la collecte de l'eau des toits. Les réservoirs de surface sont généralement en métal, en bois, en plastique, en fibre de verre, en briques, en blocs qui s'emboîtent, en blocs de terre ou de gravats compressés, en ciment ou en béton armé. Le choix du matériau dépend de sa disponibilité localement et du budget dont on dispose. Dans la plupart des pays on trouve facilement des réservoirs en plastique de volumes variés. Les réservoirs de surface sont généralement plus chers que les citernes, mais ils sont plus durables ; ils doivent aussi être munis d'un robinet permettant de se servir en eau.

5 LA "*MATFIA*" UNE CONSTRUCTION SYMBOLE DE LA POPULATION D'ATLAS MARROCAIN

Au Maroc, l'utilisation des réservoirs d'eau de pluie (appelés « ***Matfia*** ») pour l'approvisionnement en eau est une pratique bien établie et relativement commune, en particulier dans les zones rurales et isolées (Fig.3). Mais il n'existe aucune statistique les concernant.

Fig.3 Photos des matfias à la vallée Assif El Mal (région de Marrakech).

De nombreuses techniques ont été développées par des générations de la population d'Atlas mal pour rendre plus productif un milieu jugé ingrat. Parmi celles-ci, on trouve *tinoutfay (sing. tanoutfi), matfia* en arabe. Ce sont ces ouvrages ingénieux bien connus de la montagne atlasique qui permettent la collecte des eaux pluviales. De part sa nature hydrographique et l'absence de sources, le Haut et le Moyenne Atlas est avant tout un pays de citernes de toutes les formes et dimensions possibles. Ces réservoirs sont le symbole de l'adaptation et de la fixation de ces populations dans ces milieux jugé aride.

La forme de ces *tinoutfay* n'a certainement pas changé depuis leur mise en place mises à part quelques améliorations qui ont été apportées notamment grâce à l'utilisation du ciment comme enduit.

Les constructeurs ont cherché et préféré ici épouser au plus près la topographie du terrain, ce qui leur permet vraisemblablement une meilleure récupération et un stockage des eaux pluviales de ruissellement qui dévalent les versants comme peuvent en témoigner les différentes canalisations d'alimentation de ces ouvrages. Les façades extérieures de ces *matfias* sont intégralement construites selon la technique de la pierre sèche, employant le matériau calcaire disponible sur place, avec un induit intérieur [39].

La vie peut alors se poursuivre pendant parfois les trois mois d'été sans pluie, grâce à ces réserves dont on use avec parcimonie. Le besoin en eau devait se faire cruellement sentir pour qu'il pousse ces montagnards à mettre en place ces réservoirs sur des pentes aussi ingrates et caillouteuses. Sans doute, la population ont refait aussi beaucoup plus nombreuse que de nos jours. Elles sont relativement coûteuses en énergie dans la mesure où elles exigent, par rapport à celles établies dans les plaines, un travail supplémentaire de défoncement, de nivellement, de transport surtout quand l'on sait qu'elles ont été mises en place à une époque où tous les travaux étaient faits manuellement. Chaque famille paysanne en possède une au moins. Un habitant a signalé que même la mosquée du village a sa propre citerne.

Les éléments qui composent ces réservoirs construits sont absolument semblables à ceux que l'on trouve en si grand nombre sur toute cette partie occidentale de Haut-Atlas marocain, tant par leurs matériaux de construction, leurs dispositifs d'alimentation ou de puisage, que par leurs petits bassins de décantation aménagés juste à l'entrée du réservoir.

Ces *matfias*, de formes rectangulaires et en partie enterrées et taillées dans les affleurements de calcaires, ont été construites, entièrement en pierres sèches du même calcaire. Comme le met très clairement en évidence la photographie ci dessous, dans leur logement, les petites pierres sont simplement calées les unes par les autres sans être fixées par aucun mortier. Seuls le sol et les parois latérales sont rendus étanches à l'intérieur, soit par de l'argile soit par un enduit de chaux ; pour toutes celles que l'on entretient ou on restaure aujourd'hui, on utilise de plus en plus le ciment. Le plafond n'est pas enduit, par contre le toit de la *matifia* l'est et c'est d'ailleurs le ciment que l'on utilise le plus souvent aujourd'hui ; la figure 4 présentée ci-dessous peut en témoigner comme il met aussi en évidence les différents éléments qui composent une citerne [40].

Fig.4 Détail d'une citerne (tanoutfi) et ses composantes.

Tout le dispositif technique pour la mise en place d'une *tanoutfi* est présenté sur cette photographie (Fig.3). L'essentiel de ce procédé est constitué par la citerne elle-même, c'est-à-dire ce réservoir en partie enterré et construit entièrement en pierres sèches qui sert au stockage de l'eau de pluie. Nous reviendrons plus loin sur les dimensions de ces bassins. Le toit de ces citernes, en partie visible sur la photo, est formé par des blocs de calcaires allongés et dont les deux murs latéraux sont l'assise. L'enduit d'étanchéité en ciment couvre toute la surface du toit. Celui-ci est percé par un voire deux trous de formes carrés (parfois circulaires) de puisage que l'on ferme hermétiquement et que l'on n'ouvre que pour puiser de l'eau, au fur et mesure des besoins domestiques, à l'aide d'un seau, souvent en métal, attaché à une corde. Dans d'autres cas, notamment pour les citernes très éloignées des habitations, cette ouverture est souvent protégée par une trappe en fer, fermée par un cadenas pour empêcher les vols d'eau. Le toit est souvent construit avec une petite contre-pente vers l'amont et essentiellement convergente vers le trou de puisage, probablement pour fournir un apport d'eau supplémentaire : tous les moyens sont bons dans une zone où des mois passent sans une goutte d'eau. Une ouverture suffisamment large, souvent bouchée par du jujubier soutenu par de petites pierres calcaires, est pratiquée sur une des parois de la citerne pour permettre l'arrivée de l'eau. Certes, la photographie ne le montre pas, mais cette citerne est aussi équipée d'un orifice de sortie appelé localement *talkhrajt*, une sorte d'évacuateur ménagé dans la paroi inférieure à l'opposé de l'orifice d'alimentation. Il est destiné, une fois la citerne remplie, à l'évacuation du trop-plein. Pour recueillir une eau très pure et empêcher l'entrée de dépôts solides grossiers ou des animaux dans la *tanoutfi*, la solution la plus simple adoptée par ces paysans est celle de placer du jujubier comme une sorte de « grillage ». Cet orifice d'alimentation est complété, en amont juste à l'entrée de la citerne, par un petit bassin de décantation appelé localement *tassfaït*,* littéralement cela veut dire « passoire » ; comme on peut le voir sur la photo, il s'agit d'un simple petit creux à ciel ouvert aux parois cimentées. Il permet le dépôt des éléments les plus grossiers et les plus fins. De ce petit bassin, lui-même, se détache un canal dit *assarou* (*majlab* en arabe) qui sert à ravitailler la citerne à partir d'un *impluvium* plus ou moins aménagé. Il est constitué par une simple ligne de pierres entre lesquelles il y a un remplissage de terre et de petits cailloux. L'*impluvium* constitue le premier dispositif de la technique de la citerne [39].

Les dimensions des *matfias* sont variables : de quelques mètres cubes à plusieurs dizaines de m^3 parfois. Pour celles observées au site d'étude, il s'agit des réservoirs d'environ 4 à 5 m de longueur, 2 à 4 m de largeur, et de 3 à 4 m de profondeur. La contenance varie ainsi, de 20 à 80 m^3. La hauteur de la partie non enterrée et élevée au-dessus du niveau du sol est de 20 à 80 centimètres. L'ouverture d'entrée de l'eau est d'environ quinze centimètres. L'orifice circulaire de puisage a environ 50 centimètres de diamètre.

D'autres citernes, de même type, mais beaucoup plus vastes et beaucoup plus profondes ont une longueur de 6 à 10 m et une largeur de 3 à 5 m. La profondeur, quant à elle, varie de 4 à 6 m. Le volume ainsi calculé sur cette base varie de 72 à 300 m^3. Ces citernes de grand calibre appartiennent à la collectivité dont les membres se partagent l'usage de leur eau et

participent tous à leur entretien. Il est à signaler que, à la différence d'autres citernes, celles-ci, même si elles sont profondes, ne sont équipées d'aucun escalier permettant leur curage. Celui-ci se fait en descendant dans la *matfia* par l'orifice de puisage, à l'aide d'une corde.

L'alimentation se fait directement par une séguia secondaire tracée dans le sens de la pente, qui permet de faire dévier une partie des eaux captées par la séguia principale vers les réservoirs (Fig.5).

Comme le met très bien en évidence la photographie ci-dessous, chaque séguia secondaire prend son origine à l'ouverture faite sur la séguia principale. Afin d'éviter l'érosion ravinant et capter le plus d'eau possible, la séguia déversant est armée d'une couche de gros galets que fournit le lit de la rivière.

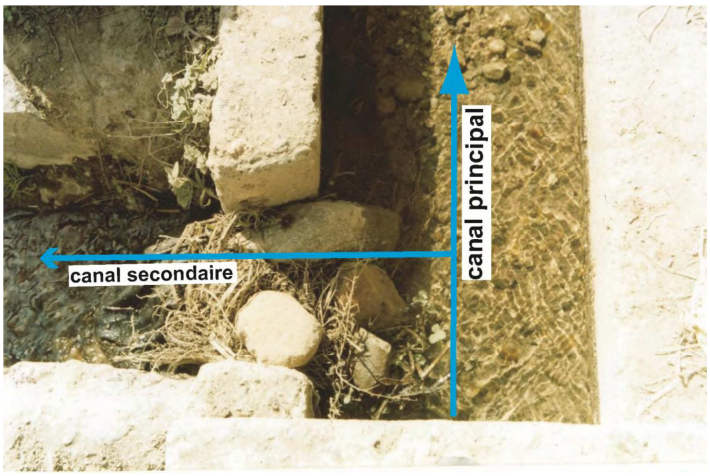

Fig.5 Détail de la séguia principale et son ouverture sur le canal secondaire.

6 LÉGISLATION LOCALE DE MISE EN PLACE DU MATFIA ET DE L'APPROVISIONNEMENT EN EAU

En ce qui concerne l'utilisation de ces *matfia*, tout dépend du leur régime juridique. En effet, les plus petites construites individuellement, sont à statut *melk* c'est-à-dire appropriées ; l'utilisation peut alors en être privée et chaque propriétaire utilise et puise l'eau de sa citerne comme bon lui semble. D'autres citernes sont *jmaâ*, c'est-à-dire qu'elles appartiennent à des communautés de *douar(s)*, elles sont souvent l'œuvre des autorités locales. Dans ce cas, l'eau est partagée entre tous les ayants droit équitablement, comme cela se fait d'ailleurs pour l'eau d'irrigation dans les *bled(s) séguia(s)*. On ne fait appel à aucune main-d'œuvre spécialisée pour l'établissement des *matfias* au moins pour la partie forage qui est faite par les propriétaires et les paysans eux-mêmes ; le creusement est fait par des moyens ancestraux à savoir le marteau, le burin, la houe, la pioche, la corde et le panier traditionnelle pour évacuer les déblais [39].

Toutes les pierres nécessaires à la mise en place de la citerne sont extraites des terres *melk* du propriétaire de la citerne en question. Une fois que cette première opération est achevée, pour la construction des parois de la citerne, les propriétaires font appel à un artisan que l'on appelle *maâlem*. Celui-ci à la charge d'élever les murs de la citerne et le toit. Les murs, une fois terminés sont revêtus, également par cet artisan, d'un enduit de couleur ocre obtenu en délayant dans l'eau un mélange de terre grise et de terre rouge.

Après la mise en place de la *matfia*, ainsi que des différents aménagements qui lui sont associés, tout un travail d'entretien et de restauration de tout le dispositif, allant de la citerne à l'*impluvium*, est nécessaire pour sa survie et son bon fonctionnement. Une fois stockée, l'eau ne fait jamais l'objet d'un quelconque traitement, mis à part que l'on y verse parfois une petite quantité d'eau de javel pour la désinfecter. Ces *matfias* sont un autre exemple de l'occupation et de l'aménagement des pentes du Haut-Atlas. Il est vrai qu'elles n'ont pas été établies à des fins agricoles, mais c'est grâce à elles qu'une population s'est maintenue dans cette région ingrate, car la seule eau disponible pour ces communautés villageoises est l'eau de ruissellement recueillie dans ces remarquables ouvrages.

7 QUALITÉ DES EAUX STOCKÉES

Les sources traditionnelles d'eau sont souvent situées à une certaine distance de la communauté. Lorsque la collecte et le stockage de l'eau se font près des lieux d'habitation, les réserves d'eau sont plus accessibles et plus pratiques à utiliser, ce qui

a des répercussions positives sur la santé [41]. Ce système renforce également le sens de la propriété. L'une des préoccupations majeures de collecte des eaux pluviales est la crainte alléguée sur la qualité de l'eau stockée dans le réservoir. De nombreuses études consacrées à la pollution des eaux de stockage, menées depuis 1970, ont confirmé l'importance de cette pollution et son impact sur les milieux aquatiques [42], [43], [44]. La récolte et l'utilisation des eaux de pluie sont considérées comme très attrayantes en l'absence des contaminants et de pollution. Diverses sources de pollution extérieures (par exemple, les micro-organismes pathogènes ou de contaminants chimiques) ont le potentiel d'influencer la qualité d'eau de pluie [40], [45], [46], [47], [48]. Les impacts de (1) la propreté et de l'âge des bassins, le réservoir de stockage, les canalisations et (2) les conditions atmosphériques contribuent chacun à la qualité d'eau récoltée [45], [46], [47].

La qualité des eaux récoltées peut être affectée par plusieurs facteurs. Les principaux facteurs qui affectent la qualité de l'eau sont l'emplacement (Fig.6) et le climat ainsi que la nature du système de captage [49]. Le lieu influe sur la qualité de l'eau de la pluie, par exemple si la zone est sujette aux pluies acides ou s'il ya une grande quantité de pollution dans le bassin versant local. La qualité des eaux de pluie récoltée est également affectée par le matériel sur le toit. Pour les clients résidentiels et commerciaux des eaux de pluie, les matériaux de toiture peuvent devenir une source sérieuse de la pollution diffuse [46]. La qualité de l'eau est également affectée par la pollution de l'air et la contamination potentielle de l'eau sur le toit par des plantes ou des animaux [47]. Dans l'État de Virginie, il ya eu quelques études qui décrivent la qualité de l'eau de pluie. Une étude des citernes [50] a montré que seulement cinquante pour cent des citernes échantillonnés répondent aux normes fédérales de l'eau potable. La plupart de ces citernes ont échoué en ce qui concerne la contamination des coliformes totaux. Ces citernes ont également été analysées en fonction de contamination possible avec plus de 30% à moins de 200m d'un système de fosse septique. Lorsqu'elle est correctement entretenue, il est prévu que la contamination des citernes peut être beaucoup plus faible que celle observée dans l'étude.

Fig.6 Photos des matfias entourée par des déchets à la vallée Assif El Mal (région de Marrakech).

Les polluants déposés sur les toits peuvent contaminer l'eau stockée et provoquer une accumulation de sédiments dans le réservoir de stockage [51], [52]. La perception générale est que le mauvais entretien des systèmes de récupération d'eau de pluie peut conduire à une contamination microbienne par des bactéries, virus et protozoaires, ainsi qu'une contamination chimique. En général, toute bassin sur le toit sera contaminé par des excréments de poussière, de matières organiques, d'oiseaux et d'animaux et de polluants provenant des activités humaines[45], [52]. Cela diversifie les risques de contamination de ces ressources en eau qui peuvent être soit chimique et/ ou microbienne [40], [53], [54].

8 CONCLUSION

Les populations des pays en développement sont alimentées en eau grâce à la connexion au réseau d'adduction, aux bornes fontaines, aux forages, puits et sources, ou utilisent des méthodes archaïques d'approvisionnement en eau à savoir le stockage des eaux de pluie ou de surface dans des citernes traditionnelles. Ce travail a porté sur une source d'eau alternative ou complémentaire au même titre que les technologies d'alimentation en eau plus conventionnelles. Il s'agit de stockage traditionnel des eaux pluviales et de surface. Les eaux des réservoirs de stockage des eaux ou *matfia* constituent une ressource précieuse très sollicitée par les populations rurales au Maroc. Ces eaux sont exploitées directement pour l'alimentation des populations locales, l'abreuvage de leur bétail et pour le développement de diverses activités domestiques. Du fait de la présence anthropique et des activités qui en découlent, les eaux de *matfia* sont continuellement

exposées aux différentes sources de pollution domestiques liquides et solides. Ceci peut conduire à des graves problèmes de santé publique, dont la propagation des maladies hydriques. Plusieurs études ont démontré l'importance des facteurs comportementaux individuels sur la qualité de l'eau stockée. Ainsi, beaucoup de chercheurs ont observé que le stockage de l'eau mène à une détérioration de la qualité de l'eau à cause de sa contamination dans leur réservoir.

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La symbiose Légumineuses-rhizobia sous conditions de salinité : Aspect Agro-physiologique et biochimique de la tolérance

[Legume-rhizobia symbiosis under saline conditions: Agro-physiological and biochemical aspects of tolerance]

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ABSTRACT: Salinity of soils and irrigation waters remains in the arid and semi arid ecosystems, a major obstacle to the development and growth of plants. This constraint on the legumes-rhizobia symbiosis occurs by an osmotic and/or ionic effect inhibiting various physiological and biochemical processes governing the growth of the host plant, the survival and proliferation of rhizobia and subsequently the inhibition of the infection process and the biological nitrogen fixation. The ability of plants to prevent and repair damages caused under saline conditions is associated with changes in many physiological and biochemical process including vacuolar sequestering of sodium ion, maintaining a high cytosolic K^+/Na^+ concentration ratio, accumulation of osmoprotector solutes, induction of an oxidative stress response and of plant hormones.

KEYWORDS: legumes, rhizobia, symbiosis, salinity, tolerance.

RESUME: La salinité des sols et des eaux d'irrigation demeure dans les écosystèmes arides et semi arides, un obstacle majeur au développement et à la croissance des végétaux. Cette contrainte sur la symbiose légumineuses-rhizobia se manifeste par un effet osmotique et /ou ionique inhibant les différents processus physiologiques et biochimiques gouvernant la croissance de la plante hôte, la survie et la prolifération des rhizobia et par la suite l'inhibition des processus d'infection et de la fixation biologique de l'azote. La capacité des plantes à prévenir et réparer les dommages engendrés sous conditions salines est associée à différents changements physiologiques et biochimiques incluant la séquestration du sodium dans les vacuoles, le maintien d'un haut ratio cytosolique K^+/Na^+, l'accumulation d'osmoprotecteurs, et l'induction d'une réponse anti-oxydante et des phytohormones.

MOT-CLEFS: légumineuses, rhizobia, symbiose, salinité, tolérance.

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1 INTRODUCTION

Dans le bassin méditerranéen, la culture des plantes légumineuses occupe une place primordiale au niveau des agro-systèmes vu leurs intérêts agronomiques, économiques et nutritionnels qu'elles apportent via leur symbiose avec les rhizobia [1]; [2];[3]; [4]; [5]. En effet, cette symbiose fournit l'azote nécessaire pour la croissance et le développement de la plante et contribue à l'amélioration du bilan azoté des sols [6]. Selon Lodwig et al. (2003) [7], la réduction biologique de l'azote atmosphérique en ammonium fournit environ 65% de l'azote disponible dans la biosphère. La majeure partie de cet azote est apporté par la symbiose légumineuses-rhizobia [8], avec un apport annuel d'azote dans les terres estimé de 200 à 300 kg N/ha [9]. Par conséquent, la symbiose rhizobienne pourrait, par la culture des légumineuses, dispenser les agriculteurs de la fertilisation chimique coûteuse et polluante.

Cependant, la salinisation des sols et des eaux d'irrigation enregistrée dans les écosystèmes aride et semi aride, en particulier dans le bassin méditerranéen, constitue l'un des facteurs limitatifs de la productivité végétale et du rendement agricole [10]; [11]; [5]. Près de 10% des terres sont affectés par le sel et 10 millions d'hectares de terres agricoles sont perdus chaque année [12]. Un grand nombre de ces terres sont cultivées avec des légumineuses pour lesquelles la salinité constitue une contrainte importante dans de nombreuses régions du monde et limite sévèrement la fixation symbiotique de l'azote [13]; [14]; [1]. En effet, la salinité agit sur la survie et la prolifération des rhizobia au niveau du sol et la rhizosphère, inhibe le processus d'infection et affecte directement le fonctionnement des nodules au niveau des racines [15]; [1]; [4], affectant ainsi la croissance des plantes, la photosynthèse et la demande en azote, et par suite la productivité et le rendement. En conséquence, les agriculteurs apportent de grandes quantités d'azote pour stimuler cette croissance, ce qui est en contradiction avec les propriétés biologiques des légumineuses et est néfaste pour l'économie des exploitations à revenu limité, ainsi que sur l'environnement en contribuant à la pollution de la nappe phréatique par les nitrates.

Dans ce contexte, la présente synthèse bibliographique a pour objectif de mettre l'accent sur les principaux effets causés par la contrainte saline sur la symbiose associant des légumineuses aux rhizobia. Beaucoup d'informations portant sur les différents mécanismes agro-physiologiques et biochimiques liés à la tolérance seront développées.

2 DEFINITION ET TYPES DE SALINITE

La salinité désigne la surcharge en sels minéraux solubles de l'eau d'irrigation ou de la solution du sol, ces sels sont représentés en grande partie par la combinaison de trois cations (Ca^{2+}, Mg^{2+} et Na^{+}) et trois anions (Cl^{-}, SO_4^{2-}et HCO_3^{-}). En général, le chlorure de sodium (NaCl) est le plus fréquent et représente plus de 90 % des sels [17].

On définit en général deux types de salinité : la salinité primaire et la salinité secondaire. La première résulte de la présence initiale de sels dans le sol ou dans la nappe phréatique. La seconde résulte des apports de l'eau d'irrigation [16].

3 LES NORMES DE LA SALINITE DES EAUX ET DES SOLS

3.1 LES SOLS

Un sol est considéré comme étant salin s'il contient assez de sels solubles pour nuire à la croissance et au développement des plantes. Un sol est salin si sa conductivité électrique à 25°C dépasse 4 $dS.m^{-1}$ (Tableau 1).

Tableau 1. Classifications des sols salinisés [18]

Classification	Conductivité électrique ($dS.m^{-1}$)	pH du sol	Ratio d'adsorption du sodium	Condition physique du sol
Saline	> 4.0	< 8.5	< 13	Normal
Salin-sodique	> 4.0	< 8.5	> 13	Normal
Sodique	< 4.0	> 8.5	> 13	Pauvre

3.2 LES EAUX

L'évaluation de la salinité des eaux d'irrigation est en général basée sur la conductivité électrique à 25°C. Les eaux dont la conductivité électrique est inférieure à 0.25 mmhos/cm sont faiblement salines alors que celles pour lesquelles cette conductivité est comprise entre 0.75 et 2.25 mmhos/cm sont très salines (Tableau 2).

Tableau 2. Classification des eaux d'irrigation selon leurs conductivités électriques [19].

Classe de salinité	Conductivité électrique (mmhos/cm)	Degré de salinité
C1	0.0 à 0.25	Faible
C2	0.25 à 0.75	Moyen
C3	0.75 à 2.25	Fort
C4	2.25 à 5	Très fort
C5	> 5	excessif

4 IMPACT DE LA SALINITE SUR LA SYMBIOSE LEGUMINEUSE-RHIZOBIA

4.1 EFFET SUR LA GERMINATION DES GRAINES

La germination constitue un stade critique dans le cycle de développement de la plante. Elle conditionne l'installation de la plantule, sa fixation sur le milieu, et probablement sa productivité ultérieure. La germination des plantes, qu'elles soient halophytes ou glycophytes, est affectée par la salinité [20].

L'influence de NaCl sur la germination de la légumineuse *Medicago sativa* L. se traduit soit par un allongement de la phase de latence avant la germination, soit par l'inhibition complète de celle-ci [21]; [2]. Chez d'autres plantes légumineuses telles que *Glycine max* L., *Mucuna poggei* Taub., *Phaseolus adenanthus* L., *Phaseolus vulgaris* L. et *Vigna unguiculata* L., Taffouo et al. (2009) ont noté que les pourcentages de germination des graines diminuaient à partir d'une concentration de 50 mM NaCl. Ces réductions peuvent être dues à la création d'un potentiel osmotique externe qui empêche l'absorption d'eau ou à des effets toxiques des ions sodium et chlorure sur les graines en germination [22]. En fait, le stress salin affecte le métabolisme de l'embryon des graines en germination et induit des perturbations dans les processus impliqués dans la mobilisation des réserves de l'endosperme [21]. La salinité entraîne une réduction de l'activité des enzymes hydrolytiques de l'endosperme des graines, telles que les amylases, les protéases et les phosphatases. Cette réduction est plus importante chez les légumineuses sensibles que chez les tolérantes [23].

4.2 EFFET SUR LA CROISSANCE DES LEGUMINEUSES

La salinité est une contrainte majeure qui affecte la croissance et le développement des plantes. La croissance de la majorité des plantes est réduite ou inhibée quand la concentration en sel dans l'environnement racinaire s'élève au dessus de 100 mM NaCl. Chez les légumineuses, l'effet dépressif du sel se manifeste à partir d'un seuil critique de concentration, caractéristique de l'espèce ou de la variété [21] ; [1]; [3]. Ainsi, la croissance végétative de *Phaseolus vulgaris* L. est fortement déprimée par une concentration de NaCl de l'ordre de 25 mM [1]. Chez la luzerne, le sel entraîne une réduction des productions de matière sèche aérienne et racinaire [13]; [24].

Plusieurs causes sont évoquées pour expliquer le déterminisme de la réduction de la croissance sous les conditions de stress salin, incluant entre autre, la diminution du contrôle du statut hydrique [22], le désordre nutritionnel [21], le ralentissement de la synthèse protéique, la perturbation de la stabilité des structures membranaires et l'inhibition de l'activité des enzymes [25];[1], les changements dans l'extensibilité de la paroi cellulaire en relation avec sa composition protéique, et la réduction de la capacité photosynthétique [26]. Mezni (2010) [27] a montré que le stress causé par la salinité inhibe de manière significative la croissance de différents organes de la luzerne, toutefois, les racines sont souvent plus touchées que les parties aériennes [28].

4.3 EFFET SUR LA CROISSANCE ET LA SURVIE DES RHIZOBIA

La salinité est un facteur majeur limitant la fixation symbiotique de l'azote. Elle affecte d'une manière délétère la croissance et la persistance des souches rhizobiennes dans le sol [4]. Jebara et al. (2000)[29] ont montré que certains isolats de *Sinorhizobium* nodulant *Medicago sp*, avaient une croissance lente sous des conditions salines. La croissance des rhizobia a été notée normale sous des concentrations en NaCl d'environ 1 %. Certaines souches ont été rapportées pour leur capacité à croître à des concentrations élevées en sel (>3%), notamment *Sinorhizobium meliloti* [30].

4.4 EFFET SUR LE PROCESSUS D'INFECTION ET LE DEVELOPPEMENT DES NODULES

Le stress salin peut affecter la symbiose légumineuse-rhizobia indirectement, en réduisant la croissance de la plante hôte et en affectant certains de ses processus physiologiques, ou bien directement en inhibant le processus d'infection et le développement des nodules [8]; [29]; [31]. Chez des cultivars tolérants de pois chiche, la salinité inhibe le processus d'infection et affecte la taille et le nombre des nodules [32], tandis que chez la fève, une inhibition du cordon d'infection a été remarquée (Zahran et Sprent, 1986). Cependant, une stimulation de la croissance des nodules a été observée chez certaines légumineuses comme les cultivars tolérants du pois chiche [33] ou de luzerne [34]. En général, les premières étapes de la nodulation sont les plus sensibles au stress salin [31].

4.5 EFFET SUR LA FIXATION BIOLOGIQUE DE L'AZOTE ET LA RESPIRATION NODULAIRE

La salinité inhibe l'activité de la nitrogénase [34] et la respiration nodulaire [35] qui cause, par la suite, une diminution des teneurs en azote total dans la plante [36]; [1]. La réduction de l'activité fixatrice de N_2 est généralement due à la réduction de la respiration nodulaire [37]. Cette réduction est due à une limitation du substrat N_2 ou à la régulation de la diffusion de l'oxygène dans le nodule [38] ou une diminution de la production de protéines cytosoliques, surtout la léghemoglobine, par les nodules [39]. Serraj et al. (1994) [35], ont montré que l'augmentation de la pression d'oxygène dans le milieu d'une racine nodulée permet de supprimer l'effet inhibiteur du stress salin sur l'activité nitrogénase. D'autres résultats suggèrent que l'accumulation des ions toxiques (Na^+ et Cl^-) dans les nodosités peut affecter le métabolisme dans ces organes et inhiber leur activité fixatrice d'azote [40].

4.6 EFFET SUR LES PARAMETRES HYDRIQUES

Dans la nature, les plantes perdent de l'eau par transpiration et ont tendance à la remplacer par son absorption à partir de la solution du sol [41].La présence des sels dans le milieu de culture limite la disponibilité de l'eau pour la plante et par conséquent, cette dernière se trouve en état de déficit hydrique [3]. Les potentiels hydrique et osmotique de plantes deviennent plus négatifs avec l'augmentation de la salinité, alors que la pression de turgescence se trouve augmentée [42]. Le stress salin réduit la teneur en eau, le contenu relatif en eau et le potentiel hydrique chez les légumineuses telles que *Phaseolus vulgaris* L. [43], *Vicia faba* L. [44] et *Ceratonia siliqua* L. [45]. Ces réductions sont plus importantes chez les cultivars sensibles comparativement aux tolérants. Le statut hydrique de la plante est un facteur déterminant pour l'activité métabolique et la survie des feuilles [46]. La réduction de la teneur relative en eau entraine une faible disponibilité de l'eau pour l'extension cellulaire [47].

4.7 EFFET SUR LA PHOTOSYNTHESE

L'effet de salinité sur la photosynthèse se manifeste essentiellement par la réduction de l'assimilation du CO_2, la conductance stomatique [48],[6] et le ralentissement de l'activité du transport des électrons du photosystème II [49]. La réduction de la photosynthèse par la salinité est l'une des causes majeures de la réduction de la croissance et de la productivité végétale. Dans ce sens, les mesures de la photosynthèse sont souvent utilisées dans les études d'adaptation des plantes à différentes contraintes du milieu, telles que la salinité. Garg et Singla (2004) [50] ont noté les réductions de l'assimilation photosynthétique nette (P_N), la concentration interne en CO_2, la conductance des stomates et la transpiration chez les plantes de pois chiche. Le même constat a été observé par Gama et al. (2007) [51] chez l'haricot. La réduction de P_N est accompagnée de la réduction de la conductance des stomates. La fermeture de ceux-ci pourrait être à l'origine de la diminution de la concentration intracellulaire en CO_2 par limitation de son entrée dans les feuilles.

4.8 EFFET SUR LE METABOLISME CARBONE

L'énergie nécessaire à la fixation de l'azote par les bactéroïdes est fournie par la plante sous forme de carbone réduit. La plante fournit du saccharose à travers le phloème. De fortes activités sucrose synthase et invertase sont présentes dans le cytosol des cellules infectées, permettant l'hydrolyse du saccharose en glucose. Le glucose est ensuite métabolisé en phosphoénolpyruvate, en oxaloacétate, en malate et en succinate. Ces deux derniers composants constituent la principale source carbonée des bactéroïdes [52]. Le malate est un métabolite clé chez les plantes et il est synthétisé par l'action de phosphoénolpyruvate carboxylase et la malate déshydrogénase. Une inhibition de l'activité de ces deux enzymes, de la sucrose synthase et de l'invertase alcaline a été noté dans les nodules de luzerne et de haricot [39]; [1].

4.9 EFFET SUR LA NUTRITION MINERALE

Le stress salin engendre un déséquilibre de la nutrition minérale de la plante qui résulte d'une perturbation de l'absorption et du transport des éléments essentiels. En général, la présence du NaCl dans le milieu de culture inhibe l'absorption des ions K^+, Ca^{2+}, P_i, NO_3^-, NH_4^+ et renforce celle des ions salins, Na^+ et Cl^- qui s'accumulent jusqu'à devenir toxiques pour la plante [27], [1]. Ainsi, Farissi et al. (2014b) [5] ont montré chez *Medicago sativa* L. que la contrainte saline engendrait des réductions significatives de K^+ et des accumulations significatives de Na^+. Chez la même espèce, Ibriz et al.(2004) [53] ont noté que la salinité provoquait une accumulation de Na^+ et Cl^-, et une réduction d'absorption de K^+, Ca^{2+} et de N. Les activités de certaines enzymes impliquées dans la nutrition azotée n'échappent pas à la surcharge en sel. En effet, il s'est avéré que le stress salin a une influence sur l'activité de la nitrate réductase [5], une enzyme clé dans les processus d'assimilation de l'azote. Gouia et al. (1994) [54] ont noté que l'effet négatif du NaCl sur l'activité de cette enzyme était plus remarquable sur les plantes de la fève sensible au sel. Egalement, l'augmentation de la concentration en NaCl réduit l'activité nitrate réductase dans les organes de *Medicago sativa* L. [55].

4.10 EFFET SUR LA PEROXYDATION DES LIPIDES

La salinité affecte la composition en lipides membranaires chez les plantes supérieures en modifiant leur intégrité, leur fluidité et par conséquence, leur perméabilité. Taffouo et al. (2004) [56] ont noté que l'augmentation de la concentration en sel dans le milieu rhizosphérique réduisait significativement la teneur des feuilles en lipides chez *Glycine max* L., *Mucuna poggei* Taub., *Phaseolus adenanthus* L., *Phaseolus vulgaris* L. et *Vigna unguiculata* L. Des teneurs élevées en MDA (Malonyldialdéhyde), métabolite issue de la peroxydation des lipides, ont été rapportées chez *Medicago officinalis* L., *Astragalus adsurgen* Pall. et *Medicao sativa* L. sous conditions de salinité [57].

5 MECANISMES DE TOLERANCE A LA SALINITE

La prévention des dommages causés par le stress salin et leur réparation sont nécessaires pour la survie des cellules. Ces stratégies peuvent inclure différents changements morphologiques, biochimiques et physiologiques.

5.1 SEQUESTRATION DU SODIUM

Les plantes en général et la symbiose rhizobienne en particulier, détectent le stress salin a travers le signal ionique (Na^+) et osmotique. L'excès de Na^+ peut être détecté par les protéines transmembranaires ou les enzymes récepteurs de Na^+ [58]. L'excès de Na^+ et Cl^- provoque des changements de structures de protéines et une dépolarisation membranaire qui peuvent conduire à la perception de la toxicité ionique.

Les antiports Na^+/H^+ de membrane plasmique, pompent le Na^+ à partir des cellules racinaires pour être transporté vers les feuilles. Ce transport est la première ligne de défense qui sert à empêcher l'accumulation de Na+ dans le cytosol [58]. En conditions de salinité, la séquestration vacuolaire de Na^+ est une stratégie importante et rentable pour l'ajustement osmotique qui en même temps peut réduire la concentration de Na^+ cytosolique. Les antiports vacuolaires Na^+/H^+ utilisent le gradient de protons générés par la H^+/adénosine triphosphatase (H^+/ATPase) vacuolaire et la H^+/pyrophosphatase (H^+/PPase) pour la séquestration de Na+ dans la vacuole. Le stress salin active les H^+/ATPase et H^+/PPase des tonoplastes [59]. Par conséquence, la coordination entre les antiports Na^+/H^+, H^+/ATPase et H^+/PPase est cruciale pour la tolérance au stress salin.

5.2 PRELEVEMENT DE K^+

Dans les conditions optimales, les plantes maintiennent un haut ratio cytosolique K^+/Na^+.Le stress salin entraîne la diminution de ce ratio, du fait que les ions Na^+ sont en concurrence avec les ions K^+, ce qui est défavorable pour les processus biochimiques cellulaires. De même, une forte concentration de potassium augmente le potentiel osmotique qui entraîne une entrée d'eau à partir du milieu extérieur [60]. Le prélèvement de K^+ est essentiel pour la turgescence cellulaire et le déroulement des processus biochimiques sous stress salin [61].

5.3 BIOSYNTHESE DES OSMOPROTECTEURS ET AJUSTEMENT OSMOTIQUE

Les légumineuses tolérantes à la salinité réalisent l'ajustement osmotique en concentrant les ions salins dans leurs tissus. Mais, les quantités accumulées deviennent rapidement toxiques. Dès lors, une des stratégies d'adaptation consiste à

synthétiser des osmoprotecteurs, principalement des sucres et des composés aminés tels que la proline et la glycine-Bétaïne [21].

Chez la luzerne plusieurs études ont montré une accumulation importante de la proline à partir d'une concentration de 100 mM de NaCl [27]; [21]. Verdoy et al. (2006) [62] ont constaté chez *Medicago truncatula* L. transgénique que la salinité provoquait l'accumulation de proline dans les nodules et améliorait la croissance et la fixation symbiotique d'azote. La proline agit comme un osmoticum dont l'accumulation cytoplasmique permet de neutraliser les effets ioniques et osmotiques de l'accumulation du sel dans la vacuole [63]. Cet acide aminé joue un rôle également dans le maintien des pressions cytosol-vacuole et de régulation du pH [64] ainsi que la stabilité des membranes [65].

Les sucres pourraient contribuer à plus de 50% à l'ajustement osmotique des glycophytes soumises aux conditions de salinité [65]. L'accumulation des carbohydrates dans les plantes légumineuses en réponse à la salinité a été documentée dans les espèces de *Phaseolus* [66] et *Medicago sativa* [21]. Leurs fonctions majeures consistent dans l'osmo-protection, l'ajustement osmotique, le stockage du carbone et le piégeage des radicaux libres [67].

5.4 INDUCTION DES ENZYMES ANTIOXYDANTES

Le stress salin provoque la formation de dérivés réactifs de l'oxygène tels que le peroxyde d'hydrogène (H_2O_2), le superoxyde (O^{2-}) et les radicaux libre. Ces dérivés causent des dommages oxydatifs aux différents composants cellulaires, y compris les lipides membranaires, les protéines et les acides nucléiques [68].

Pour faire face aux dérivés réactifs de l'oxygène, les plantes ont développé des mécanismes anti-oxydants enzymatiques et non-enzymatiques [69]. Dans ce sens, l'induction de la superoxyde dismutase est considérée comme le premier mécanisme de défense contre ces dérivés par réaction de dismutation de O^{2-} en H_2O_2 et O_2. La catalase (CAT) et les peroxydases (POD) assurent la conversion de H_2O_2 en H_2O et O_2 [70]. Chez la légumineuse *Medicago sativa* L., Wang et al. (2009) [57] ont constaté l'augmentation de l'activité des enzymes antioxydantes comme mécanisme d'adaptation au stress salin. Arab et Ehsanpour, (2006) [71] ont noté que le traitement des semences d'une plante légumineuse par l'acide ascorbique augmentait le niveau de la tolérance au sel. Le maintien d'une activité antioxydante élevée est positivement corrélé à la diminution de la peroxydation des lipides, au maintien de la stabilité des membranes cellulaires des nodules et par la suite au maintien d'une biomasse nodulaire élevée. Mhadhbi et al. (2004)[72] ont rapporté que les activités peroxydases les plus élevées ont été détectées dans les symbioses pois chiche-rhizobia les plus tolérantes au stress salin. Egalement, Tejera et al. (2004)[14] ont noté que l'augmentation d'activité SOD détectée dans les nodules de haricot exposés à la salinité expliquait l'amélioration de la tolérance.

5.5 INDUCTION DES PHYTOHORMONES

Les phytohormones telles que l'acide abscissique (ABA), l'acide indolacétique (AIA), l'acide gibbérellique (AG) et les cytokinines, sont impliquées dans la régulation de la réponse des plantes à la salinité et permettent d'atténuer les effets dépressifs de cette contrainte. Javid et al. (2011)[73] ont noté que l'ABA joue un rôle majeur dans la signalisation des réponses d'adaptation des plantes aux stress. L'ABA est produite dans les racines en réponse à une diminution du potentiel hydrique du sol et transporté vers les feuilles où il se fixe à des récepteurs de la membrane plasmique de cellules de garde des stomates [74]. Fatemeh et al. (2012)[75] ont noté que la pulvérisation des phytohormones, notamment AG, sur les feuilles améliorait la croissance sous conditions de salinité. L'effet inhibiteur de NaCl sur la photosynthèse, la croissance et la translocation des assimilats a été trouvée atténuée par ABA [76]. Chez *Phaseolus vulgaris* L., Saeidi-Sar et al. (2012) [77] ont rapporté que l'interaction de l'acide ascorbique avec AG diminuait les quantités de MDA et de H_2O_2. L'effet interactif de ces substances a amélioré la teneur en protéines et l'activité des enzymes antioxydantes dans les plantes de haricot sous stress salin.

6 CONCLUSION ET PERSPECTIVES

L'effet de la présence du sel dans le milieu racinaire sur la symbiose légumineuses-rhizobia a été discuté. L'accent a été mis sur le comportement agro-physiologique et biochimique.

Les surfaces agricoles perdues chaque année à cause de la salinité ne cessent d'augmenter et conséquemment, la lute contre la contrainte saline constitue actuellement un grand défi pour la production agricole. Une bonne compréhension de l'ensemble des mécanismes physiologiques et biochimiques impliqués dans la réponse des légumineuses à la salinité, et la détermination des liaisons existantes entre ces différents mécanismes, la croissance des plantes ainsi que la nodulation peut constituer une approches prometteuse pour aider à la sélection des variétés de légumineuses tolérantes et des combinaisons

symbiotiques légumineuses-rhizobia performantes pour la fixation de l'azote atmosphérique sous conditions salines. Egalement, la liaison avec la génomique fonctionnelle, notamment avec les avancements actuels dans la génomique et la bioinformatique, pourrait conduire à l'identification de gènes candidats (gènes codant pour les transporteurs du sodium) comme des outils pour élucider les mécanismes impliqués dans l'efficacité de la symbiose rhizobienne sous conditions des contraintes environnementales.

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Studies on the Isolation, Physico-Chemical Characterization and Microbial Activities of Melon (*Cucumis melo*) Seed Oil

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ABSTRACT: Oil was extracted from melon (*Cucumis melo*) seeds by solvent extraction method using *n*-haxane, LPE (light petroleum ether, b.p. 40-60 °C) and chloroform:methanol 50:50, v/v mixtures. The oil content of the melon seed oil was found to be 28.01%. The oil was characterized with various physical and chemical properties by standard methods and compared with those of standard oils or fats. Acid value (AV), Iodine value (IV), Peroxide value, Reichert-Meissl value (RMV), Thiocyanogen value (TV), Titre value etc. were determined and found that lightly changed due to variation of storage time. Acid value and Peroxide value were increased with the increasing of storage time but RMV, TV, IV, and Titre value were decreased, which indicates that the quality of the oil deteriorates with increasing time of storage. Fatty acid composition of the oil was determined by Thin-layer Chromatography (TLC) and identified the presence of palmitic acid, stearic acid, linolenic acid and oleic acid in the oil. The low acid value of oil indicates that it can be used in edible purpose. The de-oiled seed cake of melon seed was studied for the determination of ash content, protein, moisture content and minerals (N, P, K, and Ca) quantitatively. The microbial activities of the oil sample were investigated by standard methods.

KEYWORDS: Melon, Seed, Microbial activities, Thin Layer Chromatography, Fatty Acids.

1 INTRODUCTION

Man and animals severely depend on the plant kingdom for food, clothing, shelter, medicine and many other daily necessities of life. On the other hand they also provide us many important substances such as glycosides, alkaloids, sterols, vitamins, essential oils, resins, lignins, medicine, fats and oils etc [1]. Vegetable oils differ remarkably from fish oils in containing a great variety of fatty acids especially poly unsaturated fatty acids (PUFA). Besides the fatty acids occurring both in vegetable oils and in terrestrial animals fats, namely palmitic, stearic and oleic acid. Some vegetable oils contain great proportions of linoleic acids [2]. Essential oils also known as volatile liquids, widely available in various types of plants. Examples are turpentine oil of cloves, oils of the seed of melon etc. Seeds of melon contain α-spinasterol, stigmasta-7,22,25-trienol and stigmasta-7,25-dienol which have phenol group [3]. Melon seeds are major source of essential oils [4]. Seeds are generally treated as waste; however, medicinal effects have been reported for the seeds [5], [6]. Hexane-extracted seed oil of *Cucumis melo* hybrid AF-522 was determined to contain 64 g of linoleic acid per 100 g of total fatty acids [6]. Present study is about the physico-chemical characterization of the solvent-extracted oil from the seeds of melon found in agricultural field at Chittagong area in Bangladesh and comparing the results with the data available in literature about pharmacological aspects of seeds of melon. Performance of the oil from the seeds of melon against some common microbial species is also studied.

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2 MATERIALS AND METHODS

2.1 COLLECTION OF THE SEEDS FROM FRUITS

The melon was collected from a local garden of Chittagong. Seeds were separated and preserved in desiccators in the laboratory until extraction and chemical investigation.

2.2 EXTRACTION OF OIL

Only the seeds were kept aside separately for extraction. The method employed for extraction of the oil from the seeds was solvent extraction method. Extraction was carried out in 5-L Soxhlet apparatus by using *n*-hexane and light petroleum ether (b.p. 40-60 °C) and chlorofron:methanol (50:50, v/v) mixture [7]. Oil was recovered from combined extracts by rotary evaporator.

2.3 PHYSICAL CHARACTERIZATION

All chemicals and reagents used in this study were of analytical grade unless otherwise mentioned or chemicals prepared according to the standard procedures [8], [9], [10].

Viscosity of a liquid is the measure of resistance to flow. The viscosity of the oil was determined by Oswald viscometer at 30 °C.

The refractive index of the oil sample was determined by ABBE Refractometer (MODEL; DTM-1 Atago Co. Ltd). The specific gravity of the oil sample was determined by specific gravity bottle.

The moisture content, ash content and protein content of the de-oiled seed cake of melon seed were determined by using standard methods [11], [12].

2.4 CHEMICAL CHARACTERIZATION

Various chemical properties were determined by using suitable standard methods. Saponification value, Acid value, Percentage of free fatty acid, Saponification equivalent, Iodine value, Acetyle value [13], [14], Richert-Meissl value, Polenske value, Thiocyanogen value [15], Henher value, Kirschner value, quantity of unsaponifiable matter [16] and Peroxide value [17] were determined by standard methods.

2.5 MICROBIAL EVALUATION

The microbial activities of the oil sample against four bacteria by disc diffusion method and four fungi by the food poison technique were tested respectively [18]. Nutrient agar (NA) and potato dextrose agar (PDA) were used as basal medium for bacterial and fungal activity test respectively. Chloroform was used as a solvent to prepare 1% and 10% oil solution. Proper control was maintained with chloroform.

2.6 ESTIMATION OF MINERALS

Minerals (N, P, K and Ca) of de-oiled seed cake of melon seed were determined by modified Kjeldahl method.

2.7 CHROMATOGRAPHIC EXAMINATION

The seed oil of melon was subjected to TLC examination and its fatty acid composition was identified by comparing the R_f values of different spots of chromatograms with those of standard fatty acids reported earlier in different solvent systems [9], [10].

3 RESULTS AND DISCUSSION

3.1 PHYSICAL CHARACTERIZATION

The refractive index of melon seed oil was found to be 1.4712 at 30 °C (Table-1) which is similar to soyabean oil (1.4723-1.4756). The result indicates that the oil sample is consistent with long chain unsaturated fatty acids, which supported by it's iodine value.

The specific gravity of the fats and oils does not vary as a general rule to an extent which makes this property useful in distinguishing one oil from another. The specific gravity of melon seed oil was found to be 0.9310 at 30 °C. This value has close similarity with soyabean oil (0.922-0.920) and sunflower oil (0.924-0.926) (Table-1).

The viscosity of the melon seed oil was found to be 360.24 m.p. at 30 °C. The low viscosity suggested that there are a few hydroxyl groups in the molecule which are supported by the low acetyl values of the oil (3.87) and lower refractive index of the oil.

The activation energy of the oil sample was found to be 3.532 kcal per mole. The higher value indicates the greater viscosity of the oil.

The moisture content, ash content and protein content of the de-oiled seed cake of melon seed were determined using standard methods and were found to be 1.59%, 3.01% and 14.13% respectively.

3.2 CHEMICAL CHARACTERIZATION

The saponification value is the number of milligrams of KOH required to saponify 1 g of a fat or oil. The saponification value of the melon seed oil was found to be 187.46 as shown in Table-2, which was nearest to that of soyabean oil (190-195). This comparatively lower saponification value indicates the presence of higher fatty acids in higher proportions. The saponification equivalent value of the melon seed oil was found to be 299.26.

The acid value is the number of mg of KOH required to neutralize the free acids present in 1 g of oil or fat. The acid value of melon seed oil was found to be 0.812. The relatively lower acid value makes oil more edible and nutritive. The increase in free fatty acids is generally accompanied by a rancid odor, although the odor itself is not due to the acidity. The value near to the soyabean oil (1.27-1.54), Olive oil (0.6-1.5)[19]. Low acid value is an indication of freshness of the oil and suitability of the oil for edible purpose.

Percentage of free fatty acids (%F.F.A.) of the melon seed oil was found to be 0.408 as oleic acid which was almost same as the soyabean oil (0.35-0.85) and cotton seed oil (0.4-0.9) [20], [21].

The iodine value is the number of grams of iodine that combine with 100 grams of an oil or fat. It is the measure of the degree of unstauration of a fat or oil and thus allows its classification into non-drying, drying and semi-drying types. The iodine value of melon seed oil was found to be 125.97. This value supports that the oil was moderately unsaturated.

The ester value is defined as the number of mg of KOH necessary to combine with the fatty acids which are in combination with glycerol in 1 g of fat or oil. It is determined by subtracting the acid value (A.V.) from the saponification value (S.V.). The ester value of the melon seed oil was found to be 186.65.

The Reichert-Meissl value (R.M.V.) is the number of milliliters of 0.1N KOH solution required to neutralize 5 g of a fat or oil. The R.M.V. of the melon seed oil was found to be 0.43, which was identical to the soyabean oil (0.5-2.5) and olive oil (0.6-1.5). R.M.V. is the measure of volatile water soluble fatty acids (butyric-C_4 to capric-C_{10}) present in the oil or fat. Relatively lower R.M.V. of the oil is an indication of low content steam volatile fatty acids.

The Polenske value is the number of milliliters of 1N NaOH solution required to neutralize the volatile water insoluble but alcohol soluble fatty acids distilled from 5 g of a fat or oil. The Polenske value of the melon seed oil was found to be 0.91, which indicates that the low content of the volatile alcohol soluble but water insoluble fatty acids present in the oil.

The Henher value is a measure of water insoluble fatty acids in an oil or fat. The Henher value of the melon seed oil was found to be 86.21 which was almost same as the palm oil (94.2) and cotton seed oil (94.6). It indicates that higher percentage of water insoluble fatty acid having high molecular weight is present in the oil.

Peroxide value is the amount of iodine liberated from potassium iodide by the peroxides present in the oil or fat, in terms of milliequivalents per kg or millimoles per kg. The peroxide value of the melon seed oil was found to be 81.36 meq/kg.

The acetyl value is the number of mg of KOH required to neutralize the acetic acid obtained by saponifying 1 g of acetylated fats or oil. The acetyl value of the melon seed oil was found to be 3.87, which indicates low content of free hydroxyl groups present in the oil sample.

The percentage of unsaponifiable matter (U.S.M.) of the melon seed oil was found to be 0.6021% which was almost same as the soyabean oil (0.7-1.6) and cotton seed oil (0.8-1.8). The Fat Analysis Committee of the American Chemical Society proposed that if the percentage of U.S.M. exceeds 2%, some type of foreign matter is probable to present in the oil. The foreign matter may consist of a mineral or similar hydrocarbon oil, wax or fat, spermaceti of rosin oil etc. Low U.S.M. value of the oil indicates that low content of foreign matter is present in it.

The titre value of an oil or fat is the solidifying point of the mixed fatty acids. The titre temperature is a value for characterizing oils or fats and assuming the hardness. Titre value of the melon seed oil was found to be 29 (30 °C).

The Thiocyanogen value of the oil sample was found to be 68 which is supported by Iodine value and peroxide value.

The Kirshner value of the oil sample was found to be 0.59.

3.3 ANTIBACTERIAL TEST

The antibacterial activities of the sample were studied against two gram positive and two gram negative bacteria by standard method and the results shown in Table-3. It is evident from the table that the oil sample was found to be active against all test bacteria. Highest inhibition zone (19 mm) was observed against *Salmonella typhi* for the 10% oil solution.

3.4 ANTIFUNGAL TEST

The antifungal activities of the melon seed oil were studied against four fungi and the results shown in Table-4. The oil sample was not active against the mycelia growth of *Curvularia lunata*. Except this the mycelia growth of all test fungi was inhibited by the oil sample. Highest inhibition zone (29.03 mm) was observed against *Aspergillus funiculosus* for the 10% oil solution.

3.5 ESTIMATION OF N, P, K, AND CA IN DE-OILED SEED CAKE OF MELON SEED

The people of our country have been suffering to a lot extent from protein malnutrition. From Table 5, it is proved that melon seed oil contains 2.436% of nitrogen which is well balanced in respect of essential amino acids. The percentage of phosphorus (2.974%) indicates that phospholipid may present in the oil sample. The percentage of potassium (1.17%) in the oil sample may be helpful to increase blood pressure of the people having low blood pressure. The percentage of calcium (1.432%) may help formation of rigid bone structure of the growing childs.

3.6 THIN-LAYER CHROMATOGRAPHIC (TLC) EXAMINATION OF THE MELON SEED OIL

The fatty acid methyl esters mixture obtained from the melon seed oil was subjected to TLC examination and their fatty acid composition was identified by comparing the results with the R_f values of methyl esters of standard fatty acids as reported (Table-6) in different solvent systems. It was found from the chromatograms of the oil sample that the oil gave about four to five spots. Among the spots, four spots were identified as palmitic acid, stearic acid, linoleic acid and oleic acid in the oil sample.

Table - 1: Physical properties of some important commercial oils and melon seed oil

Name of the oils	Sp. gr. at 15.5 °C	R. I. at 15.5 °C	Viscosity in m. p.	Activation energy in kcal/mole
Linseed oil	0.931-0.938	1.4479-1.48	296.0841	--
Cotton seed oil	0.912-0.922	1.4743-1.48	358.4261 at 30°C	--
Olive oil	0.915-0.919	1.4657-1.4667	466.8129	--
Sunflower oil	0.924-0.926	1.4659	331.1249 at 30°C	--
Soyabean oil	0.922-0.920	1.4723-1.4756	248-98	--
Coconut oil	0.926	1.4530	297.90	--
Tung oil	0.939-0.945	1.515-1.52	--	4.132
Castor oil	0.9561 at 27°C	1.4761	293.42	--
Palm oil	0.837	1.4510	309.24	--
Mehagini oil	0.9334 at 30°C	1.4751 at 30°C	459.32 at 30°C	3.047
Corn oil	0.921-0.938	1.4733	--	3.147
Neem seed oil	0.9192 at 30°C	1.4623 at 30°C	360.0024 at 30°C	--
Melon seed oil	**0.9310 at 30 °C**	**1.4712 at 30 °C**	**360.24 at 30 °C**	**3.532**

R. I. = Refractive index. Sp. gr. = Specific gravity. "-"= data not available.

Table-2. Chemical constants of some important commercial oils and melon seed oil.

Name of the sample	S.V.	S.E.V.	A.V.	F.F.A. (%) (as oleic)	I.V.	T.V.	Acetyl Value	Titre Value ValueºC	U.S.M. (%)	R.M.V.	P.V.	H.V.	Peroxide Value meq/kg	K.V.
Olive oil	190-195	287-295	0.6-1.5	0.25-0.60	80-88	75-83	10.04	17.26	0.5-1.5	0.6-1.5	0.5	0.6	----	----
Sunflower oil	190-194	287-295	0.6-2.4	0.15-0.45	125-140	78.4-81.3	----	17	0.3-0.9	0.5	----	----	----	----
Cotton seed oil	192-198	283-292	1.0-5.0	0.4-0.9	103-111	61-69	0.7-12.2	30.37	0.8-1.8	0.95	----	94.6	----	----
Linseed oil	189-195	287-296	4.0	0.5-0.75	175-200	----	----	----	1.0-1.5	----	----	94.8	----	----
Soyabean oil	190-195	287-295	1.27-1.54	0.35-0.85	129-137	77-85	----	22-27	0.7-1.6	0.5-2.5	0.2-1.0	----	----	----
Coconut oil	255-260	210-250	2.5-10.0	----	8.2-9.6	6.1-7.0	----	20-24	0.15-0.7	7.0-8.0	15-17	82	----	----
Palm oil	248	220-250	----	----	15-18	----	----	----	----	28	----	94.2	----	----
Melon seed oil	**187.46**	**299.26**	**0.812**	**0.408**	**125.97**	**68**	**3.87**	**29**	**0.6021**	**0.43**	**0.91**	**86.21**	**81.36**	**0.59**

S.V. = Saponification value. T.V. = Thiocyanogen value. S.E.V. = Saponification equivalent value.
U.S.M. = Unsaponifiable mater. A.V. = Acid value. R.M.V. = Reichert-Meissel value
F.F.A. = Free fatty acid value. P.V. = Polenske value. I.V. = Iodine value. H.V = Henher value.
K.V. = Kirschner value. " –" = data not available.

Table-3: Antibacterial activity of melon seed oil

Name of the bacteria	Diameter of inhibition zone in mm		
	Oil soaked in chloroform	1% oil sample	10% oil sample
Escherichia coli	17	14	17
Salmonella typhi	18	16	19
Staphylococcus aureus	13	10	12
Bacillus cereus	12	9	11

Table-4: Antifungal activity of melon seed oil

Name of the fungi	Radial growth inhibition (mm)	
	1% oil sample	10% oil sample
Aspergillus funiculosus	27.42	29.03
Fusarium equiseti	12.16	13.75
Curvularia lunata	-20.46	-22.33
Alternaria alternata	12.41	15.31

(-) means no inhibition.

Table-5: Percentage of minerals of melon de-oiled seed cake.

Name of the de-oiled seed cake	Nitrogen (%)	Phosphorus (%)	Calcium (%)	Potassium (%)
Melon seed	2.436	2.974	1.423	1.17

Table-6: The R_f values of thin-layer chromatographic examination of the melon seed oil.

Solvent System	R_f values of standard fatty acids				R_f values obtained from the spots of oil sample			
	PA	SA	LA	OA	PA	SA	LA	OA
P:E (80:20)	0.941	0.943	0.933	0.287	0.943	0.939	0.896	0.284
P:E:A (80:20:1)	0.822	0.839	0.893	0.415	0.819	0.835	0.723	0.454
H:E (80:20)	0.823	0.812	0.641	0.201	0.757	0.745	0.638	0.203

PA- Palmatic acid, SA- Stearic acid, LA- Linoleic acid, OA- Oleic acid.

4 CONCLUSION

Physico-chemical characterization and microbial studies of melon seed oil indicates that it consists of moderate amount of unsaturated fatty acid which can be used in edible purpose. Present research demonstrates the potential of the cultivation of melon seed for edible and industrial use. Presence of foreign matters such as sterols, tocopherols, vitamins A and D, is considered with respect to U.S.M % and low hydroxyl group content was confined by acetyl value of the sample. From antibacterial studies we can conclude that this work will provide valuable information about the prospect of derivation of antibiotics, pesticides and pharmaceuticals components from the seed oil of melon with further research. De-oiled seed cake of melon seed contains significant amounts of minerals (N, P, K and Ca).

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Find Real Time Passenger Information using Intelligent Transportation System (ITS)

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ABSTRACT: Intelligent Transportation System (ITS) will cover core systems such as Vehicle Tracking System, Real Time Passenger Information System and Central Control Station. Core technologies include Geographical Positioning System (GPS), Electronic Display Systems, and Information & Communication Technologies. ITS Solutions worldwide has been prominent in the development of efficient, transparent and environmental friendly public Transport solutions resulting in growth of economies and transport. Public transport generally occupies less road space and causes less pollution per passenger-km than personalized vehicles. Public transport is a more sustainable form of transport. Hence, local authorities should promote investments in public transport and make its use more attractive than personalized vehicles. With ITS improving the efficiency and management of transport across city, improved training and two way communication capability between driver and operations staff it is expected to reduce accidents with the use of incident management facility in ITS.

KEYWORDS: ITS, Vehicle Tracking System, GPS and Electronic Display System.

1 INTRODUCTION

Interest in Intelligent Transportation System (**ITS**) comes from the problems caused by traffic congestion and a synergy of new information technology for simulation, real-time control, and communications networks [**1**]. Traffic congestion has been increasing worldwide as a result of increased motorization, urbanization, population growth, and changes in population density. Congestion reduces efficiency of transportation infrastructure and increases travel time, air pollution, and fuel consumption.

The United States, for example [**2**], saw large increases in both motorization and urbanization starting in the 1920s that led to migration of the population from the sparsely populated rural areas and the densely packed urban areas into suburbs. The industrial economy replaced the agricultural economy, leading the population to move from rural locations into urban centers. At the same time, motorization was causing cities to expand because motorized transportation could not support the population density that the existing mass transit systems could. Suburbs provided a reasonable compromise between population density and access to a wide variety of employment, goods, and services that were available in the more densely populated urban centers. Further, suburban infrastructure could be built quickly, supporting a rapid transition from a rural/agricultural economy to an industrial/urban economy. Recent governmental activity in the area of ITS, specifically in the United States is further motivated by the perceived need for homeland security. Many of the proposed ITS systems also involve surveillance of the roadways, which is a priority of homeland security. Funding of many systems comes either directly through homeland security organizations or with their approval. Further, ITS can play a role in the rapid mass evacuation of people in urban centers after large casualty events such as a result of a natural disaster or threat. Much of the infrastructure and planning involved with ITS parallels the need for homeland security systems.

2 BACKGROUND

In the developing world [**3**], the migration of people from rural to urbanized habitats has progressed differently. Many areas of the developing world have urbanized without significant motorization and the formation of suburbs. In areas like Santiago, Chile, a high population density is supported by a multimodal system of walking, bicycle transportation, motorcycles, buses, and trains. A small portion of the population can afford automobiles, but the automobiles greatly increase the congestion in these multimodal transportation systems. They also produce a considerable amount of air pollution, pose a significant safety risk, and exacerbate feelings of inequities in the society. Other parts of the developing world, such as China, remain largely rural but are rapidly urbanizing and industrializing. In these areas a motorized infrastructure is being developed alongside motorization of the population. Great disparity of wealth means that only a fraction of the population can motorize, and therefore the highly dense multimodal transportation system for the poor is cross-cut by the highly motorized transportation system for the rich.[**4**] The urban infrastructure is being rapidly developed, providing an opportunity to build new systems that incorporate ITS at early stages.

3 AIMS AND OBJECTIVES OF THE THESIS:

AIMS

In the present age of modern technology, every single system is converting into computer automated systems due to it's a lot of benefited features. The main aim of the thesis is to develop software for the automation of Intelligent Transportation System instead of present manual system. This automated system ensures appropriate computerized mechanism with proper security to store data.

OBJECTIVES

The objective of this system is to introduce with the idea of feasibility study of a problem domain of a system. These are:

a. Understand the necessity of automation.
b. Be aware of drawbacks of the manual system.
c. Know the whole overview of the present and proposed Intelligent Transportation System.

4 PROCESS

My thesis working flow will revolute according to the steps of advanced Software Development Life Cycle (**SDLC**) which is stated at background point. To solve our problem domain and its sub problems, we have to at first perfectly study the problem and find its requirements. Depending on customer's requirements, we have to decide through which technique we will solve it. For this feasibility study is compulsory. The more efficient feasibility study, the more efficient, reliable and convenient software will produce.

My problem domain is automation of Intelligent Transportation System. To find a feasible solution we fix all the sub problems within it. According to solution we evaluate/analyze and take decision.

Through this feasibility study, I have determined with strong arguments that automation of Intelligent Transportation System is better than that of manual system. The feasible solutions of the present problems of the thesis are best and these will work efficiently to implement automated software for the transport. The solutions are considered as feasible depending on some software essential attributes- cost, maintainability, dependability, efficiency, usability and time preservations.

5 METHODOLOGY

Software is a complex artifact created by human being. The entire complex being is produced in a step-by-step procedure, which is called methodology for that artifact. Therefore, methodology is needed for software in order to build it with consistency.

Generally methods are techniques that used to perform some objective. It provides Techniques and tools for developing a software system. So methodology is required to develop our Intelligent Transportation System software. The software Development Life Cycle (SDLC) methodology is appropriate for developing Intelligent Transportation System software. Here we show an advanced Software Development Life Cycle system in **Fig. 1.**

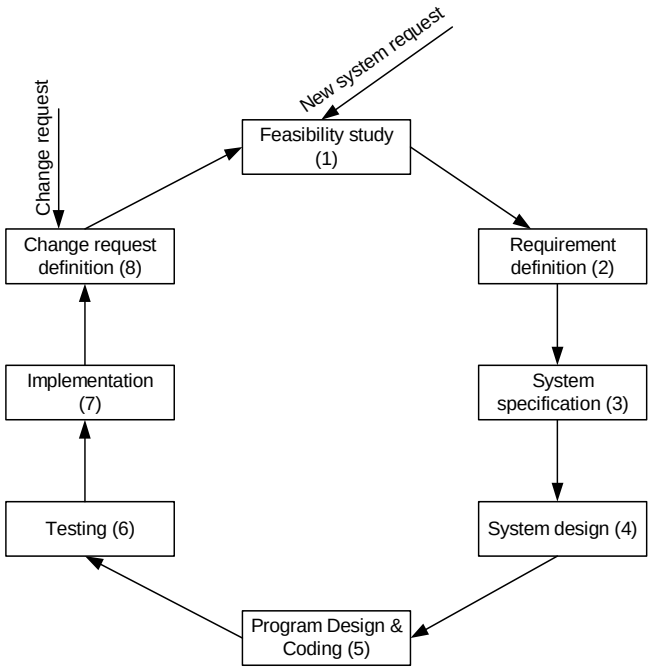

Fig. 1. Advanced Software Development Life Cycle system (SDLC)

5.1 SOFTWARE DEVELOPMENT LIFE CYCLE

My thesis working flow will revolute according to the steps of advanced software development Life Cycle (**SDLC**) which is stated at background point. To solve our problem domain and its sub problems, we have to at first perfectly study the problem and find its requirements. Depending on customer's requirements, we have to decide through which technique we will solve it. For this feasibility study is compulsory. The more efficient feasibility study, the more efficient, reliable and convenient software will produce.

6 INTELLIGENT TRANSPORTATION APPLICATIONS

6.1 ELECTRONIC TOLL COLLECTION

Electronic toll collection (ETC) makes it possible for vehicles to drive through toll gates at traffic speed, reducing congestion at toll plazas and automating toll collection. Originally ETC systems were used to automate toll collection, but more recent innovations have used ETC to enforce congestion pricing through cordon zones in city centers and ETC lanes.

6.2 EMERGENCY VEHICLE NOTIFICATION SYSTEMS

The in-vehicle eCall is an emergency call generated either manually by the vehicle occupants or automatically via activation of in-vehicle sensors after an accident. When activated, the in-vehicle eCall device will establish an emergency call carrying both voice and data directly to the nearest emergency point (normally the nearest E1-1-2 Public-safety answering point, PSAP). The voice call enables the vehicle occupant to communicate with the trained eCall operator. At the same time, a minimum set of data will be sent to the eCall operator receiving the voice call.

6.3 CORDON ZONES WITH CONGESTION PRICING

Cordon zones have been implemented in Singapore, Stockholm, and London, where a congestion charge or fee is collected from vehicles entering a congested city center. This fee or toll is charged automatically using electronic toll collection or automatic number plate recognition, since stopping the users at conventional toll booths would cause long queues, long delays, and even gridlock. The main objective of this charge is to reduce traffic congestion within the cordon area.

6.4 AUTOMATIC ROAD ENFORCEMENT

A traffic enforcement camera system, consisting of a camera and a vehicle-monitoring device, is used to detect and identify vehicles disobeying a speed limit or some other road legal requirement and automatically ticket offenders based on the license plate number [**5**]. Traffic tickets are sent by mail. Applications include:

- Speed cameras that identify vehicles traveling over the legal speed limit. Many such devices use radar to detect a vehicle's speed or electromagnetic loops buried in each lane of the road.
- Red light cameras that detect vehicles that cross a stop line or designated stopping place while a red traffic light is showing.
- Bus lane cameras that identify vehicles traveling in lanes reserved for buses. In some jurisdictions, bus lanes can also be used by taxis or vehicles engaged in car pooling.
- Level crossing cameras that identify vehicles crossing railways at grade illegally.
- Double white line cameras that identify vehicles crossing these lines.
- High-occupancy vehicle lane cameras for that identify vehicles violating HOV requirements.
- Turn cameras at intersections where specific turns are prohibited on red. This type of camera is mostly used in cities or heavy populated areas.

6.5 COLLISION AVOIDANCE SYSTEM

Japan has installed sensors on its highways to notify motorists that a car is stalled ahead. **[7]** The Collision Avoidance System prevents collisions between vehicles and vehicular collisions with pedestrians, trains, and stationary objects by monitoring, controlling, documenting, and reporting the speed and position of vehicles. The system guards against speeding violations, moving violations, and particular safety hazards by invoking a reduction of vehicle speed or by restricting vehicle movement to control its position. This is primarily accomplished with the activation of a controllable road perturbation. A computer is used to determine if the vehicles are adhering to the traffic laws or other safety concerns. Alarms may accompany the system output to inform the operator what must be done to prevent a collision.

6.6 DYNAMIC TRAFFIC LIGHT SEQUENCE

Intelligent RFID traffic control has been developed for dynamic traffic light sequence. It has circumvented or avoided the problems that usually arise with systems such as those, which use image processing and beam interruption techniques. [**6**] RFID technology with appropriate algorithm and database were applied to a multi vehicle, multi lane and multi road junction area to provide an efficient time management scheme. A dynamic time schedule was worked out for the passage of each column. The simulation has shown that, the dynamic sequence algorithm has the ability to intelligently adjust itself even with the presence of some extreme cases. The real time operation of the system able to emulate the judgment of a traffic policeman on duty, by considering the number of vehicles in each column and the routing proprieties.

7 CONCLUSION

The term **Intelligent Transportation System** (ITS) refers to efforts to add information and communications technology to transport infrastructure and vehicles in an effort to manage factors that typically are at odds with each other, such as vehicles, loads, and routes to improve safety and reduce vehicle wear, transportation times, and fuel consumption. I will try my best to automate manual **Intelligent Transportation System** (ITS). Due to my several limitations some features are not focused perfectly. I am still working for this thesis. In future I must recover my leakages. Finally I want to say I try to best and work hard to develop this software. I implement the knowledge which i learned when study about software.

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BIOGRAPHY

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I was born and grew up in Bangladesh. I am a recent graduate of the department of Computer Science and Engineering at the University of Chittagong, Bangladesh. I joined as a Lecturer in Computer Science and Engineering department at Sylhet Agricultural University, Bangladesh. I am a believer in life-long learning and I am passionate about the natural language processing, semantic knowledge base, compiler design, operating system and bioinformatics.

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Design of FFT Processor using Modified Modulo 2^n+1 Adder

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ABSTRACT: In this paper we present two different architectures for modulo 2^n+1 adder and by using this an efficient FFT computation is performed. One of the architecture is based on a sparse carry computation unit in which only some of the carries are computed. In this an inverted circular idempotency property of the parallel prefix carry operator is used and its efficiency is increased by a new prefix operator. The resulting adders will be having less area and power. The second architecture is derived by modifying modulo 2^n-1 adders with minor hardware overhead. By using this adder we can implement FFT processor with improved performance.

KEYWORDS: Parallel prefix carry computation, Modulo addition, Diminished-1 addition, inverted circular idempotency, IEAC adder.

1 INTRODUCTION

Very Large Scale Integration (VLSI) has made a dramatic impact on the growth of integrated circuit technology. The positive improvements have resulted in significant performance/cost advantages in VLSI systems. As we know, to human decimal numbers are easy to implement for performing arithmetic operations. Binary adders are one of the most essential logic elements in a digital system. Therefore, binary addition is essential and any improvement in binary addition can result in improved performance of the system. The major problem for binary addition is the carry chain. As the width of the input operand increases, the length of the carry chain increases. In this paper two architectures for modulo addition is designed and is verified using Xilinx. The main goal is to improve the performance of the system in terms of area, speed, power etc. Using this a modified FFT processor is also designed using the above modified modulo adders.

The concept of the modulo 2^n+ 1 adder is based on an inverted end around carry(IEAC) n- bit adder which is an adder that accepts two n-bit operands and provides a sum increased by one compared to their integer sum if their integer addition does not result in a carry output. Since the carry output depends on the carry input, a direct connection between input and output forms a combinational loop which leads to an unwanted race condition .To avoid this Zimmermann [2],[3] proposed IEAC adders that make use of a parallel-prefix carry computation unit along with an extra prefix level that handles the inverted end-around carry.

In [4] it is explained that the recirculation of the inverted end around carry can be performed within the existing prefix levels, that is, in parallel with the carries' computation. In this way, the need of the extra prefix level is canceled and parallel-prefix IEAC adders are derived that can operate fast with a logic depth of $\log_2 N$ prefix levels. Since this requires more area than [2], [3] a double parallel-prefix computation tree is required in several levels of the carry computation unit. Select-prefix and circular carry select IEAC adders proposed in [5], [6] has less area but only less operating speed.

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A fast Fourier transform (FFT) is an algorithm to compute the discrete Fourier transform (DFT) and it's inverse. Fourier analysis converts time (or space) to frequency and vice versa, FFT rapidly computes such transformations by factorizing the DFT matrix . As a result, fast Fourier transforms are widely used for many applications in engineering, science, and mathematics. Here an efficient FFT algorithm is also implemented.

2 PARALLEL –PREFIX ADDERS

Generally parallel-prefix n-bit adder considered as a three stage circuit. They are pre-processing-stage, carry-computation-unit and post-processing-stage. Suppose that A =A_{n-1} .A_{n-2} . . ...A_0 and B =B_{n-1} .B_{n-2} . . …..B_0 represent the two numbers to be added and S =S_{n-1} S_{n-2} . . . S_0 denotes their sum. The preprocessing stage computes the carry-generate bits G_i, the carry-propagate bits Pi, and the half-sum bits H_i, for every i; 0 <= i <=n-1, according to

$$G_i = A_i . B_i : P_i = A_i + B_i : H_i = A_i \text{ xor } B_i$$

Where . , +, and xor denote logical AND, OR, and exclusive OR, respectively. The second stage of the adder called the carry computation unit, computes the carry signals C_i, for 0 <=i <=n -1 using the carry generate and carry propagate bits G_i and P_i. The third stage computes the sum bits according to

$$S_i = H_i \text{ xor } C_{i-1}$$

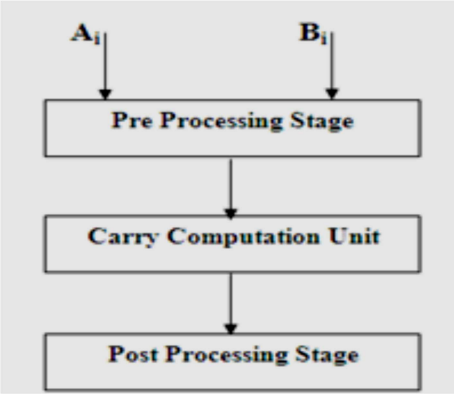


Fig. 1. Parallel prefix addition basics

2.1 PRE-PROCESSING STAGE

The preprocessing stage computes the carry-generate bits G_i, the carry-propagate bits Pi, and the half-sum bits H_i, for every i; 0 <= i <=n-1, according to

$$G_i = A_i . B_i : P_i = A_i + B_i : H_i = A_i \text{ xor } B_i$$

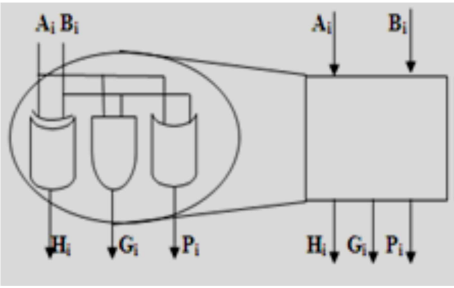


Fig.2. Pre processing stage

2.2 CARRY COMPUTATION UNIT

The second stage of the adder called the carry computation unit, computes the carry signals C_i, for 0<=i <=n -1 using the carry generate and carry propagate bits G_i and P_i. The third stage computes the sum bits according to

$$S_i=H_i \text{ xor } C_{i-1}$$

Carry computation is done by using an operator called parallel prefix operator i.e, 'dot' operator, which associates pairs of generate and propagate signals and is defined as

$$(G,P)o(G',P')=(G+P.G',P.P').$$

In a series of associations of consecutive generate/propagate pairs(G,P), the notation ($G_{k:J}$; $P_{k:J}$), with k > J, is used to denote the group generate/propagate term produced out of bits k; k -1; . . ; J.

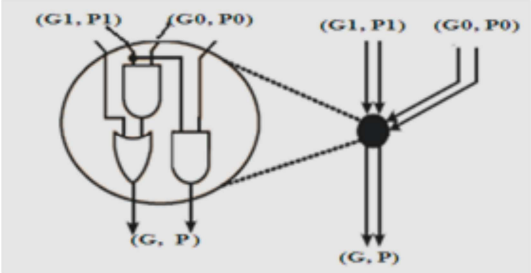


Fig.3. Carry computation unit

2.3 POST PROCESSING STAGE

The third stage computes the sum bits according to

$$S_i=H_i \text{ xor } C_{i-1}$$

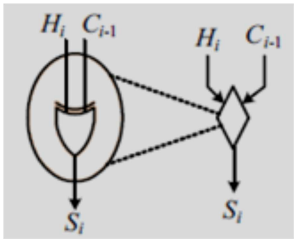


Fig.4. Post processing stage

Based on these concepts three types of parallel prefix adders are designed.

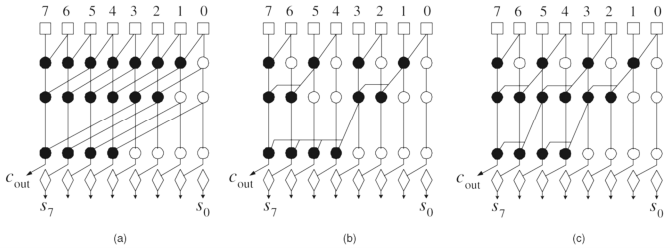


Fig.5. Examples of 8-bit parallel-prefix adders. (a) Kogge-Stone [7], (b) Ladner-Fischer [8] and (c) Knowles [9] family of adders

3 MODULO 2^N±1 ADDERS

3.1 MODULO 2^N–1 ADDERS

The modulo 2^n- 1 addition is defined as

$$(A+B) \bmod (2^n-1) = \begin{cases} (A+B) & , (A+B)<2^n \\ (A+B+1) \bmod (2^n) & , (A+B)\geq 2^n \end{cases} \quad (1)$$

A modulo $2^n - 1$ adder can be implemented using an integer adder that increments also its sum when the carry output is one. (when $A + B \geq 2^n$). The conditional increment can be implemented by an additional carry increment stage as shown in fig. 6. In this case, one extra level of '•' cells driven by the carry output of the adder, is required. When $A + B = 2^n + 1$, the adder may produce an all 1s output vector, in place of zero. In most applications, this is the second representation for zero.

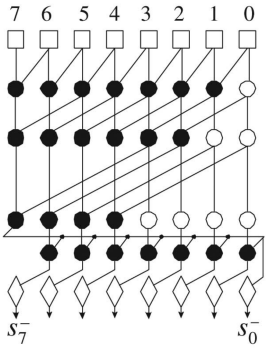


Fig .6. Parallel prefix modulo 2^8 -1 adder

The implementation of a modulo $2^n - 1$ adder requires the connection of the carry output $C_{n-1} = G_{n-1:0}$ of an integer adder to its carry-input port. The carries of the modulo $2^n - 1$ adder is given by $C_i^- = G_{i:0} + P_{i:0} . C_{in}$. Therefore, connecting the carry output to the carry input leads to $C_i^- = G_{i:0} + P_{i:0} . G_{n-1:0}$. This relation can be simplified to

$$C_i^- = G_{i:0} + P_{i:0} . G_{n-1:i+1} \quad (2)$$

The simpler equation can be equivalently expressed using the ◦ operator as follows

$$C_i^- = (G_i, P_i) \circ \ldots (G_0, P_0) \circ (G_{n-1}, P_{n-1}) \circ \ldots \circ (G_{i+1}, P_{i+1}) \quad (3)$$

The above equation (3) that computes the modulo $2^n - 1$ carries has a cyclic form and the number of generate and propagate pairs (G_i, P_i) associated for each carry is n. This means that the parallel-prefix carry computation unit of a modulo 2^n -1 adder has significantly increased area complexity than that of a corresponding integer adder. In terms of delay, the carries C- can be computed in $\log_2$ n levels using regular parallel-prefix structures using end around technique. The final sum bits

S_i^- are equal to Hi xor C_{i-1}^-.

3.2 MODULO 2^N+1 ADDERS

- First method

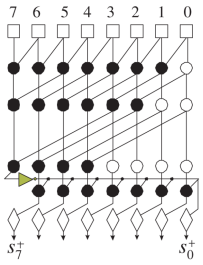


Fig .7. Parallel prefix modulo 2^8 +1 adders

First method is obtained by giving slight modification to modulo 2^n-1 adders. Similar to modulo 2^n-1 case, the carry C_i^+ at the i^{th} bit position of an IEAC adder, when feeding the carry input $C_{in} = C_{-1}^+$ with the inverted carry out $\overline{Cn-1} = \overline{Gn-1:0}$ can be computed as

$$C_i^+ = G_{i:0} + P_{i:0} \,.\, \overline{Gn-1:i+1}$$

Which is expressed as

$$C_i^+ = (G_i, P_i) \circ \ldots (G_0, P_0) \circ \overline{(Gn-1, Pn-1)\ o \ldots o\ (Gi+1, Pi+1)}$$

where $(\overline{g,p})$ is equal to $\overline{(g,p)}$, and the final sum bits are equal to H_i xor C_{i-1}^+.

- Second method

In this section, we focus on the design of diminished-1 modulo adders with a sparse parallel-prefix carry computation stage [1] that can use the same carry-select blocks as the sparse integer adders. The sum of a diminished-1 modulo adder is derived according to the following cases:

1. When none of the input operands is zero their number parts A* and B* are added modulo 2^n+1.
2. When one of the two inputs is zero the result is equal to the nonzero operand.
3. When both operands are zero, the result is zero.

So a true modulo addition in a diminished-1 adder is needed only in case 1, while in the other cases the sum is known in advance. The result is given as

$$S^+ = (A^*+B^*) \bmod (2^n+1) = \begin{cases} (A^*+B^*+1) \bmod 2^n & , A^*+B^* < 2^n \\ (A^*+B^*) \bmod 2^n & , A^*+B^* \geq 2^n \end{cases}$$

Based on [1] different architectures for modulo 2^{16}+1adders are designed .According to the inverted circular idempotency property

$$\begin{aligned}(G_{i:0}, P_{i:0}) \circ \overline{(Gn-1:i+1, Pn-1:i+1)o(Gi:0, Pi:0)} \\ = (G_{i:0}, P_{i:0}) \circ \overline{(Gn-1:i+1, Pn-1:i+1)}\end{aligned} \quad (4)$$

With $\overline{(G,P)} = (\bar{G}, P)$.

Figure (8) shows sparse-4 modulo 2^{16}+1 adders (a)using doubled up operators and (b) using the sparse approach which is enabled by the inverted circular idem potency property. In first case the computation can be performed within $\log_2 N$ logic levels. Here some prefix operators are doubled up, since two carry computations need to be performed in parallel; one on normal propagate and generate signals, while the other on their complements. Although the sparse version of the parallel-prefix adders has a lot of regularity and the area-overhead problem there is still a lot of space for improvement.

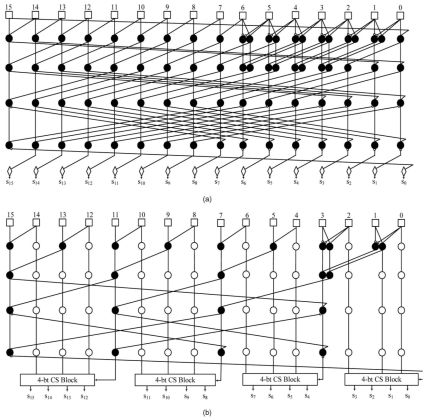


Fig.8. Modulo 2^{16} + 1 diminished-1 adders (a) existing and (b) using a sparse carry computation unit

To avoid this problem a new prefix operator called gray operator is introduced. Gray operator accepts five inputs and produces four outputs. Three of the inputs of a gray operator residing at prefix level j -1, namely, G^{j-1} v, P^{j-1} v and $T^{j-1}{}_{V}$ form the operator's vertical input bus, the rest two $G^{j-1}{}_{L}$ and $P^{j-1}{}_{L}$ form its lateral input bus. The lateral bus signals are driven inverted to the operator. The gray operator produces three signals for its vertical successor of level j ($G^{j}{}_{V}$; $P^{j}{}_{V}$ and $T^{j}{}_{V}$) and one (c_j) for its lateral successor. Compared to the 'o' prefix operator, the gray operator requires one extra gate but no extra logic levels.

Based on [1], by using gray operator,

1. Doubled up operators that associate inverted signals can be removed,
2. We can replace the top operator of every column excluding the leftmost that accepts a feedback signal with a gray operator, where T_V input is tied to zero
3. Replace every vertical successor of a gray operator in the previous step with a gray one.

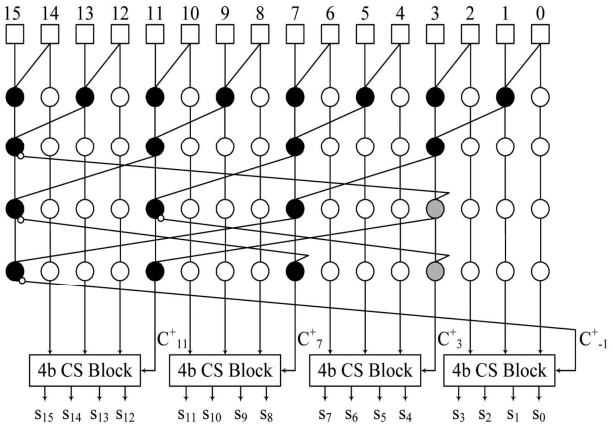


Fig.9. Proposed [1] sparse-4 modulo 2^{16} +1 diminished-1 adder.

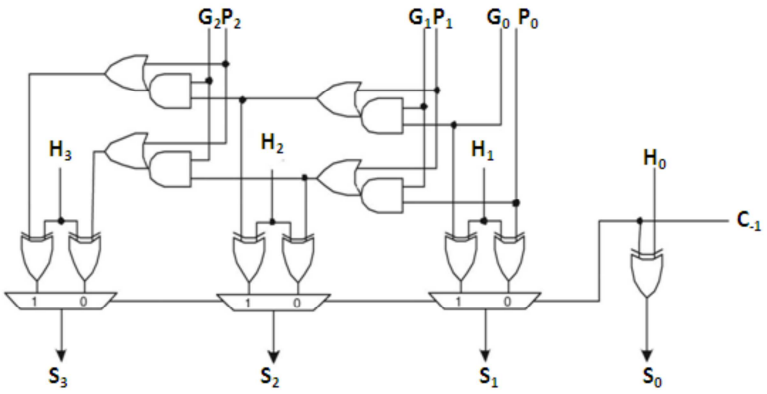


Fig.10. Design of a 4-bit Carry Select Block

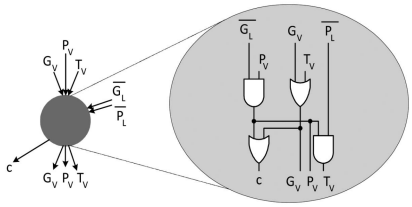


Fig.11. Design of a gray operator

By using this proposed sparse-4 modulo Diminished-1 adder an efficient radix-2 FFT algorithm is also implemented. A fast Fourier transform (FFT) is an algorithm to compute the discrete Fourier transform (DFT) and it's inverse. Fourier analysis converts time (or space) to frequency and vice versa; an FFT rapidly computes such transformations by factorizing the DFT matrix into a product of sparse (mostly zero) factors.

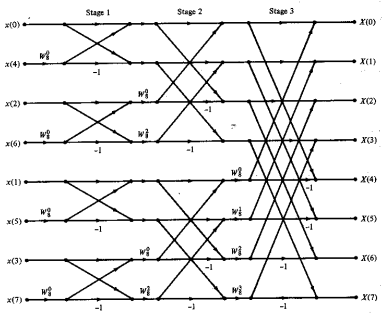


Fig.12. 8-point DFT FFT algorithm

Let us consider the computation of the $N = 2^v$ point DFT. We split the N-point data sequence into two $N/2$-point data sequences $f_1(n)$ and $f_2(n)$, corresponding to the even-numbered and odd-numbered samples of $x(n)$,that is,

$$F1(n)=x(2n)$$

$$F2(n)=x(2n+1), \quad n=0,1,.....N/2 -1$$

Now the N-point DFT can be expressed in terms of the DFT's of the decimated sequences as follows

$$X(k) = \sum_{n=0}^{N-1} x(n) W_N^{kn}, \qquad k = 0,1,\ldots, N-1$$
$$= \sum_{n \text{ even}} x(n) W_N^{kn} + \sum_{n \text{ odd}} x(n) W_N^{kn}$$
$$= \sum_{m=0}^{(N/2)-1} x(2m) W_N^{2mk} + \sum_{m=0}^{(N/2)-1} x(2m+1) W_N^{k(2m+1)}$$

Hence the sequence X(k) will be obtained. Here we are considering the 8-point dft using the modified modulo 2^n+1 adder. The Inputs are given in parallel. The advantage of using this is power and area reduction. But the hardware requirement is high. So in order to reduce this pipelining concept is introduced in which the critical path is reduced by placing delay elements between the registers. It also helps to increase the speed.

4 RESULT ANALYSIS

The simulation is performed using XILINX in verilog HDL. The figure below shows the experimental results after the simulation.

Table 1. Experimental Results for Parallel Prefix Adders

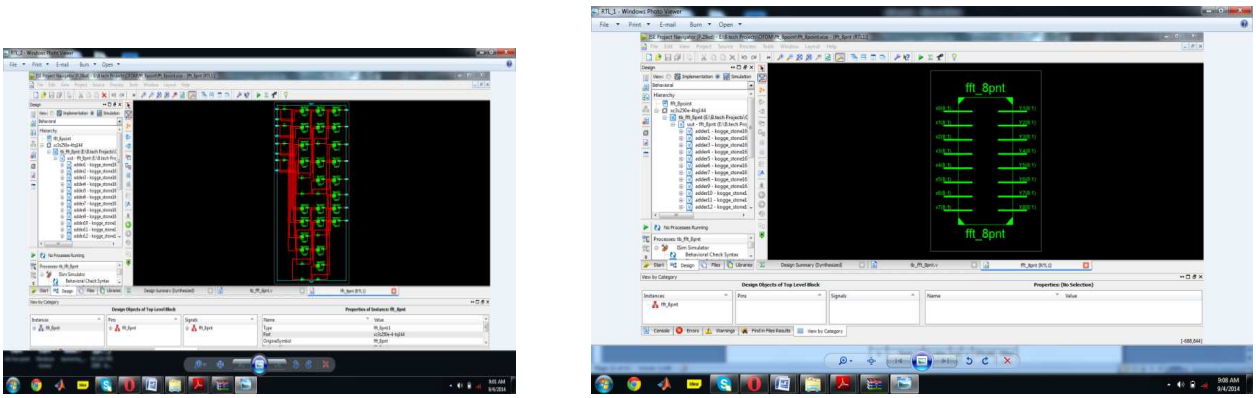
	Koggestone adder	Ladner-fischer adder	Knowles adder
Delay(ns)	2.951	2.396	13.572
Memory Usage(kb)	316132	317092	199496
Power(mw)	0.067	0.066	0.52

Table 2. Experimental Results for modulo 2^{16}+ 1 adders

	Existing modulo 2^{16}+1 adder	Modulo 2^{16}+ 1 adder using sparse carry computation	Proposed sparse-4 modulo 2^{16} +1 diminished-1 adder
Delay(ns)	4.387	3.868	3.301
Memory Usage(kb)	318372	234916	144816
Power(mw)	0.068	0.066	0.042

4.1 RTL SCHEMATIC OF 8-POINT FFT PROCESSOR

Here 8 inputs are given and correspondingly there will be 8 outputs also. Corresponding RTL schematic is given below.



(a) (b)

Fig.13. RTL schematic

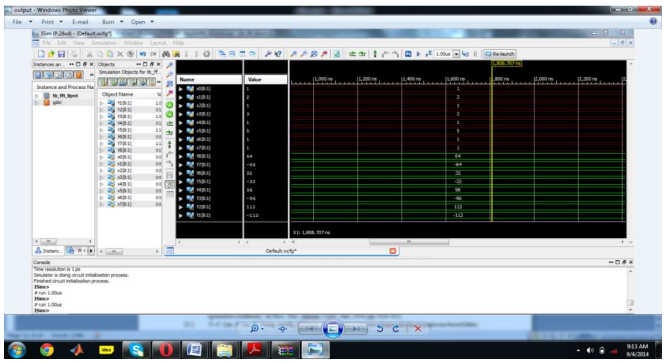


Fig .14. output waveform

5 CONCLUSION

In this paper, two modified power efficient modulo $2^n + 1$ adders are presented. A novel architecture has been proposed that uses the inverted circular idempotency property of the parallel-prefix carry operator in modulo 2^n+1 addition and by introducing a new prefix operator that eliminates the need for a double computation tree in the earlier fastest proposals. The experimental results indicate that the proposed architecture heavily outperforms the earlier solutions. Also an efficient 8-point FFT is designed using the modified modulo adders which has performance advantages in terms of power and area.

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Detection of Splicing in Digital Images Based on Illuminant Features

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ABSTRACT: Nowadays digital images are widely used in our day to day life. Image forgery is the process of manipulation of an image to hide some meaningful information of the image. Today digital image forgery become easy due to the availiability of powerful computers, advanced photo editing softwares so that even ordinary users have more access to the digital doctoring tools than even before. The driving forces for the detection of forgered images are the need of authenticity and to maintain the integrity of the image. In this paper an automatic machine learning method for detecting the forgery due to image composition or splicing is considered. Here GLCM features and edge based features are extracted from the illuminant map of an image and 'then provide to a machine learning approach for obtaining the result. Here we use kNN classifier for classifying the image as whether it is original or forgered.

KEYWORDS: Edge detection, GLCM features, illuminant estimator, image splicing detection, kNN classifier, machine learning

1 INTRODUCTION

Today digital images are everywhere from our mobile phones to the online sites. This means a huge amount of visual information is available to the users everyday. With the availiability of low cost digital cameras, high speed internet facilities as well as powerful image editing softwares it is very easy to tamper the images without having a brilliant knowledge. It will badly affect the authenticity of the image. Therefore Digital Image Forensics is an emerging research area that aims at authenticating the images and to detect various image forgery possibilities.

Before thinking about the actions that is to be performed in an questionable image, one must be able to detect whether the image is manipulated or not [1].There are various techniques available for tampering decision.

There are various image manipulation techniques such as copy-move, splicing, retouching, steganography etc. Among these image composition or image splicing is the most common image manipulation technique. Image splicing is a technique in which two or more images are combined to create a false image. An example of image splicing is shown in figure 1.The manipulation performed in this figure is not a harmful one. But in certain cases this type of manipulation will create serious issues.

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Fig. 1. Example of a spliced image

The effective technique for splicing detection is illumination inconsistencies. There are various illuminant estimates to create an intermediate representation called illuminant map. It is hard to achieve proper adjustment of all the illuminant conditions. Create face pairs for each image and classify the illumination of each pair of faces as either consistent or inconsistent. If any of the face pair is classified as inconsistently illuminated, then tag the image as manipulated.

2 METHOD OVERVIEW

The method consist of five main components

- Dense Local Illuminant Estimation - The input image is segmented into regions of similar color. Estimate the illuminant color for each of the segment and recolor each of the segments with the estimated illuminant color. Then an intermediate representation called illuminant map.
- Face Extraction – Each of the faces in the input image is extracted. It can be done in automatic or semiautomatic method. Here semiautomatic face detection is used. Operator sets bounding boxes around each of the faces in the image under investigation and then crop bounding boxes out of each illuminant map.
- Estimation of Illuminant Features – For each face regions both texture based and edge based features are extracted. The texture features are computed using Gray Level Co-occurrence Matrix and edge features using HOGedge.
- Paired Feature Creation – Create all possible pair of faces in an image to check whether any one of the face pair is inconsistently illuminated. The joint feature vectors consisting of all possible face pairs is constructed.
- Classification – An automatic machine learning approach is used to classify the feature vectors. Here kNN classifier is used to classify each pair of faces as either consistently or inconsistently illuminated.

The block diagram representation of the method is shown in figure 2.

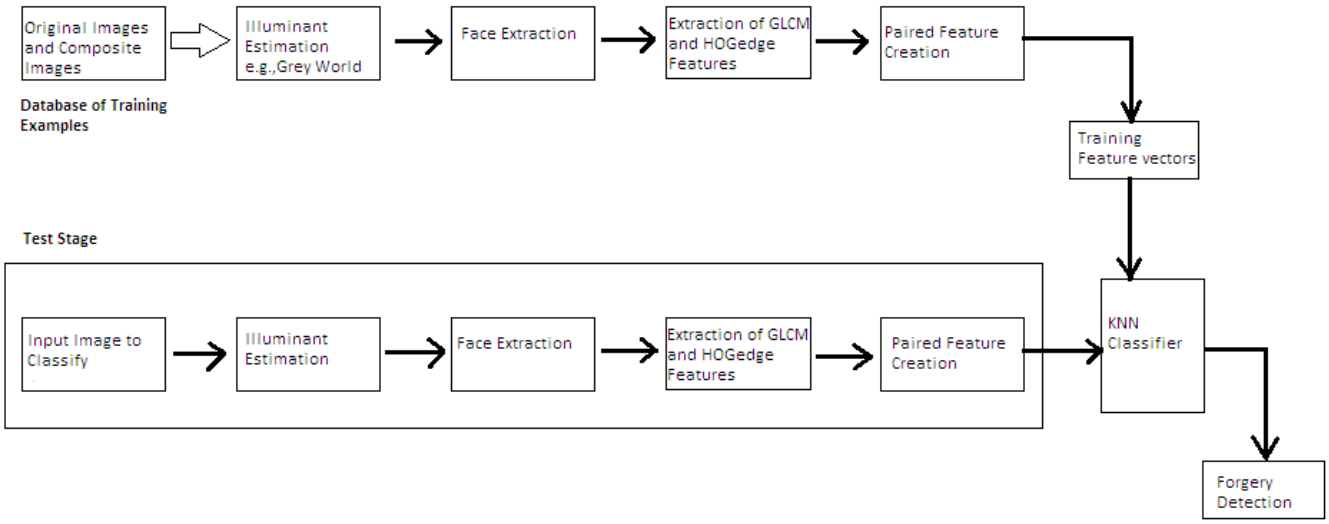

Fig. 2. Method Overview

3 METHOD DETAILS

3.1 DENSE LOCAL ILLUMINANT ESTIMATION

Dense local illuminant estimation is performed by subdividing the input image into superpixels [2].The illuminant color of each superpixel is estimated. Here we use generalized gray world illuminant estimator. In Gray world, the average color of scene is considered as gray. Any deviation from this assumption is due to the illuminant.

The color of the illuminant e is estimated as

$$ke^{n,p,\sigma} = \left(\int \left| \frac{\partial^n f^\sigma(x)}{\partial x^n} \right|^p dx \right)^{1/p}$$

Integration is performed over all the pixels in the image where x denote pixel co-ordinate, k is scaling factor, ð is differential operator, $f^\sigma(x)$ is the observed intensity at x and σ is the Gaussian kernel. Then recolor each of the superpixels with the estimated illuminant color.

3.2 FACE EXTRACTION

The illuminant color estimation is error prone and is affected by different materials in the scene. Local illuminant estimates are most discriminative when comparing objects of similar material. Therefore here consider the illuminant of each of the faces in the image [3].It can be performed either in automatic or semiautomatic method. Here semiautomatic face detection is used to avoid false detection of faces.

It is the only step where a human operator is required to draw bounding boxes around each of the faces in the image and crop the bounding boxes out of the illuminant map to obtain the illuminant estimates of only the face region.

3.3 EXTRACTION OF ILLUMINANT FEATURES

Feature extraction is a reduction process in which the input data is transformed into a reduced representation. This type of transformation of input data into a set of features is called feature extraction. Both texture based and edge based features are extracted from each of the faces in the image. Texture feature extraction is based on Grey Level Co-occurrence Matrix (GLCM) and edge information is provided by a new feature descriptor called HOGedge.

Extraction of texture information : The Grey Level Co-occurrence Matrix, GLCM also called Gray Tone Spatial Dependency Matrix gives information about the occurrence of different combinations of pixel brightness values in a gray scale image. That means GLCM calculates how a pixel with gray level value i occur horizontally, vertically or diagonally to a nearby pixel with value j [4].

Extraction of edge points : Edge points can be extracted using Canny Edge Detector [5].The statistics of these edges differ in original images and doctored images. These edge discontinuities are characterized by a feature descriptor called HOGedge.

At first extract equally distributed edge points and determine the HOG descriptor for each of the edge points. The computed HOG descriptors are summarized in a visual dictionary. The appearance and shape of objects in an image are determined from the distribution of edge directions. Firstly divide the image into small regions called cells and compute local 1-D histogram of each cell. The feature vectors are constructed by combining and contrast-normalizing the histogram of all cells within a spatially large region.

3.4 PAIRED FEATURE CREATION

In this step all the face pairs in the image are detected and feature vector of each of the face is concatenated with other face in the pair. The idea behind this is that feature concatenation from two faces is different when one face is original and the other is spliced. If an image contain n_f faces ($n_f \geq 2$), there are $(n_f(n_f-1))/2$ possible face pairs.

3.5 CLASSIFICATION

In this step illumination for each face pairs are classified as either consistent or inconsistent. If any of the face pair is illuminated inconsistently then tag the image as spliced one. Here classification is performed by k-Nearest Neighbor (kNN) classifier. The classification is machine learning based to improve the detection performance. The classifier stores all the training data and when a new data is given, the classifier look up its k nearest data points and label the new data to the set that contains majority of its k neighbours.

4 CONCLUSION

In this paper a new method for detecting the forgery in digital images using illuminant color estimator has been proposed. Here the illuminant color is estimated by the generalized gray world illuminant estimator. The texture informations are extracted using GLCM and edge point informations are obtained from HOGedge algorithm. Then classification of face pairs are performed using KNN classifier. This method requires only a minimal user interaction and provide a correct statement on the authenticity of the image.

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THE SPREAD OF THE EBOLA VIRUS DISEASE AND ITS IMPLICATIONS IN THE WEST AFRICAN SUB-REGION

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ABSTRACT: On August 8, 2014, the United Nations World Health Organization declared the current Ebola outbreak in West Africa an international public health emergency. The high level of poverty in the West African sub-region and the dearth of medical personnel couple with the inadequate medical equipment poses a serious challenge to the prevention, treatment and eradication of the virus. In curbing the spread, there have been calls for collective support for containment of the disease in the affected countries. The paper examined the spread of the Ebola Virus Disease and its implication in the West Africa sub-region. The correlation analysis revealed a strong positive association between the reported cases of new infections and fatalities suggesting that as the number of new infections increases so is the strong likelihood of the number of fatalities increasing. The Kruskal Wallist Test revealed a statistically significant difference in the reported cases of infections and fatalities across the months. The paper finds that the spread of the virus has effects on health, productivity of workers, social life, migration, and national economy. Efforts towards prevention have been acknowledged at the international, regional, and national level. The study, however, cannot be empirically generalized in the analytical term. There is the need for further study to know the remote cause of the virus, how it is transmitted, the impact on affected persons and the treatment in a holistic perspective. The paper recommends:strong political will, quick intervention and efficient case management; improvement in the medical infrastructure base; and widespread education.

KEYWORDS: Ebola Virus, Health, Response, West Africa, World Health Organization

1 INTRODUCTION

Ebola Virus Disease (EVD), formally known as Ebola hemorrhagic fever or Zaire Ebola is a critical illness that habitually leads to death. Its mortality rate is up to 90% and affects human beings as well as animals [1]. The first Ebola virus outbreak occurred in Zaire, now the Democratic republic of Congo in 1976. Subsequent outbreaks have been experienced in Uganda, Gabon, Cote d'Ivoire, and Sudan. There is no cure for the virus which has brought great concern to the people of West Africa and the international community. In mid-December, 2013, an outbreak occurred in Guinea but was officially communicated to the World Health Organization in March 2014 [2]. Thereafter, the virus has spread to Liberia, Sierra Leone and Nigeria.

On August 8, 2014, the United Nations World Health Organization (WHO) declared the current Ebola outbreak in West Africa an international public health emergency. According to Dr. Chan, it is the "largest, most severe, most complex in the nearly four-decade history of this disease" [3]. In March 23, 2014, the EVD resurfaced in West Africa, where out of the first 49 cases of infection reported, 29 persons were recorded dead. Thereafter, the WHO has reported about 2,615 cases and 1,427 deaths as at August 20, 2014. The Centre for Disease Control has reported about 1,528 cases and 844 deaths which have all been confirmed in the laboratory.

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The high level of poverty in the West African sub-region and the dearth of medical personnel couple with the inadequate medical equipment have posed a serious challenge to the prevention, treatment and the eradication of the virus. For instance, the family of the late Dr. Ameyo Adadevoh who contracted the virus from the Liberian-American, Patrick Sawyer berated the Nigerian government for not doing enough to provide substantial treatment for her. In another development, the Head of Medecins Sans Frontieres Elwa Hospital in Liberia, Joanne Lu asserts that lack of leadership and emergency management skills are hindering the effort to curtail the spread of the deadly virus. According to her, "we are missing everything right now; we are missing a strong leadership centrally, with core nation capacity and disease emergency management skills. It's not happening" [4]. The spread of EVD continues to ravage the West African sub-region despite efforts made by governments, stakeholders, non-governmental organizations and the international community to curb the spread of the disease, Dr. Chan posits that "our collective health security depends on support for containment in support in these countries" [3].

This paper examines the spread of the Ebola disease and its implication in the West Africa sub-region. It specifically focuses on the spread of the EVD taking into account analysis of reported cases of infection and fatalities, its implications and efforts towards prevention. It concludes with recommendations towards curbing the spread of the disease.

2 SPREAD OF EVD IN THE WEST AFRICAN SUB-REGION

Guinea was the first country that the EVD broke out in December 2013 but not until March 2014 that the WHO alerted the world on the outbreak. Indication emerged from medical experts that the first person to contract the virus in 2013 and that led to the subsequent outbreak in 2014 was a two-year old boy from Guinea who later died in December 2013. Before his death, he had passed the virus to some members of his family who also transmitted the virus to other people in a village [5], [6]. The proximity of Sierra Leone and Liberia to Guinea increased the chances of these two countries being affected with the Ebola Virus. The disease eventually surfaced in the Lofa and Nimba counties of Liberia in March, 2014 [7]. Thereafter, it spread to other parts of the country [8].

In the case of Sierra Leone, the first clinical samples from suspected cases proved negative for the deadly virus. But afterward, cases of EVD were reported in the Kilahun District close to the Guinea border [9]. The outbreak of the EVD spread to other regions in Sierra Leone including the capital Freetown. Unlike the cases of Liberia and Sierra Leone that are neighbours to Guinea which made the easy transfer of EVD to these countries. The case of Nigeria was different. Patrick Sawyer, who contracted the disease during her sister's burial who had died from the virus, travelled to Nigeria en-route to the United States of America. The hospital where Sawyer was first admitted in Lagos transmitted the disease to some of the medical officers in the hospital.

2.1 ANALYSIS OF REPORTED CASES

This section of the paper presents an analysis of the reported cases of EVD in West Africa. Statistical tables and graph were used in presenting the findings. Data (as per occurrence in the month) was extracted from the Time Magazine based on the WHO figures as at 19th August, 2014. The analysis focused on establishing a relationship with the number of newly reported cases of infection and fatalities.

As shown in Table 1, the distribution showed an increasing growth in both newly reported cases of infection and fatalities aside the month of May. This was confirmed in the correlation analysis which revealed a strong positive significant association between newly reported cases of infections and fatalities (r=.893, p-value=.000, N=49). This suggests that as the reported cases of new infections increases, so is the likelihood of the reported cases of fatalities increasing. The variable, month, was controlled for in order to find out whether it influences the relationship between the cases of infections and fatalities. The result did not differ much from the previous finding (r=.826, p-value=.000, N=49) as shown in Appendix A. Thus, irrespective of the month under consideration, there exists a positive likelihood of experiencing both newly reported cases of infection and fatalities.

Table 1: Distribution of newly reported cases of infection and fatalities

Month	Number of new infections	Number of new fatalities
March	116	74
April	132	74
May	120	66
June	231	148
July	724	367
August	917	500

Source: *Extracted from the Time Magazine Map based on World Health Organization (2014)*

As shown in Figure 1, the distribution of the newly reported cases of infections and fatalities is not uniform. From mid-May, the distribution gets more erratic and intense. Although, Figure 1 does not highlight country-specific cases of infections and fatalities, the WHO, as of August 20, 2014, published the following confirmed or suspected cases of Ebola: Guinea (607 cases, 406 deaths); Liberia (1082 cases, 624 deaths); Nigeria (16 cases, 5 deaths); and Sierra Leone (910 cases, 392 deaths) resulting in 2,615 cases and 1,427 deaths.

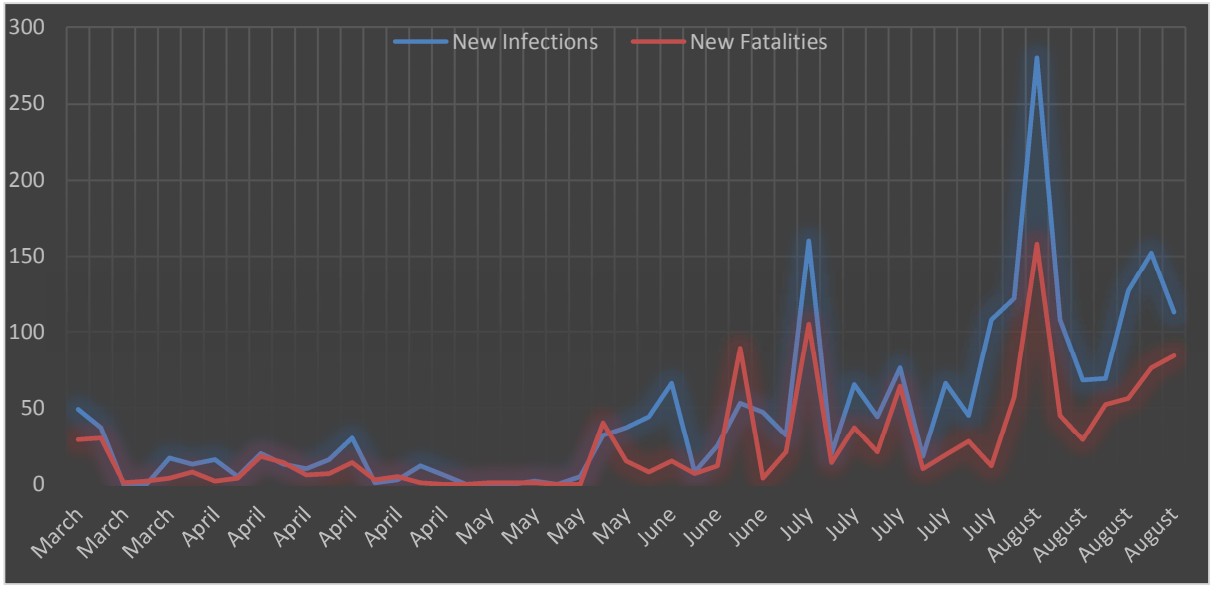

Fig. 1: Graph showing newly reported cases of infections and fatalities across the months.

Source: Extracted from the Time Magazine based on the World Health Organization (2014).

Between March and April, there was a positive change in the number of newly reported cases (13.79%); however, this reduced by 22.88 percentage points in May. With the number of newly reported cases of fatalities, the period between March and April recorded no change. The number of fatalities fell by 10.81 percentage points in May. Beyond this month, there was a huge increase by 101.59 percentage points and 135.05 percentage points in June for both the number of newly reported cases of infections and fatalities respectively. Similarly, the month of June and July recorded the highest percentage change of 213.14 percent and 147.97 percent and fell later in August by 186.76 percentage points and 111.73 percentage points for both the number of newly reported cases of infections and fatalities respectively. The general trend can be described as a rise and fall of the number of infections and fatalities.

The non-parametric test of K-independent samples was used and results are shown in Appendix A. The choice for this test was based on the skewed distribution of both the reported cases of new infections (skewness=2.2) and new fatalities (skweness=2.1) suggesting the presence of outliers. Similarly, the Tests of Normality were significant (p-value=.00) for both cases at the five percent alpha level suggesting violation of the assumption of normality. The K-independent samples test was used to explore whether the newly reported cases of infections and fatalities differ across the months. The data analysis from

March to August revealed that the median case of newly reported cases of infections and fatalities was 30 and 14 respectively.

The Kruskal Wallist Test showed a statistically significant difference in the newly reported cases of infections [χ^2(5, n = 49) = 31.013, p = .000.] and fatalities [χ^2(5, n = 49) = 26.036, p = .000.] across the different months (March, *n* = 6: April, *n* = 11: May, *n* = 9: June, *n* = 6: July, *n* = 10: August, *n* = 7). With respect to newly reported infections, the median scores declined from March (*Md* = 15) through April (*Md* = 12) to May (*Md* = 2). It subsequently rose through June (*Md* = 39.5), July (*Md* = 65.5, and August (*Md* = 113). Similarly, the median scores for the newly reported cases of fatalities declined from March (*Md* = 6) through April (*Md* = 5) to May (*Md* = 1) and subsequently rose through June (*Md* = 13), July (*Md* = 24, and August (*Md* = 56). The preliminary findings suggest that the spread of the virus is on the ascendency after the month of May, hence the need for critical action.

Further analysis was undertaken using the Mann-Whitney U Test to explore which of the months were statistically significantly different from the other in terms of the newly reported cases of fatalities and infections. To control for Type I errors, a Bonferroni adjustment to the alpha values was applied (alpha value divided by the number of categories in the categorical value; 0.05/6=0.008) to compare each month with the other. The results showed that statistically significant differences were recorded in the newly reported cases of fatalities between March and August (p = .005), April and July (p = .001), April and August (p = .000), May and July (p = .004), and May and August (p = .001). Similarly, the results showed statistically significant differences in the newly reported cases of infection between March and August (p = .003), April and July (p = .001), April and August (p = .000), May and July (p = .004), May and August (p = .000), and June and August (p = .003). Inferring from this preliminary finding, it is instructive to probe the issues surrounding the rise and fall of recorded cases of infections and fatalities.

3 EFFECTS AND IMPLICATIONS OF EVD

The outbreak of the EVD has affected the way of life especially for the people of the West African sub-region. Its effects have been felt in the areas of health, social life, and migration. Consequently, these effects have implications for the national economy. Any action or inaction taken in mitigating the spread of the EVD will simply have implication in people's way of life.

3.1 HEALTH

The health effects of Ebola Virus Disease are disastrous and when it attacks its victim it causes a severe damage to the skin. People get contact with the virus through close contact with blood, secretions, organs or bodily fluids of infected animals. Once this happens, the infection can be transmitted from person to person. "Patients initially present with fever, headache, joint/muscle and abdominal pain accompanied by diarrhoea and vomiting" [10]. "In its early stages, EVD is easily confused with other tropical fever, such as malaria or dengue, until the appearance of the hemorrhagic terminal phase, presenting with the characteristic internal and sub-cutaneous bleeding, vomiting of blood and reddening of the eyes. If sufficient blood is lost, this leads to renal failure, breathing difficulties, low body temperature, shock and death" [10]. In a report by the AFP, 32 nurses between May 24 and August 14 have died from the Ebola virus while performing their duties.

People living in Ebola-prone areas risk experiencing psychological problems which can affect their health. The outbreak of the disease comes along with its attendant fear and panic, anxiety, and stress. According to Sue Towey (a mental health practitioner), living under constant fear weakens the immune system and can cause cardiovascular damage, gastrointestinal problems such as ulcers and irritable bowel syndrome, and decreased fertility [11].

The health of health workers is also at risk. The density of physicians (total number per 1000 population) in these affected countries is woefully inadequate: Guinea (0.100); Liberia (0.014); and Sierra Leone (0.022) [12]. Hence, there is a greater burden on health workers, in terms of working hours and number of patients, to go an extra mile in providing quality service for patients including Ebola-infected patients which require extreme caution. In Sierra Leone, the country's chief medical officer admits the difficulties that health workers were facing in fighting the epidemic and suggests that "we still have to break the chain of transmission to separate the infected from the uninfected", however, "there is a rejection among people of the existence of Ebola and hostility towards health workers" [13].

3.2 PRODUCTIVITY OF WORKERS

The productivity of workers is also affected. As of August 25, more than 250 health care workers have developed the disease in Guinea, Liberia, Nigeria, and Sierra Leone, and more than 120 have died [14]. The demise of these health workers in these affected countries means a deprivation of not only experienced and dedicated medical care but also inspiring

national heroes. Consequently, any ordinary worker who falls ill and visits the clinic or hospital may not receive adequate care and treatment from health workers and may have to spend some amount of his/her productive hours at the health center. Such a situation denies workers of the opportunity of using their working hours for productive use.

3.3 SOCIAL LIFE

Another knock-on effect of the EVD is on social life. As reported by the Daily Nation in an interview with a Kenyan who returned from Monrovia, "there are no handshakes or hugs. Life has changed a lot. People are uncertain because they know there is an epidemic that has neither a cure nor a vaccine" [15]. In Liberia, the president has restricted the movement of people living in the densely populated West Point slum area. In addition, the president has ordered cinemas, theatres, night clubs, muster points shut in order to curtail the spread of the virus. In Nigeria, the Federal government and the Lagos government met with some leading pastors with large congregations to take precautionary measure to hinder the spread of the virus in the church. In Ghana, a few numbers of churches have asked their members not to hug and handshake each other [16]. Hand sanitizers have been provided by these churches for members to use. Religious and cultural practices that require either a handshake, hug or kiss remain challenged by the outbreak of Ebola disease. In a situation where one unconsciously stretches the arm for a handshake or a hug, that gesture may be frowned upon leading to embarrassment. The normal way of greeting is never the same again.

3.4 MIGRATION

The migration of people has also been restrained. A number of countries have banned flights coming from these infected countries. In particular, Nigeria and Ivory Coast have restricted flights from Ebola-infected countries emphasizing fears of the virus in West Africa. Zambia has also banned all citizens of Guinea, Sierra Leone, Liberia, and Nigeria from entering the country [17]. Furthermore, Kenya has banned flights from Sierra Leone and Liberia as a precautionary measure in preventing the disease from entering its territory. Ghana is also considering banning flights from Ebola affected countries once the spread becomes threatening in West Africa [18]. This situation has resulted in screening of all passengers leaving international airports, seaports, and major ground crossings as directed by the UN health agency. The challenge is that if immigrant workers are not provided with the proper protective clothing and equipment, they stand the risk of getting infected with the virus and when infected with the virus, they become agents of transmission. The outbreak has also affected hosting of international conferences. In the case of Ghana, the government per the ECOWAS meeting has cancelled all international conferences between August and November as part of an attempt to prevent the spread of the disease.

3.5 NATIONAL ECONOMY

The effects of the EVD on health, productivity, social life, and migration have serious implications for the national economy. There is the risk of having a direct financial drain on government budgets via increased health expenditures. Liberia has spent $12 million (nine million euros) in tackling the Ebola outbreak between April and June and may have to spend more. Moody's rating agency has warned of a severe economic toll on the economies of these affected countries as a consequence of mitigating the spread of the virus.

Given the low ratio of physicians per 1000 population in these affected countries, there is pressure on the governments to deploy more health workers. In such a situation, workers need to be properly motivated by the provision of better working conditions which includes, but not limited to, provision of proper protective gears and equipment, pay which commensurate with the service being delivered, insurance cover, and availability of high quality care should an health worker get infected with the virus. The government of affected countries will also have to provide rapid testing equipment, mobile laboratories, and clinics. There is also the urgency for the governments to communicate effectively with international partners about the Ebola outbreak and how it is affecting communities in order to receive the required aid in mitigating its spread.

At the micro level, individual to corporate kind of business is affected as flights have been restricted to the Ebola-hit countries. Consequently, this has a negative effect on the businesses leading to a fall in revenue. The airline industry has been affected by the outbreak of the disease. According to OGA, an airline data provider, 216 flights of the 590 monthly flights that were supposed to fly to Guinea, Liberia, and Sierra Leone have been cancelled [19]. Some of the airlines that have banned flights to the virus hit countries include Arik Air, British Airways and the Korea Air. The economic implication of the cancellation of flights by these airlines is that their revenue for the year will shrink.

4 EFFORTS TOWARDS PREVENTION

This section of the paper looks at the efforts towards prevention. This is discussed in view of responses at the international, regional, and national level.

4.1 INTERNATIONAL RESPONSE

A number of efforts have been made toward the prevention of the EVD. International support as well as national and local support has been crucial in mitigating the spread of the disease. At the international level, the UN has made "a clear call for international solidarity" to boost the capacity of countries currently affected. It has also been recommended that "there should be no international travel of Ebola contacts or cases, unless the travel is part of an appropriate medical situation" and specific ways are outlined to minimize the risk of international spread of the EVD as well as giving advice to currently unaffected countries and those bordering the affected states [3].

Again, the WHO on August 11, 2014 convened a panel of medical ethicists, scientific experts, and lay people from affected countries to deliberate on the ethical implications of the potential use of unregistered interventions. Per the consensus reached, ethical justification was given for the provision of unproven interventions as a potential treatment or prevention though their efficacy and adverse effects are unknown. Nonetheless, ethical criteria including transparency about all aspects of care, informed consent, freedom of choice, confidentiality, respect for the person, preservation of dignity and involvement of the community have been issued to guide the provision of such interventions. Further, the WHO has launched a $100 million EVD Outbreak Response Plan in West Africa [3].

The international community has contributed and pledged a substantial amount of fund to bring the spread of the virus under control. For instance, the European Union, China, United States, Japan and the United Kingdom have donated large sums of money to curtail the spread of the virus. Countries that have pledged funds and vaccines to prevent the spread of the virus includes Australia, Japan and Canada.

Despite these efforts aimed at curbing the spread of the disease, the international response has been criticised. In a report by the Guardian, de la Vigne, the operations director of Doctors Without Borders, have indicated that "Globally, the response of the international community is almost zero" adding that "Leaders in the West are talking about their own safety and doing things like closing airlines—and not helping anyone else." However, the international governmental response has, to a large extent, focused on containing the virus in West Africa.

4.2 REGIONAL RESPONSE

The Africa Union has urged its members to recruit more health care workers. The ECOWAS Commission has also directed that "all meetings and missions be suspended unless absolutely essential and well-guided, a three (3) month moratorium be placed on all international conferences and international gatherings which have the potential of spreading the Ebola Virus" [20]. There has also been regional support from the south. In a report by the AFP, South Africa has extended a helping hand to Sierra Leone by sending a mobile laboratory to be installed in the capital city to ensure quick access to analysis of blood samples.

4.3 NATIONAL RESPONSE

At the national level, governments and local associations are making commitments in curbing the spread of the disease. For instance, in Guinea, Medicines San Frontieres (MSF) is running centers for the treatment of EVD. According to Reference [20], the ministry and MSF are collaborating in the transfer of Ebola victims by ambulance for treatment in Conakry. In Liberia, the response of the government is encouraging despite some hiccups in the prevention, treatment and precautionary measures taken by the government. The Liberian Ministry of Health began to implement the tactical plan in accordance with the Accra meeting that was held on 23 July, 2014 to enhance the country's response to the EVD outbreak [1]. Furthermore, Ellen Johnson Sirleaf, the Liberian President, has ordered the shut down of nightclubs, Cinema houses and other gathering points in order to halt the spread of the virus. However, the spread of the virus is likely to increase because of the Ebola clinic that was attacked and ransacked by an angry mob in the West Point region who were concerned that the clinic was located in their region [22].

The case of Nigeria in respect to the fatality being caused by the EVD is smaller when compared to other infected countries. Despite this, the Nigerian government is not leaving any stone unturned since the introduction of the virus to Nigeria by the Liberian Patrick Sawyer. All those who came in contact with Sawyer were put under surveillance. The Nigerian

Federal Government and the Lagos state government are working jointly in the control, prevention and the treatment of EVD patients. The government has approved a whopping sum of N1.9 billion as an intervention fund to restrict the spread of the virus. The measures taken by the Sierra Leone government include the introduction of the reactivation of its "Active Surveillance Protocol" [23]. The declaration of a state of emergency and the deployment of troops to quarantine the epicenters of the virus [24]. In addition, the government passed a law that will see anybody hiding Ebola victims with a two-year jail term.

In Ghana, the government has allocated GH¢6 million ($1,612,903.23) and announced plans to procure protective gears for frontline workers in health, immigration and other agencies who are most likely to encounter a possible victim. Also, the Pharmaceutical Society of Ghana has put up an initiative dubbed PREVENT (Patients' Research Empowerment Vigilance and Education through new Technologies) which seeks to prevent the entry of fake and counterfeit medicines via the country's supply chain.

5 CONCLUSION AND RECOMMENDATIONS

This study evaluates the spread of Ebola virus disease in the West African sub-region vis a vis its implications in the affected countries. It finds that the spread of the EVD has effects on health, productivity of workers, social life, migration, and national economy. Also, efforts towards prevention have been acknowledged at the international, regional, and national level. The study, however, cannot be empirically generalized in the analytical term. There is the need for further study to know the remote cause of the virus, how it is transmitted, the impact on affected persons and the treatment in a holistic perspective. The following recommendations are made to mitigate the spread of the virus.

In order to win this war on Ebola, there are a number of issues that needs to be addressed. First, in the words of Brice de la Vigne, "The solution is not that complicated but we need to have a political will to do so. Time is running out. But you need very senior people with high profiles, the kind of people who can coordinate a response to a million people affected by an earthquake." Great and influential leaders have to make a personal commitment to champion the cause of mitigating the spread of EVD. For instance, the UN Secretary General and other philanthropists such as Bill and Melinda Gates and some most powerful people in Africa such as, AlikoDangote (President, Dangote Group), Christo Wiese (Chairman, Shoprite), and Kofi Annan (immediate past UN Secretary-General) can help demonstrate the political will to win the war on Ebola.

Secondly, quick intervention and efficient case management as well as psychosocial support are crucial. Also, as has been suggested by a number of concerned persons, there is the urgent need to deploy more health workers to work in the treatment centers in the affected areas. These workers should educate people about protection measures and provide medical and emergency relief by tracing people who may be infected with the virus. This sacrifice requires that health workers be provided with proper protective gears and equipment, a remuneration that will be commensurate with health workers' heroic work as well as a comprehensive medical insurance cover that ensures immediate delivery of quality healthcare service to health workers who get infected with the disease in their line of duty.

Another issue of concern is that the level of investment towards building medical infrastructure in these Ebola-hit countries is lacking. Hence, the local government has to focus on providing funds in developing its medical infrastructure base. Also, access to the necessary supplies of medical drugs, provision of additional mobile laboratories, clinics, and rapid testing equipment are crucial. Local government should also liaise with international partners to receive support in terms of training of its health workers, provision of medical equipment, and communicating effectively about the outbreak of the EVD to its communities.

Again, managing the Ebola panic which Dr. Joanne Liu notes as "emergency within an emergency" has to be addressed properly. According to Liu, the threat has caused deaths due to malaria and other diseases with similar symptoms since hospitals may not treat such patients for fear that they may be carriers of the Ebola virus. An unfortunate case is that of the 24-year-old American, Nathaniel Dennis, who died of an unrelated illness because the hospital in Liberia refused to treat him because the hospital attributed the illness to the Ebola virus [25]. Early detection, investigation, reporting, active surveillance and diagnostic capacity should be a matter of concern. The need for widespread education on the risk factors for transmission, signs and symptoms, method of control and prevention of the disease is relevant to forestall such future occurrence. The washing of hands should be encouraged.

Finally, even though the WHO admits that the current statistics regarding the Ebola outbreak is "vastly underestimated", timely release of data on the number of patients who are receiving treatment, and experiencing partial or full recovery is relevant for statistical analysis. It will be of great importance if data could be obtained with respect to countries on the number of reported cases of infection and fatalities. This will inform policy makers about appropriate measures. Nonetheless,

as the correlation analysis revealed a strong positive relationship between the number of newly reported cases of infection and death, the sooner we take a decisive political action, the better the chances of saving a dignified human life.

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APPENDIX A

Correlations

Correlations

		Number of new infections	Number of new fatalities
Number of new infections	Pearson Correlation	1	.893**
	Sig. (2-tailed)		.000
	N	49	49
Number of new fatalities	Pearson Correlation	.893**	1
	Sig. (2-tailed)	.000	
	N	49	49

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

Partial Corr

Correlations

Control Variables			Number of new infections	Number of new fatalities
Month	Number of new infections	Correlation	1.000	.826
		Significance (2-tailed)	.	.000
		df	0	46
	Number of new fatalities	Correlation	.826	1.000
		Significance (2-tailed)	.000	.
		df	46	0

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Number of new infections	.200	49	.000	.776	49	.000
Number of new fatalities	.223	49	.000	.747	49	.000

a. Lilliefors Significance Correction

Statistics

		Number of new infections	Number of new fatalities
N	Valid	49	49
	Missing	0	0
Mean		45.7143	25.0816
Median		30.0000	14.0000
Mode		.00	1.00
Skewness		2.157	2.120
Std. Error of Skewness		.340	.340

NPar Tests
Kruskal-Wallis Test

Ranks

	Month	N	Mean Rank
Number of new infections	March	6	17.67
	April	11	15.32
	May	9	13.11
	June	6	28.17
	July	10	35.60
	August	7	43.93
	Total	49	
Number of new fatalities	March	6	20.75
	April	11	16.32
	May	9	12.94
	June	6	27.33
	July	10	34.20
	August	7	42.64
	Total	49	

Test Statistics[a,b]

	Number of new infections	Number of new fatalities
Chi-Square	31.013	26.036
df	5	5
Asymp. Sig.	.000	.000

a. Kruskal Wallis Test

b. Grouping Variable: Month

Mann-Whitney Test

Ranks

	Month	N	Mean Rank	Sum of Ranks
Number of new fatalities	March	6	3.75	22.50
	August	7	9.79	68.50
	Total	13		
Number of new infections	March	6	3.50	21.00
	August	7	10.00	70.00
	Total	13		

Test Statistics[b]

	Number of new fatalities	Number of new infections
Mann-Whitney U	1.500	.000
Wilcoxon W	22.500	21.000
Z	-2.790	-3.004
Asymp. Sig. (2-tailed)	.005	.003
Exact Sig. [2*(1-tailed Sig.)]	.002[a]	.001[a]

a. Not corrected for ties.

b. Grouping Variable: Month

Ranks

	Month	N	Mean Rank	Sum of Ranks
Number of new fatalities	April	11	6.00	66.00
	August	7	15.00	105.00
	Total	18		
Number of new infections	April	11	6.00	66.00
	August	7	15.00	105.00
	Total	18		

Test Statistics[b]

	Number of new fatalities	Number of new infections
Mann-Whitney U	.000	.000
Wilcoxon W	66.000	66.000
Z	-3.489	-3.489
Asymp. Sig. (2-tailed)	.000	.000
Exact Sig. [2*(1-tailed Sig.)]	.000[a]	.000[a]

a. Not corrected for ties.

b. Grouping Variable: Month

Ranks

	Month	N	Mean Rank	Sum of Ranks
Number of new fatalities	May	9	5.11	46.00
	August	7	12.86	90.00
	Total	16		
Number of new infections	May	9	5.00	45.00
	August	7	13.00	91.00
	Total	16		

Test Statistics[b]

	Number of new fatalities	Number of new infections
Mann-Whitney U	1.000	.000
Wilcoxon W	46.000	45.000
Z	-3.248	-3.359
Asymp. Sig. (2-tailed)	.001	.001
Exact Sig. [2*(1-tailed Sig.)]	.000[a]	.000[a]

a. Not corrected for ties.

b. Grouping Variable: Month

Ranks

	Month	N	Mean Rank	Sum of Ranks
Number of new fatalities	June	6	4.50	27.00
	August	7	9.14	64.00
	Total	13		
Number of new infections	June	6	3.50	21.00
	August	7	10.00	70.00
	Total	13		

Test Statistics[b]

	Number of new fatalities	Number of new infections
Mann-Whitney U	6.000	.000
Wilcoxon W	27.000	21.000
Z	-2.143	-3.000
Asymp. Sig. (2-tailed)	.032	.003
Exact Sig. [2*(1-tailed Sig.)]	.035[a]	.001[a]

a. Not corrected for ties.

b. Grouping Variable: Month

Ranks

	Month	N	Mean Rank	Sum of Ranks
Number of new fatalities	May	9	6.11	55.00
	July	10	13.50	135.00
	Total	19		
Number of new infections	May	9	5.72	51.50
	July	10	13.85	138.50
	Total	19		

Test Statistics[b]

	Number of new fatalities	Number of new infections
Mann-Whitney U	10.000	6.500
Wilcoxon W	55.000	51.500
Z	-2.868	-3.159
Asymp. Sig. (2-tailed)	.004	.002
Exact Sig. [2*(1-tailed Sig.)]	.003[a]	.001[a]

a. Not corrected for ties.

b. Grouping Variable: Month

Ranks

	Month	N	Mean Rank	Sum of Ranks
Number of new fatalities	April	11	6.73	74.00
	July	10	15.70	157.00
	Total	21		
Number of new infections	April	11	6.32	69.50
	July	10	16.15	161.50
	Total	21		

Test Statistics[b]

	Number of new fatalities	Number of new infections
Mann-Whitney U	8.000	3.500
Wilcoxon W	74.000	69.500
Z	-3.314	-3.629
Asymp. Sig. (2-tailed)	.001	.000
Exact Sig. [2*(1-tailed Sig.)]	.000[a]	.000[a]

a. Not corrected for ties.

b. Grouping Variable: Month

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The Socio-Economic Implications of Boko Haram Insurgency in the North-East of Nigeria

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ABSTRACT: The continued bombings, killings, kidnappings and the destruction of property by Boko Haram have become of great concern to the Nigerian government and the international community. The activities of Boko Haram have effects on the economy and the people. This paper examines the implications of the operations of the Boko Haram insurgency in the northeast of Nigeria. Findings from the study indicates that the atrocities of Boko Haram have severe implications on the economy and social lives of the people of the northeast where the activities of the sect is concentrated. The paper recommends for the insurgency to come to an end, the government needs to provide employment to the teeming youths, dialogue with the sect if the need arises and equip the military with sophisticated gadgets in order to confront Boko Haram foot soldier.

KEYWORDS: Boko Haram, Insurgency, Northeast, Poverty, Socioeconomic.

1 INTRODUCTION

Democratic government was installed in Nigeria in 1999 after more than 16 years of military dictatorship. The aspiration of the populace was that with the coming of civilian government the dividends of democracy will spread to all nooks and crannies of Nigeria. However, their hopes have been dashed by the recent events in Nigeria. Fifteen years after civilian rule, the country's security situation is pathetic that nobody in the country is safe from the attacks of terrorists, kidnappers, armed gangs and militants. Electoral and communal violence has also compounded the security situation that has made Nigeria unsafe for residence. The activities of the dreaded Islamic terrorist group Boko Haram have been a great concern to the Nigerian government and the international community, as in up to date, Boko Haram has killed more than 10,000 citizens despite the security measure taken by the federal government of Nigeria to checkmate the heinous crime of the sect against humanity. It was in the light of the failure of the government counter terrorism drive that made youths in the North- East part of the country to form a youth anti-terrorism movement called "Civilian JTF" to complement the effort of the government counter terrorism strategy.

According to Alozieuwa (2012) as cited by Anyadike (2013) "the challenge posed by Boko Haram in Nigeria is not only about the viciousness of either its terror campaigns or the sect's avowed mission to impose Islamic law on the country, but about the confusion regarding the exact cause(s) of the violence". A lot of factors have been attributed to the cause of Boko Haram insurgency in Nigeria such as socioeconomic, political and religious factors. However, Awojobi (2014) and Onuoha (2014) posit that the high-rate of poverty in Nigeria has made the youths enlisted in the ranks of Boko Haram foot soldiers which has elongate the conflict since 2009. Most of the activities of the sect are concentrated in the North-East of Nigeria. Despite the state of emergency that was declared by the Federal government, the killings, bombings and kidnappings of Boko Haram continue unabated. The activities of Boko Haram sect have led to economic, social and psychological implications in the North-East Nigeria where the sect has a strong presence. The purpose of this study is to unravel the implications of Boko Haram insurgency in the North-East Nigeria.

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1.1 STATEMENT OF RESEARCH PROBLEM

Since 2009 when Boko Haram initially started its insurgency and the aftermath of the killing of Mohammed Yusuf the leader of the sect, the activities of the sect have continued unabated despite the effort of the government to curtail the heinous crime of the sect, over 10,000 people have been killed by Boko Haram. Most of the operations of the sect are concentrated in the North-East of Nigeria. The sect has use kidnapping and raping of women as a weapon of war. The poor are the most victims of the sect atrocities and the implications of the sect insurgency fall on the ordinary Nigerians. The purpose of this study to examine the implications of the sect in the North-East of Nigeria where the sect operations are predominant.

1.2 OBJECTIVE OF THE STUDY

- To examine the implications of Boko Haram insurgency
- To evaluate its operations in the North-East Nigeria
- To make recommendations for the way out of the sect insurgency

1.3 SIGNIFICANCE OF THE STUDY

The study will be vital to the government, security apparatus and the general public. It will also contribute to knowledge of the implications of Boko Haram insurgency. Furthermore, the study will generate theory regarding the implications of Boko Haram insurgency in the North-East Nigeria.

2 REVIEW OF LITERATURE

Boko Haram has intensified its operation in the North-East of Nigeria despite the state of emergency that was declared by the federal government in the three states in the northern region where Boko Haram activities are concentrated. The activities of the sect have been of concern to scholars who have written various academic papers on the modus operandi of Boko Haram. Eme and Ibietan (2012) analyze the origin and ideology of the sect, from their analysis they posit that Jama'atu Ahlis Sunna Lidda'awati Wal-Jihad better known as Boko Haram is an Islamic terrorist group that has a strong operational based in the northeast of Nigeria. The ideology of the sect according them is to bring to an end the secular system of government and introduce sharia law in Nigeria. However, Lister (2012) did not subscribe to the notion that the Boko Haram aim is to Islamize Nigeria through the introduction of sharia law. According to him, the foot soldiers of the sect are disgruntled youths who have been paid by unscrupulous Northern politicians to cause mayhem in the country because of their selfish ambitions. The is this assumption from the southern part of Nigeria, where the incumbent president comes from that the activities of the sect was more intensified because of the emergence of the current president who is a southerner. The high rate of poverty, unemployment and political corruption have been blamed on the elongation of the conflict. Most of the foot soldiers of Boko Haram are youths that are frustrated because the lack employment, income and they have been disdained by politicians after being used by these politicians for their elections victory. Cook (2013); Awojobi (2014); Onuoha (2014) all assert that the youths enlisted into Boko Haram because of the prevalence of poverty in the North. The poverty profile of Nigeria that was released in 2011 by the National Bureau of Statistics (NBS) indicated that the northern region has more poor people than people in the south. Aside the killings, kidnapping and bombing of the sect, their activities constitute a hindrance to the socioeconomic development of the northeast where their operation is focused and Nigeria as a whole. Eme and Ibietan (2012); Ogochukwu (2013); Odita and Akan (2014); Ovaga (n.d.) agree with their study on the Boko Haram insurgency that the sect heinous crimes hinder socioeconomic development in Nigeria. For the major attacks and modus operandi of the sect see (Eme and Ibietan 2012; Ovaga, n.d.; Odita and Akan 2014) for details.

3 THEORETICAL FRAMEWORK

The study will use the poverty breeds conflict hypothesis for the theoretical framework. Academic debates continue on the correlation between poverty and insecurity. Some scholars have argued that most of the conflicts in developing countries are caused by the prevalence of poverty. There is causality from high poverty rate to conflict Kanbur (2007). Ted Gurr deprivation theory subscribed to this assumption. The theory explains why the youths are always taking to violence. According to the deprivation theory, “aggression is always a consequence of frustration” and “frustration always lead to aggression” (Leeds 1978). “The poor are led to violence owing to their relative deprivation and needs” (Odumosu 1999 cited in Awojobi 2014). Frustration, lack of income, unemployment have prompted the youths in the northern Nigeria to become

foot soldiers of Boko Haram (Awojobi 2014). Insecurity, terrorism, conflicts and violence are caused by the high poverty rate in most societies (Gurr 1970 and Burton 1997). Sarmiento and Bacerra (1998) and Sarmiento (1999) are the leading scholars on the poverty breeds conflict hypothesis. However, the likes of Gaitan (1995); Rubio (2000); Sanchez and Nunez (2001) and Sanchez, Solimano and Formisano (2005) objected to this hypothesis. Empirical evidence from the works of Collier and Hoeffler (2002); Bellows and Miguel (2006); Ford (2007) indicated that poverty was the major cause of conflict in Africa. For instance, Collier and Hoeffler (2002) examine conflicts in Africa, from their findings, they notice the interface between income and conflict. Rice et al. (2006); Collier and Hoeffler (2002); Fearon (2004); Walter (2004) subscribed to the notion that poverty helps to extend conflicts once it started. Evidence has shown that when income drops there is a tendency for conflict to surface or reignited. A study by Paul Collier and Anke Hoeffler from the Oxford University, James Fearson and David Laitin both from the Stanford University, and Professor Nicholas Sambanis from the Yale University gave credence to this hypothesis (Collier and Hoeffler 2004). The table 1 below illustrates their findings.

Table 1: Key findings of Per Capita Income and Conflict

Source	Finding
Collier/Hoeffler (2004)	Countries at different income levels have the following risk experiencing civil conflict at $ 250 GDP per capital, a 15% risk of war within 5 years; at $600 GDP per capita, a 7.5% risk of war within 5 years; and at $5,000 GDP per capita, less than 1% risk of war within 5 years (Humphreys 2003)
Fearon/ Laitin (2003)	Countries at different income levels have the following risk of experiencing civil conflict: at $579 GDP per capita, a 17.7% risk of war within 1 year; at $2,043 GDP per capita, a 10.7% risk of war within 1 year; and at $9,466 GDP per capita, less than 1% risk of war within 1 year.
Sambanis (2003)	Average GDP per capita for countries that experienced war within 5 years is $2,176. Average GDP per capita for countries that did not experience war within 5 years $5,173
Collier/Hoeffler/ Rohner (2006)	Average GDP per capita for countries that experienced war within 5 years is $1,100. Average GDP per capita for countries that did not experience war within 5 years $5,764.

Source: Rice et al. 2006

The Boko Haram insurgency has been blamed on the high rate of poverty in Nigeria. However, some security experts have debunked this assumption. But in the words of Kastina (n.d.) who posits that whatever argument surrounding the cause of Boko Haram insurgency the "salient facts which cannot be demised always easily. The most important of this is that we have to admit that even if the group has its antecedents in theology, its swelling rank is as a result of a huge reservoir of unemployed urban youths from many parts of the country. These youths who have completely become disenfranchised are readily to provide the group with foot soldiers who commit all manners of atrocities, including assassination and suicide bombings in the name of religion." Onuoha (2013) empirical study on why do youth join Boko Haram, the findings of the study indicated that poverty played a major role in luring the youth in joining Boko Haram.

4 BOKO HARAM ATTACKS AND FATALITIES

Since the first attack of Boko Haram in 2009 in one of the police barracks in Bauchi state that killed scores of people, including police officers and members of their family, and the subsequent killing of the leader of the sect, Yusuf Mohammed, the coordinated attacks by Boko Haram have intensified. The extrajudicial killing of the sect leader made the group intensified its attacks on government departments, the church, markets, homes, police and military formations (Ajah, 2011). It is erroneous to believe that the sect attacks churches without doing same to the muslim worshiping centers. Boko Haram has attacked mosques in the northeast and even killed some Islamic clerics that are opposed to their ideology. It is estimated that over 10, 000 Nigerians have been killed and maimed by the sect since 2009. Abubakar Shekau who was the deputy of Mohammed Yusuf took over the mantle of leadership of the sect after Yusuf's death. The year 2014 has been the worst period of the group attacks, according to Human Right Watch. Over 700 people have been killed in attacks on 40 villages in the northeast states of Borno, Yobe and Adamawa. Most of the attacks are concentrated in these three states. However, the nation's capital Abuja, Jos, Kano and some part of the north have experienced attacks from Boko Haram. Figure 1 illustrates Boko Haram attacks and fatalities.

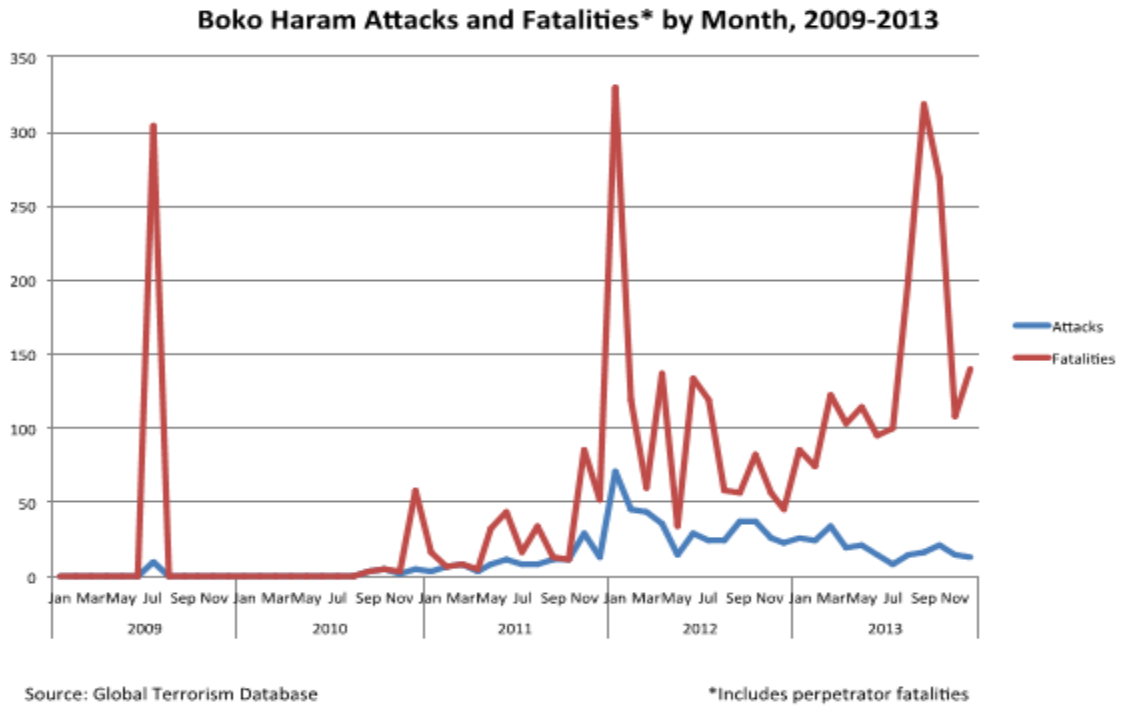

Figure. 1

The sect attacks churches, mosque, schools, markets, motor parks and houses. The attacks of Boko Haram have led to the displacement of thousand of people in the northeast. In order to curtail the heinous crime of the sect against humanity the federal government in 2013 declared a state of emergency in the three states that the sect activities are predominate. The state of emergency did not stop the sect from the continuation of bombings, killings, kidnappings and the destruction of property. In a nutshell, the attacks of the sect in the period of state of emergency surpassed when there was no state of emergency. The question on the lips of Nigerians what is the purpose of the state of emergency when Boko Haram has intensified its attacks on innocent Nigerians? Professor Clionadh Raleigh of the University of Sussex created a data that demonstrates the attacks of Boko Haram before and after the declared state of emergency.

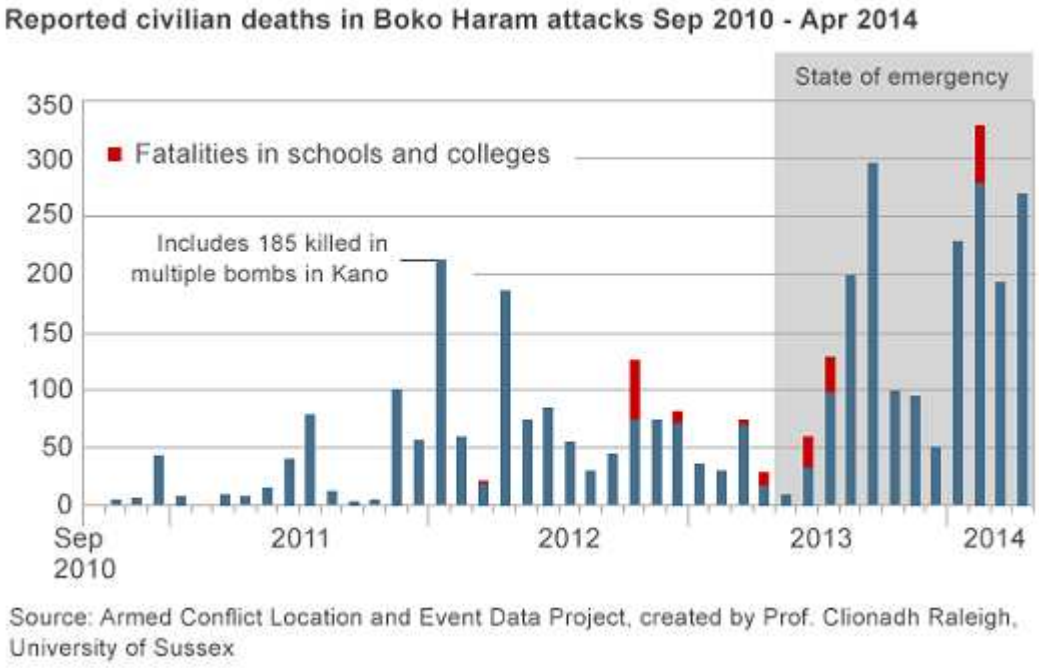

Figure 2

From the data, it is known that the attacks of the sect were intensified during the period of state of emergency.

4.1 Rape and Kidnapping as Weapons of War

Rape and Kidnapping form parts of Boko Haram strategies (modus operandi). The sect uses both methods as weapons of war. On April 15, 2014, Boko Haram attacked a government girls' school in Chibok, Borno state and kidnapped over 250 female students. The effort to secure the release of the girls has remained elusive despite the involvement of the international community in seeking the releasing of these girls. Boko Haram as used these kidnapped school girls as a human shield in order for the military not to attack their location in the Sambia forest. The special assistant to the president on media, Dr. Doyin Okupe while be interviewed on the Cable Network Television (CNN) in New York confirmed that the Nigerian government knew where these girls are being held but the Nigerian Military cannot go after them because any military assault to free these girls will put their lives in danger. This statement was also corroborated that of the Chief of Defence Staff, Air Marshal Alex Badeh who was the first government officials to confirm the location of the abducted girls. If the government has located the kidnapped school girls why are they not being rescued? According to security analysts, Boko Haram sect is using these girls as a human shield to prevent the military onslaught on their camps. The sect is on kidnapping rampage, they continue to kidnap and most of their victims are women. Aside kidnapping, some of the women they kidnap are sexually abused and in some scenarios, foot soldiers of Boko Haram forcefully married some of these women to satisfy their sexual orgy. The raping of women around the surrounding villages close to Sambia forest has made some of the women to flee their homes to neighboring Chad republic. Horwood (2004) in his study Perpetrators and Motivation: Understanding Rape and Sexual Violence in War sees sexual violence and rape as an instrument in a war in order to punish, intimidate, destabilize and to drive people away from their land. This is the case in the northeast of Nigeria where Boko Haram insurgency is concentrated. According to Jennifer Leaning and Tara Gingerich (2005) on their elaboration of the strategy on rape as a weapon of war, they list some factors to be considered as tools for rape to be the aim of combatants:

- Rape instills fear in women and dissuade them from moving around during war
- It dehumanized women and make them to flee conflict
- It is a strategy of aggression

5 The Socio-Economic Implications Of Boko Haram Insurgency In The Northeast Of Nigeria

Aside the human cost in the Boko Haram insurgency, the atrocities of the sect have socioeconomic implications, especially in the northeast where Boko Haram has dominance. The economic, social and psychological costs of the insurgency cannot be quantified. Commercial activities in the northeast have been reduced because of the unprecedented attacks by the sect. Banks, markets and shops do not open regularly due to the fear of the coordinated attacks from Boko Haram. According to Okereocha (2012) human capital and investors drain is hampering economic development in the northeast this is due to the attacks on banks, markets, parks and government departments. The attacks on these commercial areas have led to the migration of people to other parts of the country. Shiklam (2012) posits that:

> *"The Maiduguri Monday Market said to be the biggest market in the city is reported to have been seriously affected as hundreds of shop owners, especially Southerners are said to have closed their businesses and left the troubled city. About half of the 10,000 shops and stalls in the market were said to have been abandoned by traders who have fled the city."*

Aside the migration of people who have business in the northeast to other parts of Nigeria, foreign nationals of Chad, Cameroun and Niger are being repatriated to their home countries for what the government of Nigeria said they constitute the members of Boko Haram. Evidence has shown that not all the repatriated nationals of the above countries are members of Boko Haram. Definitely, those who have business in cities like Maiduguri, Damaturu and Yola will form part of those that are sent homes which will actually affect the economic activities in these cities. Ovaga (n.d) asserts that under this situation, the economy of the northeast will seriously be affected if foreign citizens who contribute large quota to the development of the northeast vis a vis their economic activities are sent back to their countries of origin. The never-ending attacks by Boko Haram in Borno, Yobe and Adamawa states have a severe impact on the economic lives of people living in these areas. A case in point is that the working duration of most commercial banks in the affected areas hit by Boko Haram bombings has been reduced from eight hours to three hours (Mohammed, 2012). "In Maiduguri, Borno state, where the sect originated, the frequent bombings and clashes between Boko Haram and the security agents have weighed down seriously on the commercial and businesses activities in the city as many business have reportedly crumbled while many people have fled the state" (Shiklam, 2012). There is already a dichotomy in the north and south development in Nigeria. The poverty profile released by the National Bureau of Statistics illustrates that there is the prevalence of poverty in the north as compared to

the south. It is in this data that the Businessday newspaper predicted if the insecurity situation continues development in the northern part will remain static and the gap between the north and south will broaden further (BDN, 2012). "The region needs peace and stability more than any region in the country, particularly because the region clearly lagging behind in term of infrastructure, education and other development indices" (Minster of Information, Labara Maku cited in Ogochukwu, 2013). Prominent Nigerians who have bemoaned the economic impact of Boko Haram insurgency in northeast Nigeria including the President Goodluck Jonathan and Northern Governors forum According to Obaremi (2014) "Economic affairs in the north is already depleting due to a massive departure of people and financial institutions from the northern region. But if the government delays in the implementing comprehensive plans to tackle insecurity from its roots, then not only will the northern region be economic desolation, the country as a whole risk losing billion of dollars in foreign direct investment" The business activities of telecom operators have not been left out from the attacks of Boko Haram. For instance, some telecom masts belong to some major mobile telephone operators were destroyed by Boko Haram and the banning of telephone services by the military affected the income generation of some of the mobile phone operators.

Just as the economic implications of Boko Haram atrocities cannot be quantified, the social costs are enormous. The church, school, market, clinic and mosque are potential targets of Boko Haram. For example, in April 2014, a federal government girls' college was attacked which subsequently led to the abduction of over 250 female students. Attacks on these social places have prevented people from going to these places. Some students have stopped going to school, others have been transferred to the southern part of the country to continue their education. Christians are afraid to go and worship in the church on Sundays due to the fear of being attacked by the sect. Same for the muslim faithfuls who abandon their worshiping centers because of Boko Haram attacks. The markets have become deserted. The National Youth Service Corps (NYSC) that was created by the government after the end of Nigerian civil war to foster unity among Nigeria is under threat due to Boko Haram attacks. The NYSC directorate posted 4171 corps members to Adamawa state, 1041 of the corps members have to abandon their national duty due to the precarious security situation (Ovaga (n.d.). Some parents from the south of the country have protested vehemently against the posting of their children to the northeast. Aside the socioeconomic implications, the human cost is more worrisome, more than 10.000 have been killed, a lot of people have been maimed and women have been kidnapped and raped These have left the family of the dead, the injured, the raped and the kidnapped in agony. In a nutshell, most of the family members of Boko Haram victims are going through a traumatized period. Many have left their homes and over 650 thousand Nigerians have been displaced according to the United Nations High Commissioner for Refugees (UNHCH).

6 RECOMMENDATIONS

- The Nigerian government needs to initiate policy that will generate employment for the army of unemployed youths in the country.
- Boko Haram has sponsors, the government should go after those financing the operations of the sect.
- The government should open a dialogue channel in order to know what are the grievances of the sect.
- Reports from the battlefield indicate that security personnel are not being provided with modern fighting equipment. The government should endeavor to supply the army with sophisticated military equipment.

7 CONCLUSION

It can be said that the activities of Boko Haram constitute a serious threat to the development of Nigeria. Aside the socioeconomic implications, the human cost is of great concern to everybody in Nigeria. Thousand of people have been displaced due to the persisted attacks from the dreaded Islamic sect called Boko Haram. The government should wake up from its slumber and end the insurgency for one. The nation cannot continue to lose its citizens on a daily basis from Boko Haram coordinated bombings. It is time to put an end to terrorism in Nigeria and every Nigerian should have the freedom to live in any part of the country without the fear of being attacked by anybody. Finally, this study was based on qualitative research on the impact of Boko Haram insurgency on the socioeconomic situations in the northeast of Nigeria. A quantitative research is needed for further study to investigate the effect of Boko Haram activities on the economy of Nigeria as a whole.

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Political Corruption and Underdevelopment in Nigerian Fourth Republic

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ABSTRACT: Political corruption has been blamed for the continued underdevelopment of Nigeria. Despite the creation of two anti-corruption agencies, corruption still strives in Nigeria. This study was undertaken to evaluate the impact of corruption on national development in Nigeria fourth republic. The study relied on secondary source of data collection. From the findings of this paper, corruption takes place in the executive and legislative arms of government. Furthermore, the study pinpoints how corruption by the political class hinder development in Nigeria. Finally, the study outlines some suggestions to prevent corruption in the government circle in order to move the country forward.

KEYWORDS: Democracy, Developmet, Fouth republic, Financial corruption, Political corruption, Undervelopment.

1 INTRODUCTION

The term 'first republic' in Nigeria was the period when Nigeria became a republic after independence from Great Britain in 1960. The era lasted from 1963 to 1966 because of the military intervention in the governance of the country which brought the first republic to an abrupt end (Akanade and Akanade (2011). The first republic was characterized by ethnicity, nepotism and an unprecedented level of corruption. According to Ogbeidi (2012) " the First Republic under the leadership of Sir Abubakar Tafawl Balewa, the Prime Minister, and Nnamdi Azikwe, the President, was marked by widespread corruption. Government officials looted public funds with impunity. Federal Representatives and Ministers flaunted their wealth with reckless abandon. In fact, it appeared there were no men of good character in the political leadership of the First Republic. Politically, the thinking of the First Republic Nigerian leadership class was based on politics for material gain; making money and living well." Due to the level of corruption and other reasons best known to the military, it then toppled the government of Sir Abubarka Balewa. The installation of civilian government in 1979 by the military paved way for the second republic in Nigeria. The second republic lasted for only four years because the military accused the politicians of a high level of corruption. Many prominent politicians were jailed for financial corruption by the military junta. The third republic in Nigeria did not last because it was derailed and truncated by the General Ibrahim Babangida's administration.

The fourth republic commenced with the handover of power by the military administration to a democratic elected civilian government on May 29, 1999. The return of democratic governance was greeted with widespread jubilation. However, fifteen years of uninterrupted democracy, the country has witnessed a resurgence of corruption which has undermined national development in Nigeria. The worrisome trend in the magnitude of financial corruption by politicians prompted the Obasanjo's government to introduce two anti-corruption agencies, the Economic and Financial Crime Commission (EFCC) and the Independent Corrupt Practices Commission (ICPC). Taking into cognizance of the history of corruption in Nigeria since independence, the Obasanjo led-federal government introduced two special anti-corruption agencies to checkmate the devastating effect of corruption in the Nigerian economy (Ogbeidi 2012). Ogundiya (2012) asserts that corruption is so rampant in the fourth republic that in every newspaper front page cover always carries news about financial corruption by politicians. It is argued that corruption is the bane to Nigerian development and it retard economic growth. It remains an insurmountable problem (Ayobulu, 2006). It is an impediment to Nigeria economic and political progress (Sachs, 2005). "It is a canker worm that has eaten deep in the fabric of the country and had stunted growth in all sectors" *(*Economic and Financial Crime Commission (EFCC), 2005). It has been the primary reason behind the country's underdevelopment (Independent Corrupt Practices Commission (ICPC), 2006). Smith (2007) posits that in all the challenges

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Nigeria is passing through, corruption remains the main obstacle to Nigerian development that has increased poverty and inequality. Subscribing to this notion, renowned novelist, Chinua Achebe in his epic book, 'The Trouble with Nigeria' emphasized that the trouble with the country called Nigeria is that political leaders use the instrument of power to commit and maintain corruption (Achebe 1983). It is in the backdrop of the proclamation by Achebe that this paper has investigated corruptions in the Nigerian context and how corruption has hindered the development of the country and the study provides some recommendations in order to fast-track growth and development of the Nigerian economy.

1.1 CLARIFICATION OF CONCEPTS

In order to give credence to this study, it is necessary to define corruption and underdevelopment.

1.2 CORRUPTION

Corruption in the layman's language means using one's position to collect bribe from someone who is in need of assistance such as seeking for admission into a higher institution or seeking for an employment in an establishment. Corruption goes beyond this, the World Bank conceptualizes corruption as:

> *"The abuse of public office for private gains. Public office is abused for private gain when official accepts edicts or extorts a bribe. It is also abused when private agents actively offer bribes to circumvent public policies and processes for competitive advantage and profit. Public office can also be abused for the personal benefits even if no bribery occurs through patronage and nepotism, the thief of state assets or the diversion of state revenue."*

Given credence to this definition, Salisu (2000) encapsulates corruption to mean the mismanagement of public funds for private gain. For instance, funds that are supposed to be used for development purposes in Nigeria are pocketed by politicians at the detriment of the nation's development. Atelhe and Agada (2014) make us understand that political corruption happens in a democratic setting. It rears its head when politicians and political decision makers who are the custodian of the law for the benefit of all are corrupt. Political corruption is unlawful, immoral and unofficial exploitation of one's political position for personal gain (Nager et al (2013). For various forms of political corruption see (Bayart et al. 1997; Girling 1999; Fairbanks, Jr. 1999) for details. Also see Obayelu (2007) for causes of corruption in Nigeria.

1.3 MAKING SENSE OF UNDERDEVELOPMENT

Academic scholars from the West believed that African underdevelopment is caused by the mode of production imposed externally (Zambakari, 2012). Some scholars such as (Amin 1972; Rodney, 1972) are of the views that Africa system of penetrating into the world economy is responsible for its underdevelopment. Other academic scholars blamed the condition imposed by the Breton Wood Institutions i.e the World Bank and International Monetary Fund (IFM) on Africa for its underdevelopment see (Amin, 2010b; Easterly, 2001; Goldstein & Montiel, 2007) for more details. On the other hand, (Amin, 1990; Arrighi, 2007) assert that the problem of underdevelopment in Africa lies with the system of production and the capitalist system. However, new research by African scholars has put the blame of the continent underdevelopment on the doorstep of African leaders. They argued on this hypothesis that corruption in Africa leads to the continent's underdevelopment. This assumption is based on that funds that would have been used to develop the continent are stolen by African leaders and splashed in foreign accounts overseas. The proponents of this theory are (Nageri et al. 2013; Agbiboa, 2012; Maunro, 2007; Obayelu, 2007; Sachs, 2005; Smith 2007). Underdevelopment means when a nation's potentials or resources are not fully utilized for the benefit of all in a country. Walter Rodney makes us understand that underdevelopment is not the absence of development (Rodney, 1973). If so, what then is development? "Development in human society is a many-sided process. At the level of the individual, it implies increased skill and capacity, greater freedom, creativity, self-discipline, responsibility and material well-being" (ibid). In a similar vein, (Seer, 1977; Goulet, 1978; Egharevba, 2007; Lawal, 2007) conceptualize development as the growth in human society that incorporates quality of life, equality, income distribution, social justice. At the same time, development entails economic, political and cultural transformation.

2 REVIEW OF LITERATURE

What is the cause of the third world underdevelopment? This issue has polarized the academic world into three groups. The modernization theorists such as Emile Durkheim, David Apter, David McClelland and Wait Rostow argued that developing countries have to follow the development path of Rich Western Nations before they can develop. However, the dependency school of thought that has the likes of Walter Rodney, Francois Perrous, Kurt Rothschild, Walden Bello and

Kunibert Raffer counter the modernization theorists assumption of underdevelopment in third world countries. Their argument is that the rich Westen nations are responsible for the underdevelopment of countries in the global south. The third group that has emanated from what Samuel Huttenton called the 'conflict of interest' is the African scholars that posit that African leaders are the cause of the economic woe of the continent. In the fold of this new school of thought are (Nageri et al. 2013; Agbiboa, 2012; Maunro, 2007; Obayelu, 2007; Sachs, 2005; Smith 2007). Their hypothesis is based on the fact that Africa is endowed with natural resources and money that is accrued from the sale of the mineral resources to other countries that are supposed to be used to increase the quality of life for Africans are misappropriated by African leaders. It is on this account that Adewale asserts that "corruption is an act of diverting the resources that should have been used for the developmental purposes of the society to private or personal use. The accumulation of the nation's economic resources for personal benefits had variously contributed to the leakage of capital from Nigeria for illegal deposits abroad." He further stated that corruption has a crowding effect on the growth and development of the country. "Its contributing effects on poverty and poor infrastructural development is more worrying." (Adewale 2011 cited in Nagari et al. 2013). Fabayo et al. (2011) take a critical look at the impact of corruption on investment in Nigeria using the Ordinary Least Square modus operandi and the Transparency International (TI) corruption index between 1996 to 2010. In their analysis, they revealed that Nigeria is always at the bottom of (IT) rankings which indicated that the increased high-level of corruption in Nigeria leads to lower investment drive and slippery economic growth. In a similar study, Akindele (2005) evaluates the interface between corruption and development. The empirical results of the study after using some economic variables denote that corruption hinder economic development. He concluded that there is a strong negative relation between corruption and development nexus and corruption remains the core barrier to the development of any society. Further to this, Adewale (2011) examines the crowding-out effect of corruption in the Nigeria fourth republic. Using the simulation approach to evaluate the effects of financial corruption in Nigeria. He pinpoints from his empirical findings that corruption retards economic growth in Nigeria which implies that corruption has a crowding-out impact on economic growth. In addition, new African scholars in the horizon such as (Nageri et al. 2013; Agbiboa, 2012; Maunro, 2007; Obayelu, 2007; Sachs, 2005; Smith 2007) are of the view that corruption is the bane to African development.

3 THEORETICAL FRAMEWORK

For the purpose of this study political elite theory will be our operational guide.

3.1 POLITICAL ELITE THEORY

Elite theory is a theory of the state that described the power relationships in a contemporary society. The theory asserts that a small clique (minority group) composing of members of the political class and the policy making network hold the most power in a state and they exert substantial power over policy decisions. Vergara (2013) posits that the elite is a small powerful group that controls large amount of power. Pareto (1963) emphasized the psychological and knowledgeable power that the political elite has obtained and he considered them to be the governing elite. The political elite is a cabinet of people that control the reign of government (Vergara (2013). In the Nigerian context, the political elite is a group of people you see in government institutions such as the Presidency, National Assembly and the Federal Executive Council that control government machinery. At the state level, they control government apparatus. They include governors and members of the State Houses of Assembly. Renowned constitutional lawyer, Professor Itse Sagay has berated the political elite in Nigeria for the country's underdevelopment. He accused members of the National Assembly for consuming large amount of the country's wealth as salaries at the expense of Nigeria's development. The former Central Bank of Nigeria Governor Sanusi Lamido corroborated this fact when he said in 2010 that the National Assembly members that are less than 1 percent of the population consumed 25 percent of the nation's budget. Billions of dollars have been mismanaged by the ruling class since independence which have dragged the country's development into crisis. The former EFCC chairman Nuhu Ribadu and the former World Bank Vice President for Africa Oby Ezekweleze have estimated that over 400 billion dollars have been stolen from the Nigerian coffer by public office holders since independence. Corruption breeds poverty and that is why there is the prevalence of poverty in Nigeria. In a similar manner, poverty breeds insecurity. The security challenges befalling Nigeria has been blamed for the high-level poverty in the country (Awojobi 2014).

4 POLITICAL CORRUPTION IN THE FOURTH REPUBLIC (1999-2014)

The first, second and third republic in Nigeria was characterized by widespread corruption that gave the military the impetus to overthrow democratic governance. The irony of this is that even the military that came into power in some instances to save the country from the grip of Kleptocratic government (rule by thieves) are enmeshed in an unprecedented level of corruption. The fourth republic has not been exempted from widespread corruption despite the two anti-corruption

agencies that were created by the Obasanjo's administration. The next section will analyze financial corruption in government institutions since 1999 to 2014.

4.1 Financial Corruption in the Presidency and Federal Executive Council

The Presidency is the highest political office in Nigeria and it has been enmeshed with corrupt tendency. During the reign of Obasanjo from 1999-2007, the presidency was involved in a corruption scandal. For example, the former vice president, Atiku Abubakar was indicted by Senate committee set by the Senate Chamber to investigate the vice president role in the activities of the Petroleum Technology Development Fund (PTDF). Aside the vice president, Obasanjo also used his influence as the president of the country to acquire shares at Transcrop. Further to this, Obasanjo used his political power to persuade the economic elite of the country to build a presidential library for him in Abeokuta. In addition, the 16 billion dollars that was budgeted for power generation in the 8-year reign of Obasanjo cannot be accounted for since there is still erratic power supply in Nigeria. Yar'Adua succeeded Obasanjo in 2007. The Yar'Adua seems to have a clean bill of health on corruption. However, he was accused of bowing to the whims and caprices of the politicians who bankrolled his election to remove the dogged former EFCC chairman, Nuhu Ribadu. Just like Obasanjo, the incumbent president, Goodluck Jonathan was embroiled in a controversy when an Italian construction firm built a church as a gift to the president in his home community of Otuoke in Bayelsa state. The president Jonathan has also been accused of conspiracy silence in the corruption allegation levelled against the Minister of Petroleum. Furthermore, the incumbent president have been berated for granting presidential pardons to convicted political criminals. Among the federal ministers since 1999 that have been accused of corruption included Sunday Afolabi, Fabian Osuji, Hussaini Zannuwa Akwanga, Alice Osomo and Stell Oduha.

4.2 Financial Corruption in the National Assembly

The National Assembly is the watchdog of the executive arm of government. The separation of power in the presidential system of government allows the National Assembly to checkmate the excess of the Executive which include financial monitoring of Budget spending. However, since the installation of democracy in Nigeria in 1999, some members of the National Assembly have used the legislative power bestowed on them to enrich themselves illegally. Take for instance, two former Senate presidents, Chuba Okadigbo and Adolphus Wabara were involved in a corruption scandal. Other Senators and honorable members of the national assembly that have been engulfed in corruption scandals include Chimaroke Nnamani, Iyabo Obasanjo, Dimeji Bankole and his deputy, Patricia Etteh and her deputy, Farouk Lawal, Boniface Emanalo, Ndudi Elumelu and Herman Hembe. However, the likes of former speaker Dimeji Bankole and his deputy, and Edudi Elumelu have been exonerated by the civil court of corruption charges.

4.3 Financial Corruption at the State Level

Corruption at the federal level is also being replicated at the state level. Just of recent the Minister of Finance tasked Nigerians to ask their governors what are they doing with the federal allocation they do receive from the federation account. She made this suggestion because the huge allocation to some of the states did not indicate the presence of physical development in these states. In a nutshell, what this indicates is that most of the governors are using allocation to these states for their personal gain. That was the reason the former EFCC chairman Nuhu Ribadu 2006 once said that 31 state governors have corruption cases to answer. However, when Ribadu was replaced by Farida Waziri, she let Nigerians know that the case files of the 31 governors were missing up to this present moment. Among the former and present governors in the fourth republic that have been convicted and have corruption cases with EFCC are Diepreye Alamieyesigha, James Ibori, Uzor Kalu, Genga Daniel, Alao Akala, Rashid Ladoja, Samimu Turaki, Jolly Nyame. Others are Lucky Igbinedion, Boni Haruna, Attahiru Bafawara and Adamu Abdullahi.

5 How Political Corruption Undedeveloped Nigeria In The Fourth Republic

Corruption is a by-product of underdevelopment. In Nigeria, funds that are allocated to the development of the country after the installation of democratic governance in 1999 are mismanaged by political office holders. For instance, the Minister of Finance bemoaned the absence of physical development in most states of the federation despite the huge federal allocation to these states. According to Ngwube and Okoli (2013) corruption leads to the use of resources to finance elephant projects at the expense of infrastructural development such as schools, hospitals, roads, water supply and electricity supply. Osoba (1996) cited in Alemika (2012) posits that financial corruption dent a nation's capacity to provide the basic necessity of life for the populace. Political corruption is the main factor responsible for Nigeria underdevelopment in all sectors (Egharevba and Chiazor, 2012). "The is significantly so because the greatest challenge to Nigeria's development are Nigerians

themselves as represented by the political leaders who should be held responsible for the present pathetic state of underdevelopment in the country" (Falola, 2005). Since democracy berth in Nigeria in 1999, corruption has constituted a major hindrance to development in the country. For the past 15 years, budgetary allocations for infrastructure development have not yielded any positive achievement. For instance, billion of dollars were allocated for the Turn Around Maintenance (TAM) of the four refineries, yet the refineries are not working to full capacity. The health and the power sectors are in comatose due to corruption. Furthermore, the majority of the federal roads are dead traps because funds that are allocated for the maintenance these roads are mismanaged. The former governor of Abia State, Uzor Kalu once accused the former Minister of Works Tony Anenih of the embezzlement of N3 billion that was meant for the maintenance of federal roads. Corruption in Nigeria has been blamed for the high-rate of poverty in the country, for example, the official released of the poverty profile of Nigeria by the National Bureau of Statistics (NBS) revealed that 112 million Nigerians live in relative poverty. This data was supported by the confirmation of the United Nations Development Programmes (UNDP) representative in Nigeria that said 100 million Nigerians live in destitution. Just of recent, the World Bank named Nigeria as the third country in the world with a large number of poor people. Poverty is a by-product of insecurity. The security challenges that are facing Nigeria have been blamed on the high level of corruption and poverty in the country. The hypothesis is that corruption breeds poverty and poverty breeds insecurity. Despite the government effort through the two anti corruption agencies to curtail corruption. The menace still continues unabated. The EFCC has been accused of not doing enough to prosecute corrupt politicians. The president has also been accused of using the EFCC to go after political opponents. Former United State Secretary of State, Hilary Clinton accused the EFCC under the leadership of Farida Waziri of inept. Nigeria has always remained at the bottom of the (TI) corruption index ranking because of the high-degree of corruption in the country (Adesote and Abimbola (2012). Protagonists of the corruption lead to underdevelopment hypothesis are (Nageri et al. 2013; Agbiboa, 2012; Maunro, 2007; Obayelu, 2007; Sachs, 2005; Smith 2007). According to Adesote and Abimbola (2012), "there is a correlation between financial corruption and national development in Nigeria. The essence of financial corruption is bribery and illegal and greedy acquisition of public funds into private pockets, which otherwise would have been invested for the public good. Financial corruption undermines democracy and the legitimate of the state, reduces the potential for economic growth, and threatens the freedom and security of citizens, altogether constitutes hindrances to national development." Mohammed (2013) gave a summary how political corruption hinders development in the new democratic dispensation in Nigeria:

- Poor social welfare
- Loss of public trust and legitimacy by the government
- Increase insecurity
- Increased poverty and unemployment
- Low investment

Aside all these, one main area that corruption has hinders is the decay in infrastructure. For instance, health services, water supply, power supply, good roads, sound education are a mirage in the fourth republic, despite the promised made to Nigerians during election campaigns that all these areas will be addressed by the new democratic government. Fifteen years after, the story remains the same or even getting worse and this is one of the reasons Nigerians have turn India to their medical tourism because of inadequate medical facilities and manpower at the government hospitals.

6 SUGGESTIONS AND CONCLUSION

6.1 SUGGESTIONS

- The government should strengthen the powers of the EFCC and ICPC in order for the two agencies to prosecute corruption offenders without delay.
- There is a need of the independence of EFCC in order to prevent government interference in its operations.
- Special anti-corruption court should be established to quicken all corruption cases.
- The government should stop granting pardon to convicted political criminals.

6.2 CONCLUSION

Corruption hinders development and economic growth. It increases poverty and dent the image of a country. The total eradication of corruption in Nigeria should involve everybody and not only the government. For Nigeria to move forward and for the citizens to benefit from the democratic dividends a national awareness campaign is necessary to let Nigerians know the implications of corruption on the economy. Furthermore, the government should take the giant stride to lead by example

by inculcating good governance, transparency, accountability in order for Nigerians to have hope in the democratic governance.

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Interactive Television: Knowledge, Attitude, Practices and Potential Opportunities in India

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ABSTRACT: This research focuses on the study of the uses of TV and the potential for interactive TV services among the Indian users and operators. A survey and in-depth interviews were conducted as part of the study. The results show that TV, computer and mobile phone usage is high among the respondents. Concerning TV viewing habits, most do it in a collective manner. While watching TV viewers do other activities like working on computers, speaking with others and domestic work. Two thirds of the participants regularly recommend TV programs, but they do it in traditional ways, none mediated, since the iTV domain in the Indian market is still in its early stages. Regarding the expectations for upcoming iTV services, the majority of respondents are highly interested in having more interactive services for communication, recommendation; participation in shows/contests and a small percentage for shopping through the TV. There is a warm welcome for social interactive features in TV among the users and operators. The study has also confirmed that there is a good scope and market for ITV services.

KEYWORDS: iTV, Social iTV, Viewing habits, India, TV Distribution.

1 INTRODUCTION

Media technologies and content have a very important place in society. Television (TV) is holding an important role among them. Some may argue TV is an idiot box, some say that is an intellectual box, but TV proves itself to be an inevitable box.

TV provides information and entertainment and also supports communication (Kalwachwala and Joshi, 1990). It has emerged as a remarkable medium of communication and has revolutionized the lives of people (Reddi, 1994). TV proves to be a medium which can be used effectively to reach and teach (Kumar, 1998). Its penetration and usage are remarkable in developing countries providing an opportunity for benefiting from innovative features and programs (Arulchelvan, 2010).

TV has faced many innovation and developments from its inception. Interactive television (ITV) is a central issue in the TV industry nowadays. It offers the immediacy of interaction with content allowing instant feedback and a wide variety of interactive applications. People can use it in three ways as to control TV shows, buying products/ services and for voting on shows (Burke, 2011).

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Since, the earliest days, producers were trying to make their programs more dynamic through participation. *Winky Dink and You* is one of the best earliest attempts. The 1964 AT&T's picture telephone was also one of the earlier innovations in video interaction (Constantakis-Valdez, 2011). During the 1970s, the most publicized ITV experiment was QUBE.

1.1 SOCIAL INTERACTIVE TELEVISION

Social Interactive Television (SITV) is a recent development in the area of ITV. It focuses on new opportunities to the viewers to socialize through the TV screen. Features associated with SITV include inviting friends to share video content and to start viewing at the same time (Oumard et al., 2008). SITV features include sharing the TV presence information, freeform communication and enhanced information (Cesar and Chorianopoulos, 2008, Harboe, 2009).In this area, SMS TV chat and AOLTV were one of the first solutions to be launched. In 2001, the research community started exploring SITV in projects like 2BeOn, from the University of Aveiro. AmigoTV from Alcatel, Media Center Buddies from Microsoft Labs and ConnectTV from TNO are other successful pioneer SITV experiments. Meanwhile a number of corporate research labs like Alcatel-Lucent, Microsoft, Google/Motorola, PARC, AT&T, and Siemens have been developing their SITV prototypes/concepts (Harboe, 2009).

1.2 USES OF SITV

TV, in its interactive form serves many social purposes, such as providing topics for conversations, easing interaction and promoting the feeling of togetherness (Lull, 1990). SITV offers distant TV viewers a joint TV viewing and communication experience (Schatz et al., 2007). In the 2BeOn experiment, users agreed that the social features lead to a higher tendency to start a conversation, prompted either by viewing the same channel or by direct channel recommendations (Abreu and Almeida, 2010). This was confirmed in the SITV2 experiment that showed that participants wanted to be aware of their friends' availability and with the support of that information; they were motivated to interact with them. Once they were viewing together (mediated by the iTV platform), they would usually send messages/emoticons and sometimes this would end up with a phone call (Harboe et al., 2008). A survey of the Connect TV experiment showed that more than half of the participants were interested in the ITV services and willing to pay for the services (Boertjes et al., 2010).

A more recent research project, WeOnTV, was implemented and tested in Set-Top Boxes of a commercial iPTV service in Portugal. It showed that participants were highly motivated for chatting while viewing TV, for sharing the channel they were watching and for sending program recommendations to their buddies (Abreu et al., 2009).

Rangaswamy (2008) said that, the TV viewing is overwhelmingly shared and diverse among people. Adoption of interactive TV technology and services, offering novel design to fit contexts will be good for the next generation of TV industry. The referred projects and other results from literature are clearly showing that there is a growing field for Interactive TV.

2 TV MARKET IN INDIA

India is the world's third largest TV market with 138 million TV Households next to China and USA. Cable and Satellite penetration has reached close to 80%. The TV and broadcasting industry has grown tremendously over the last two decades, with double digits. The industry counts for more than 600 million viewers and an offer higher than 550 channels. Even though India is the largest media consuming market, the size, scale and profit of the industry is limited. Despite this large penetration of TV, the exploitation of potential interactive services and features is still limited. At the same time, there are 88 million non-TV households indicating the potential for growth (FICCI & KPMG, 2012).

Apart from the 500 channels offer, there are still more than 250 channels waiting for approval as there is a growing optimism. A great demand is expected for satellite bandwidth with the introduction of HD channels, HITS platform, DTH expansion, new channels and VSAT (FICCI & KPMG, 2012). The pay TV offer in India includes: 1) Cable TV; 2) Direct-To-Home (DTH) - via satellite, and; 3) Internet protocol TV (IPTV). Pay TV households increased to an average of 100 million (PWC, 2012).

2.1 TV DISTRIBUTION CHARACTERISTICS AND OPERATORS

The TV distribution industry has been mainly run by small operators. The emergence of large operators (MSO) has been changing the market, mainly in the major cities were they are concentrated (Nokia, 2011). Cable TV forms the backbone of the distribution. It has a wide penetration supporting almost 74 million subscribers. The cable industry is still dominated by

analogue connections (PWC, 2012). Digital cable TV is also gaining popularity (Changrani, 2011). Digital cable subscribers reached more than 5 million in 2012. But the growth is limited because it requires large upfront investments in infrastructure (FICCI & KPMG, 2012). Therefore, 90% of the digital market in India is DTH based and only 10% by cable (Srinivasan, 2011).

DTH subscriber base has expanded from 0.75 million in 2005 to more than 30 million in 2011. DTH is expected to cross the 50 million subscribers mark and will be bigger than both North America and Western Europe by 2014. IPTV also has constraints like digital cable in terms of last mile connectivity. The technology is promising due to its superior quality and interactive services but the reach is limited to households having broadband. Both capital and operating costs are higher for IPTV players (FICCI & KPMG, 2012).Though broadband connectivity and the users have increased, the speed is still not up to the level. IPTV connections provided by government organizations such as BSNL&MTNL seem to be growing. However, there are less than one million IPTV users, which are negligible. Now, with the arrival of 3G, some players have started to offer mobile TV. Though the tariff plans seem attractive, bandwidth remains an issue. TV content requires larger bandwidth than normal data services (PWC, 2012).

Service providers are trying to offer triple play services in India to grow their fixed line business, increase the ARPU of broadband and heading towards convergence (Shariff, 2008). MTNL was launched in 2007 and BSNL has recently joined. Other private players are planning to enter. Many technologists believe that as triple-play mandates a unified infrastructure to support a range of services, it represents the next step in convergence getting high attention from telecommunication companies (Bahri, 2009). But the triple-play services are not expanded commercially in India.

3 MOBILE PHONE & INTERNET USAGE IN INDIA

India has the fastest growing telecom network. India's public sector BSNL is the 7th largest telecom company in the world. India is expected to overtake China to become the world's largest mobile market this year, 2013. (TSI, 2011).

Mobile phone subscribers count for 906.6 million (73%) of the total population now and 699 million active users and it is increasing 20 million/month. Among the subscriptions 70.6 million (6%) have 3G subscriptions (Mobithinking, 2013). Internet penetration in India reaches about 150 million and out of that 50 million is through mobile phones (SandeepAggarwal, 2013). 3G mobiles and services are going cheaper day by day. Almost every major web site like Facebook, Twitter, Orkut and Gmail has got their mobile versions, so that there is easy mobile internet access. WordPress, Blogger have also come out with numerous plugins to make them mobile friendly (Kartik, 2011). India will add 30 million new Internet users in 2013 reaching a total of 180 million. This implies a 20% growth in Internet users. An Internet user in India on average is spending 13 hour per week and this number will likely reach 16 hours per week. The incremental time spent online will largely be spent on social media, photo/video sharing, E-Commerce, and utilities/banking/bill payments. Mobile Internet penetration will go up from 6% to 10% and it could double at 100 million estimated by end of 2013. So far India's Internet usage is heavily oriented towards male gender and for work and educational establishments. In 2012 E-Commerce reached $550 million in gross revenue and it is expected to touch $900 million in gross revenue by the end of 2013. India Internet advertising generated $300 million in revenue in 2012 and can double in 2013 to reach $600 million (SandeepAggarwal, 2013).

According to a study from Nokia in collaboration with Cornell University, the Indian Smartphone users prefer business-focused apps such as e-mail and expense managers. 77% of them use approximately 30 apps. Female are active in social networking apps with 43% using this apps. Social networking apps got top followed by music, business, utilities and games. 18-24 age groups are pointed out to obtain and use social networking apps. 31% of people use apps while they lounge at home whereas 29% prefer them on the go. 48% smartphone owners use these apps throughout the day and 22% like to log in and out two to three times on a week. 58% refer they select applications based on their beneficial values whereas 48% liked staying in tune with changing times (Nokia, 2011).

Nielsen &Informate Mobile Intelligence reveals that smart phone users spend more time on the Internet than voice calls and SMS. In average users spend 2.30 hour and 72% of that time goes into gaming, entertainment and Internet, only 28% goes to voice calls and SMS. Younger's preferred browsing while. 31+ year olds spend more time on classic phone related tasks (Vadlamani, 2011).

Considering TV adoption, India has high penetration of TV sets. A large numbers of people are already using the latest media and communication tools. Therefore, some TV operators are already integrating some partial type of interactive features on their channels and programs.

In this context, there is a need to study the people's expectations for ITV. It will help to know the people's prospects and their interests. For that a study was carried to know the expectations of the viewers and their opinions towards ITV.

The specific goals of this study include: i) to understand the uses and behaviour towards TV and ITV ii) to collect the expectations towards ITV and Social iTV and; iii) to pave the way to the identification of guidelines on how to develop iTV and specially SiTV applications in India; iv) To know the operators and broadcasters stand about the SiTV.

4 METHODOLOGY

To gather information on the expectations of Indian population towards Interactive Television a two stages research was conducted.

First, an online survey was conducted through a structured questionnaire targeted at media professionals and students, during the months of November and December 2011. The sample of the surveyed population included mainly media students, academics and media professionals in a total of 200 valid respondents. The decision on this specific target audience was based on the fact that they are early adopters of the new technologies and may embody the future profile of Indian tech consumers. The survey was implemented with the support of a Google spreadsheet and the URL was spread by e-mail and through social networks, namely Facebook. The questionnaire is structured in three sections including personal characterization of the respondents (gender, education level, profession, age and city), ownership of media gadgets (ownership of TV, computers, internet, fixed phone connection, mobile phones), TV and other communication media usage (TV viewing habits, activities while watching TV, TV connectivity type, service providers, operators, interactive TV usage, among others) and expectations for ITV (interest in getting ITV services, interest in social TV related uses and features like sharing program recommendations and comments, the willingness to pay for ITV services, among others).

Two hundred respondents from various cities across India answered the survey. Incomplete questionnaires were removed from the list and 153 were considered valid and used for data analysis. The data gathered, both quantitative and qualitative, was coded in the SPSS software. Different statistical treatment including comparative analysis and chi-square tests was done. The results of the survey are presented in the following sections.

In the second stage of the research, targeted at getting a deeper understanding of the willingness of Indian media professionals and consumers, a demonstration followed by an interview was carried. Users were presented with a Social Interactive TV application called “WeOnTV”. The demonstration was carried to some of the respondents and also to some executives of the different TV operators and channels in southern part in India. Their opinion was collected through in-depth interview. These results are also presented in this paper.

5 RESULTS AND DISCUSSION

5.1 PERSONAL CHARACTERIZATION

As referred, the research gathered a total of 153 valid respondents being 97 (63.4%) male and 56 (36.6%) female from the cities of Chennai, New Delhi, Hyderabad, Bangalore and Madurai.

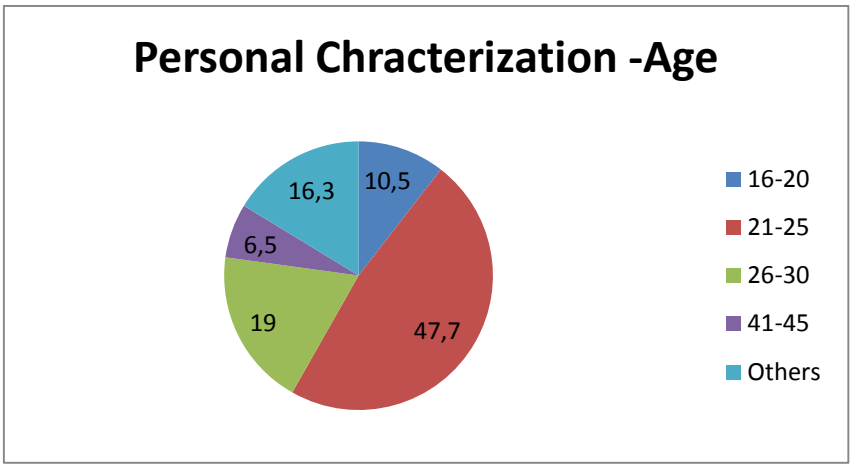

Figure 1.Age Group of Respondents

In this study various age groups of respondents participated from 16 to 70 years. Among the respondents the 21-25 age group is the largest one with 73 respondents (47.7%) followed by 26-30 age group with 29 (19.0%), 16-20 with 16 (10.5%) and the 41-45 age group with 10 (6.5%). All other age groups have negligible figures. The respondents have different level of education from secondary education to Ph.D. 77 Masters (50.3%); Bachelors 33 (21.6%); M.Phil. holders 26 (17.0%) and Ph.D. holders 12 (7.8%). Among the respondents students count for 41 (26.8%), followed by the media professionals like designers, web developers and IT technicians, 34 (22.2%), Professor/Teachers 22 (14.4%), Management professionals 25 (16.3%), Journalists 18 (11.8%) and engineers 10 (6.5%).

5.2 Ownership of Media Gadgets

The possession of gadgets may differ according to the needs, availability and spending capacity. A major part of the respondents (57.5%) have cable connection followed by DTH (42.5%). No one referred having IPTV as this technology is just starting in India.

The data shows that in India the TV connections are shared by Airtel, BSNL, DD, TATA SKY, Reliance and thousands of local cable operators. Regarding the ownership of gadgets, most of the respondents have mobile phones (91%), Internet access (89%) and fixed telephone (64%). TV and communication services are generally interrelated. Indians are not able to get more services from one provider; they are depending on many providers for different media and communication services due to the separate business models.

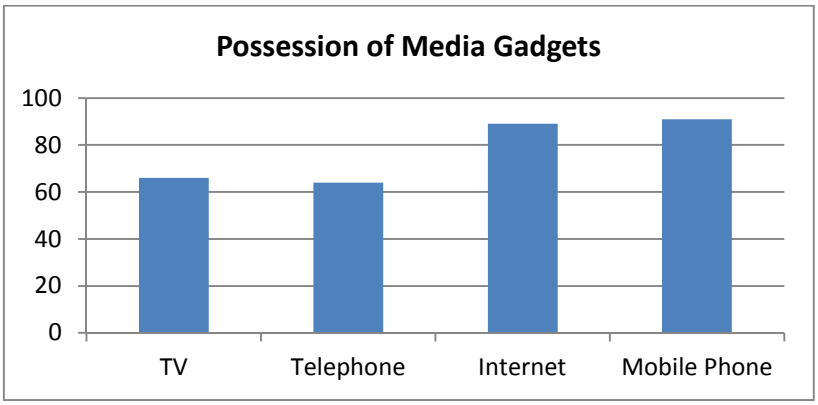

Figure 2. Possession of Media Gadgets

Increasingly houses have more than one TV set. But in India most of the houses still have only one TV set (66%), 1/3 of the houses have 2 TV sets and a minimum number of houses (3.9%) have 3 TV sets. Regarding computer ownership, 62.1% of the households have only one computer, 24.2% have 2 computers; 4.6houses have 3 computers and 2% houses have more than 3 computers.

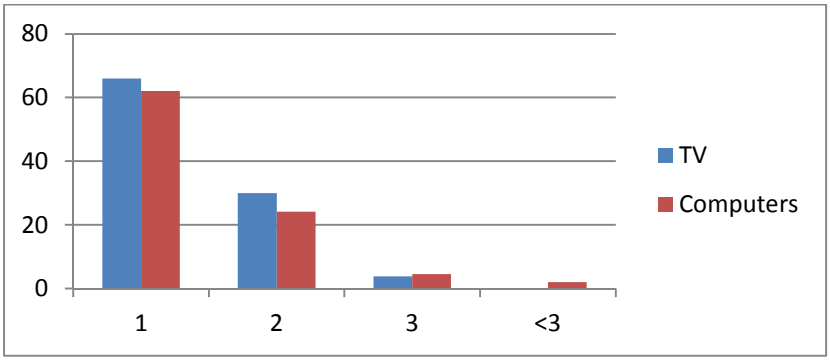

Figure 3. Number of TV and Computers per House

Watching TV is not only done through the TV set as many are using computers and mobile phones to watch it. Respondents are using different gadgets for TV viewing, they mostly use the TV set (97%), 15% watch on computer and a minimum 3% in mobile phones.

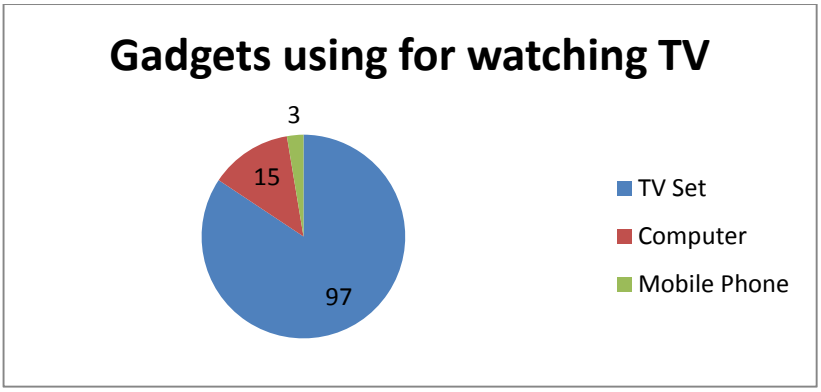

Figure 4. Gadgets Used for Watching TV

5.3 TELEVISION VIEWING HABITS

To better understand the TV viewing habits, some dimensions were observed. Considering the time spent watching TV, a major group (42%) expressed watching TV 1 to 2 hours a day, 26% watch less than one hour, 24% watch 3 to 4 hours and 9% watch more than 5 hours a day. Considering the companion while watching TV, the majority of the respondents (73.2%) do it with others. From those who watch TV with others, a majority is doing it with their family members (83.0%), followed by friends (15.2%), colleagues and other people (1.8%).

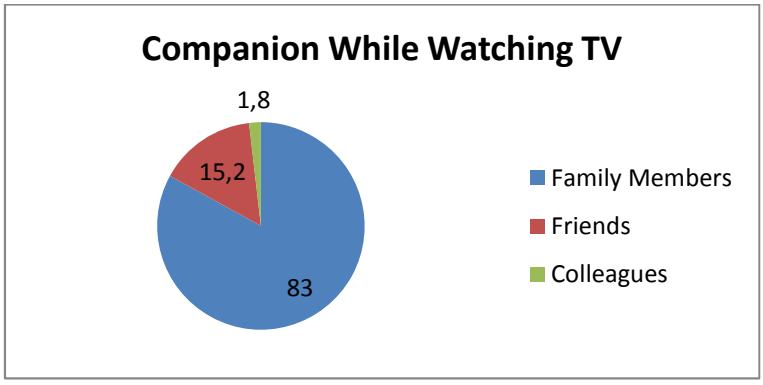

Figure 5. With whom respondents watch TV.

Considering complementary activities while watching TV, most viewers say they are doing other activities (79.7%). It includes talking on the phone 44%, working at the computer 38%, reading 27%, chatting online 23% and 47% doing some other household activities.

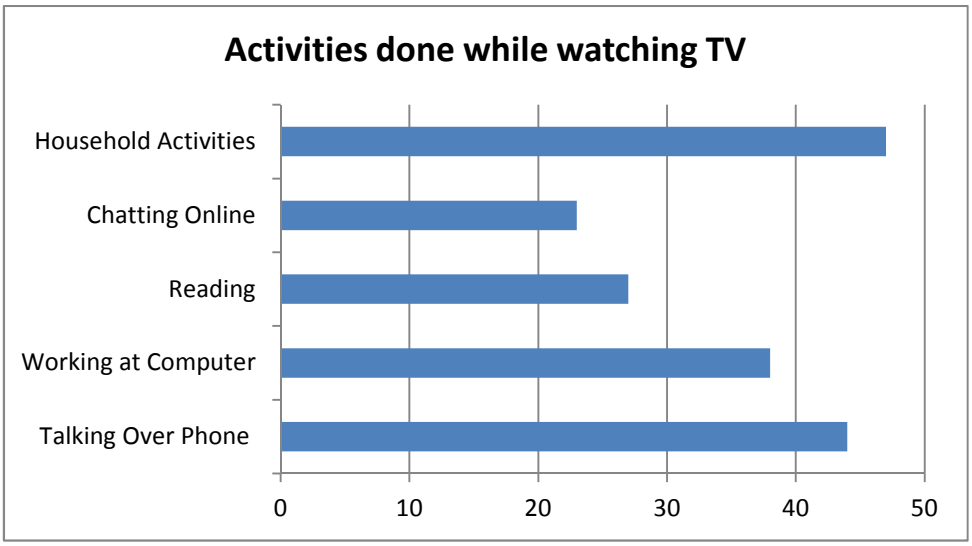

Figure 6. Other activities done while watching TV

Personal recommendation to family members, friends and colleagues are one of the most important and effective marketing techniques for any kind of services/products. Doing that for promoting TV channels and programs is especially effective. With concerns of social behaviors, about 2/3 of the respondents usually recommend programs/shows to others. They mainly do it in three different time slots, including while the program/show is broadcasted, after the program/show and in the following days. These recommendations are mostly done during the program followed by after the program and in the following days.

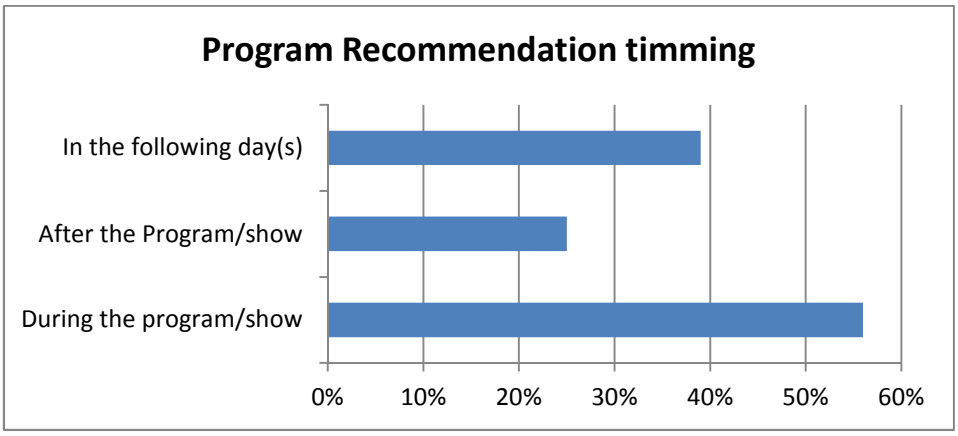

Figure 7.WhenProgram Recommendations are done

To send the recommendations different methods and gadgets are used. Indian respondents are mostly using SMS 61%, followed by phone 48%, in person 44%, through social networks 26%, and finally email 6%.

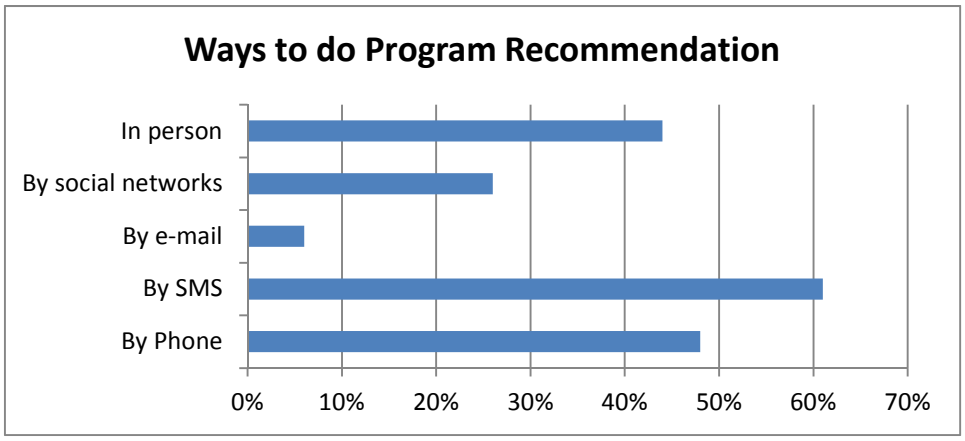

Figure 8. Ways to do Program Recommendations

People have the ability to choose from a wide diversity of programs and shows on TV. They are watching various programs according to their interest, mood, need, availability, etc. Indian people mostly watch movies (71%), followed by entertainment shows (61%), news (61%), music shows (59%), sports (38%), travel (26%), arts (20%), series (17%) and other programs.

Providing feedback about TV shows is a common behavior since the inception of the mass media and communication. The ways to provide that feedback is changing according to the technology availability and literacy level of the audience. Indians are active in providing feedback to TV shows with 20.3% doing it. In the Indian market many TV channels and operators include shopping related shows. This survey reveals that 23.5% of respondents are viewing these shows. But only a small percentage is buying products/ services.

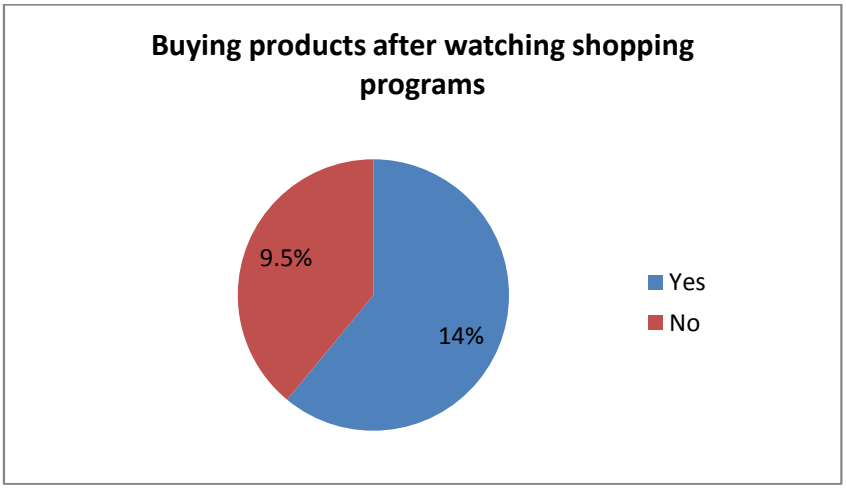

Figure 9.Buying after Watching Shopping Programs

Considering interactive (TV) features, many channels and operators are now providing some types of interactive programs. This study shows that about 26% of respondents are getting interactive programs and services with their providers. From this, Interactive games got the first position with 52% followed by TV shows information with 42%, news with 36%, cookery related interactive applications with 22% and E-Learning applications with 15%.

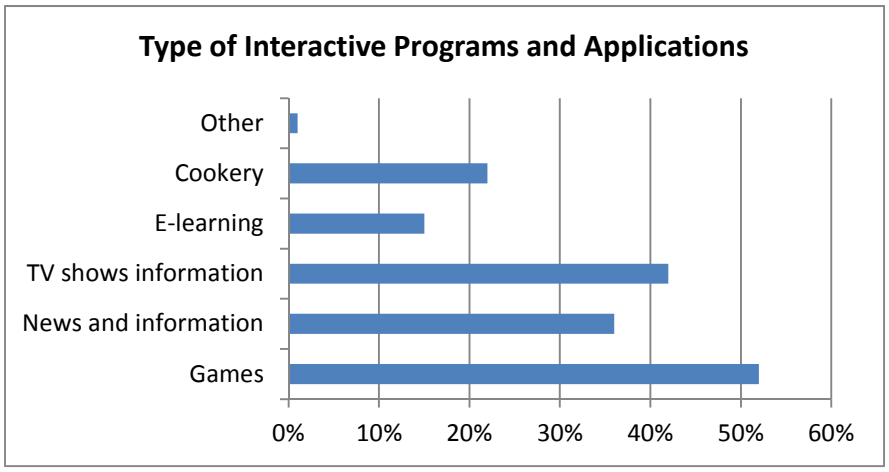

Figure 10. Type of Interactive Programs Watched

5.4 EXPECTATIONS FOR ITV

Although 26% of Indian refer having access to interactive programs, this survey reveals that about 3/4 of respondents (74%) are interested in having more interactive services in their TV. These could support communication, sharing content and recommendations, ordering products/services, interacting with social networks or getting additional information about the shows. The final section of the survey gathered the users' expectations and interests about these features. Considering features related with supporting communication with family members, friends and relatives through the TV, about 50% of respondents point that are most interested in this feature. Recommending programs/channels with others and making comments are strongly highlighted by 26% of the respondents. Participatory TV shows and contests are having more audience, but still they have not attained complete interactivity. About 40% prefer to be most interested in interacting with the shows and contests through iTV. Finally, 10% refer to be most interested in having interactive shopping applications. Considering applications for interacting with social networks, some more significant data appears. About 38% of respondents are most interested in having access to social networks through the TV. Finally, 28% of respondents are most interested in having additional information about the shows, enhanced information.

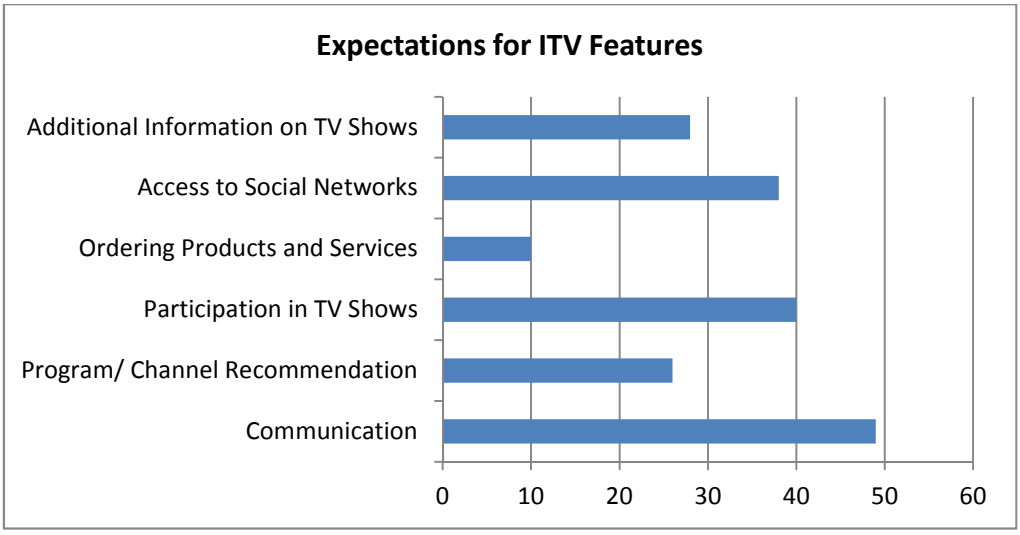

Figure 11. Expectations for ITV Features

TV viewing traditionally is a free activity. But, pay TV services are now emerging. Providing all these interactive features may carry some costs so the users were asked to say if they would pay for these features. 36% express their willingness to pay for it.

5.5 USERS EXPERIENCE WITH THE WEONTV APPLICATION

One fourth of the respondents who participated in the survey were chosen for the second phase of the research. This phase included a demonstration of the WeOnTV prototype and a feedback survey. WeOnTV is a Social TV application for supporting communication around TV content. The application was developed on Portugal's popular IPTV staging platform "MEO".It relies in the integration of Instant Messaging (IM) features on television, compatible with a popular public IM service. Along with IM features WeOnTV allows users to know what others are viewing, to make channel recommendations or chat in multiple formats(Abreu et al., 2009). The prototype demonstration video was shown to 40 users and their opinions were collected through a structured questionnaire. The results and their opinions are presented to understand in the following section.

About 40 respondents (56% male and 46% female) watched the demonstration and provided their feedback questionnaire. Among them, <25 years age group is the most represented (74%) followed by 26-35 year age group (23%). Most of the respondents are students studying master degree courses (82%) followed by bachelor (10%) and a minimum number doing Ph.D. research. They live in Chennai city and nearby towns.

They are mostly aware about SITV applications (67%). But some of them misunderstand SITV with web based social TV platforms like GoogleTV.

Regarding the demonstration of the WeOnTV application, everybody agreed that the application is understandable and more than 50% of them said that the navigation of the application is excellent and 38% said it was good. About the features of the application 96% of respondents said that it is excellent for chatting followed by 90% of them saying that is good for group discussions and 90% of them responded that it is useful for doing channel & program recommendations, 88% of them said that it is useful for program participation, and 85% of respondents said that it is useful for engaging the viewers in social activities.

A majority (62%) of the respondents are most interested is installing and using an application like WeOnTV or other SITV applications and 31% revealed to be somewhat interested. Most of the respondents (84%) said that this SITV application could support them to socialize in their day to day life.

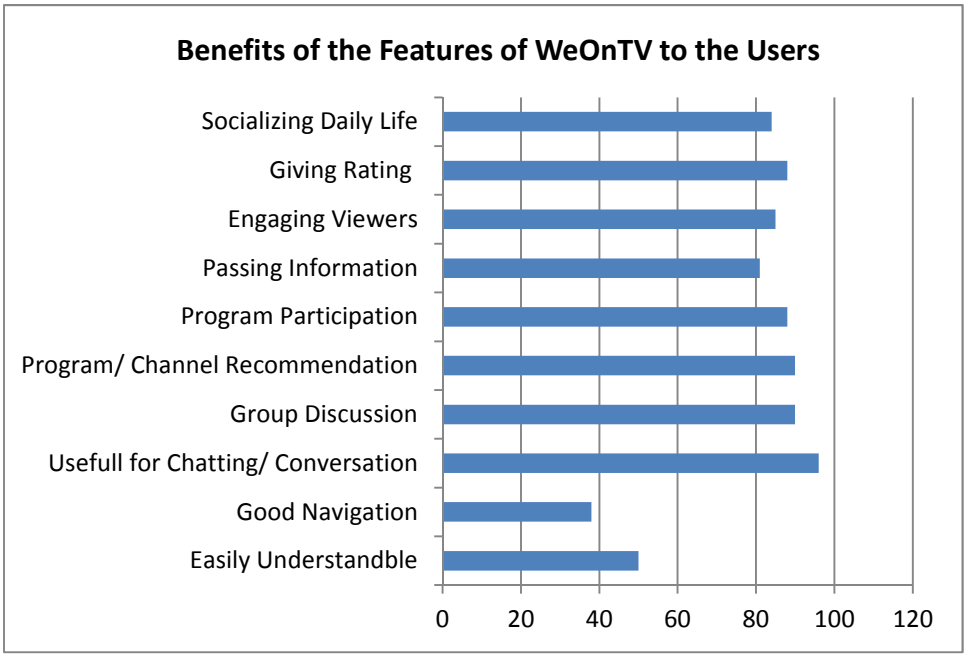

Figure 12. Benefits of the Features of WeOnTVto the Users

SITV and its applications is a new field for the Indian users. They are very excited about the concept but the same time they disclose some other constraints about the same. Some of them provided some negative opinions about SITV application. According to them, it's good, but it is complicated. Some users worried that, "we usually watch TV for relaxation; if interaction comes, it will affect our relaxation". Some other users said, "If we add our friends' means, it's more or less like

social networking sites only, not a TV. We are not interested in sociability in TV because interacting with friends and watching TV will spoil the full satisfaction of TV viewing". A user argued that, for chatting and sharing we have several other media gadgets, why should we use TV screen? Another user pointed that, "people who will use this will definitely get addicted to it". According to few young users, we are not able to get these applications from our operators. First of all we are using bigger TV screen for seeing larger images. But this application decrease the screen size, hence it affects the TV viewing. Therefore we use mobile phones for chatting and communicating.

5.6 TV Operators and Channel executives' perspectives about SITV

To know the industry's needs and their expectations, a demonstration of the WeOnTV prototype application was also presented to the executives of the TV channels and Operators. After the demonstration an in-depth interview was also conducted. But most of the company executives revealed to be very reluctant to provide answers, therefore, only a few agreed to provide the interview.

The total numbers of responses was11 from TV Channels and Multi System Operators (distributors) from the southern India (state of Tamil Nadu, Karnataka and Andhra Pradesh). The respondents have different management positions like Managing Directors, Chief Operating Officer, Executive Officers and Marketing Managers. More than half of executives are in the 36-45 age group, 27%are in the 26-35 age group, remaining are above 46 years. Most of the executives' have a master's degree.

Most of the executives (82%) are aware and know about SITV applications. 70% of executives said that their companies are providing some kind of interactive programs like games, news, TV information shows, cookery and e-learning and they are ready to deploy new innovations in this sector. 89% said that they have planned to develop and introduce SITV applications in a time span of 6 months to 3 years. 100% of executives firmly stated that SITV applications will help the TV broadcasting and distribution industry as well as viewers in terms of getting program rating, receiving feedback, engaging viewers or marketing products and services. They agreed SITV applications will totally enhance TV viewing. Other advantages that were referred included promoting TV programs, overcoming the competitors, attracting more viewers, and marketing, getting more revenue and increasing the interaction models.

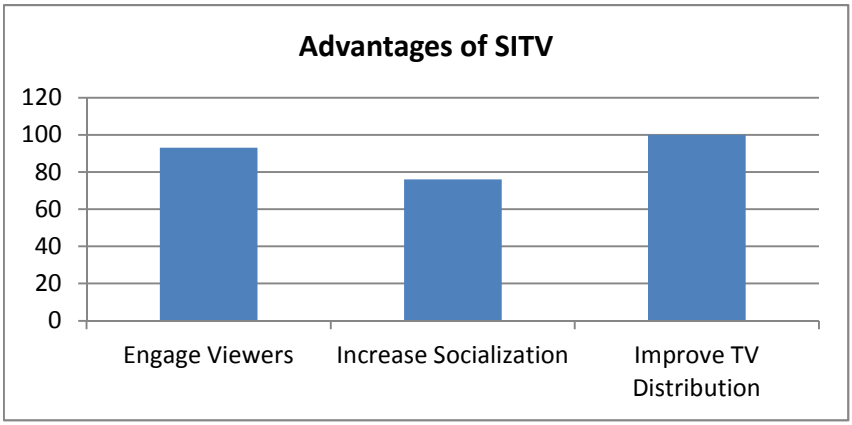

Figure 13. Advantages of SITV

Regarding the WeOnTV application all the executives (100%) said it is instantly understandable. WeOnTV's navigation is excellent. The application features like chatting and conversation, group discussions, program participation, channel and program recommendation and passing information are very good. They all agreed that it is a very good application for engaging viewers in social contexts. They expressed to be most interested in deploying this kind of SITV applications.

They also said that this type of applications is good for promoting programs and enhancing TV viewing. But they referred that legal and technical difficulties could compromise the implementation of such an application. According to the operators, they are willing to exploit these kinds of applications but many larger distribution companies and channels are reluctant to include this type of application. Also, Indian government broadcasting norms and cable acts can limit the use of this kind of applications. But in the near future the regulations may be amended to adopt innovative technologies and applications to help developing the TV broadcasting and viewing activities.

6 SUMMARY & CONCLUSIONS

This research has found that most of the Indians are active TV viewers. They spend a lot of time watching TV and are waiting for innovative services. The viewers expressed their interest for interactive features. This allows predicting a relevant potential for ITV services in India. The interactive applications available nowadays in India are mainly offline applications, but they provide an important experience that could be boosted with true iTV applications. The SITV application demonstration among the users and operators exposed that there is a warm welcome for such type of applications. Users experienced and enjoyed the SITV demonstration and understood the benefits of it. But at the same time, they realized the deficits and constraints of the new technology. They are worried about the Indian broadcasting laws and regulations not favouring the accommodation of new technologies. Nevertheless, we can expect major developments in the following years for SITV in India.

ACKNOWLEDGEMENT

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Automatic Detection of Diabetic Retinopathy Level Using SVM Technique

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ABSTRACT: The human eye is an organ which gives a sense of sight. Diabetic retinopathy is a most common diabetic eye disease which is a leading cause of blindness in India. Diabetic Retinopathy is a disease in which the retinal blood vessels swell and it may even leak. This damages the retina of the eye and may lead to vision loss if the level of diabetes is very high. Early diagnosis of Diabetic Retinopathy can prevent vision loss in patients. The method proposed in this paper for detection of Diabetic Retinopathy(DR) disease level emphasizes on determination of three important types of Diabetic Retinopathy; Macula Edema, Hemorrhages and Exudates. These types can be extracted using fundus images of patients and processing these fundus images through an appropriate image processing technique. Based on the presence of these types and their amount in the fundus image will determine the level of diabetic Retinopathy in patients.

KEYWORDS: Diabetic Retinopathy, Macula Edema, Haemorrhages, Exudates, SVM classifier

1 INTRODUCTION

The human eye is an organ that reacts with light and has several purposes. As a conscious sense organ, the mammalian eye allows vision. Rod and cone cells in the retina allow conscious light perception and vision including color differentiation and the perception of depth [22]. Therefore any damage to the retinal blood vessels affects the vision.

Diabetes occurs when the pancreas fails to secrete enough insulin. This leads to the increase in blood glucose level [22]. The blood vessels of the retina might get damaged due to increase in blood glucose level, which may even lead to vision loss. Diabetic Retinopathy (DR) is a medical condition where the retina is damaged because fluid leaks from blood vessels into the retina [20],[1]. Thus early detection of DR disease is important to overcome vision loss.

In this paper, section I includes the importance of early detection of DR disease and flow of the adopted method in the project. Section II emphasizes on the pre-processing steps on the fundus images. Section III explains the Segmentation of the pre-processed images implemented for segmenting images for presence of Macula Edema, Hemorrhages and Exudates. Section IV includes the various features extracted on the segmented images which will act as input to the SVM classifier. Section V explains the SVM classifier and its implementation in classifying the images for presence of Macula Edema, Hemorrhages or Exudates.

The detection of DR disease can be done by processing the fundus images of patients using an appropriate image processing technique providing accurate results.

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Figure 1. Normal Fundus Image

The method proposed in this project emphasizes on the detection of Diabetic Retinopathy disease level in order to prevent vision loss in humans. Exudates, Macula Edema and Hemorrhages indicate levels of Diabetic Retinopathy that is taken into consideration for the detection of level of this disease [9]. The proposed method is as shown in figure (2).

The method involves pre-processing of the colour fundus images. The colour fundus image of a normal patient (not affected by Diabetic Retinopathy) is as shown in figure (1). The detection is done by taking an input fundus image (RBG) and converting it into a Grey Scale Image. The output grey scale image is then filtered using Median Filtering for noise removal. Histogram Equalization is performed on the filtered image in order to improve the contrast of an image. After pre-processing of fundus image, the segmentation of image is performed using Histogram Thresholding. The segmented image is then fed for Feature Extraction which extracts different features of an image. The extracted features are then applied as input to SVM classifier which classifies the image based on presence Macula Edema, Hemorrhages or Exudates. The entire processing of fundus images for detection of DR disease is carried out in MATLAB.

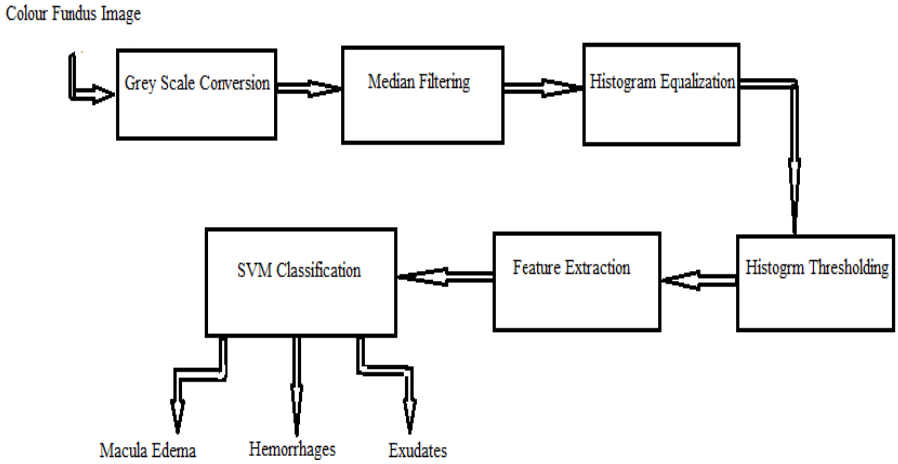

Figure 2. Detection of level of DR Disease

The fundus images of patients with features like Hemorrhages, Macula edema and Exudates is as shown in figure (3).

(a) (b) (c)

Figure 3. Features indicating DR level (a) Exudates (b) Hemorrhages (c) Macula Edema

2 PRE-PROCESSING OF COLOUR FUNDUS IMAGES

The pre-processing of colour fundus images is required to perform before the image is subjected to the actual detection mode. The pre-processing techniques include, converting the fundus image into a Grey scale image, performing Median

Filtering on the grey scaled image for removal of noise, subjecting the filtered image to Histogram Equalization in order to increase the contrast of the image.

2.1 CONVERTING COLOUR FUNDUS IMAGE INTO GREY SCALE IMAGE

Grayscale images are often the result of measuring the intensity of light at each pixel in a single band of the electromagnetic spectrum (e.g. infrared, visible light, ultraviolet, etc.), and in such cases they are monochromatic proper when only a given frequency is captured.

2.2 MEDIAN FILTERING

Median filter is the nonlinear filter more used to remove the impulsive noise from an image. Furthermore, it is a more robust method than the traditional linear filtering, because it preserves the sharp edges.

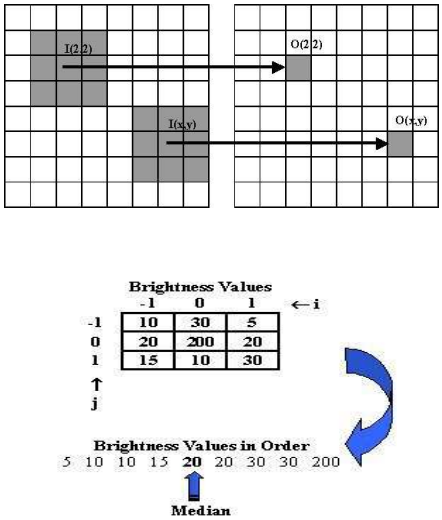

Figure 4. Median Filtering technique

Median filter is a spatial filtering operation, so it uses a 2-D mask that is applied to each pixel in the input image. To apply the mask means to center it in a pixel, evaluating the covered pixel brightness and determining which brightness value is the median value.

The median value is determined by placing the brightness in ascending order and selecting the center value. The obtained median value will be the value for that pixel in the output image. Figure shows an example of the median filter application, as in this case, habitually a 3x3 median filter is used.

2.3 HISTOGRAM EQUALIZATION

Indicate the given name and family name clearly. Histogram equalization is a method in image processing of contrast adjustment using the image's histogram. This method usually increases the global contrast of many images, especially when the usable data of the image is represented by close contrast values. Through this adjustment, the intensities can be better distributed on the histogram. This allows for areas of lower local contrast to gain a higher contrast. Histogram equalization accomplishes this by effectively spreading out the most frequent intensity values.

To accomplish the equalization effect, the remapping should be the cumulative distribution function (cdf). For the histogram H(i) , its cumulative distribution is $H'(i)$:

$$H(i) = \sum_{0<j<i} H(j) \qquad (1)$$

To use this as a remapping function, we have to normalize H'(i) such that the maximum value is 255 (or the maximum value for the intensity of the image). Finally we use a simple remapping procedure to obtain the intensity values of the equalized image:

$$equalized(x, y) = H'(src(x, y)) \quad (2)$$

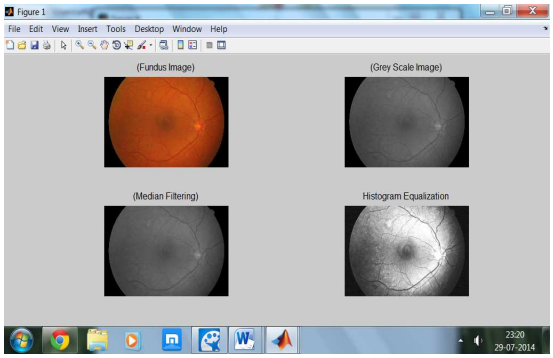

Figure 5. Pre-processing of Fundus Image

The quality of the pre-processed image can be determined by calculating two important factors of pre-processed images, i.e., MSE and PSNR.

The Mean Squared Error (MSE) represents the average of the squares of the "errors" between our actual image and our noisy image. The error is the amount by which the values of the original image differ from the degraded image. Peak Signal-to-Noise Ratio (PSNR) is an expression for the ratio between the maximum possible value (power) of a signal and the power of distorting noise that affects the quality of its representation. The PSNR is usually expressed in terms of the logarithmic decibel scale.

The higher the PSNR, the better degraded image has been reconstructed to match the original image.

$$PSNR = 20\log_{10}\left(\frac{MAX_f}{\sqrt{MSE}}\right) \quad (3)$$

$$MSE = \frac{1}{mn}\sum_{0}^{m-1}\sum_{0}^{n-1}\| f(i, j) - g(i, j) \|^2 \quad (4)$$

Where,

f- represents the matrix data of our original image
g- represents the matrix data of our degraded image
m- represents the numbers of rows of pixels of the images and 'i' represents the index of that row
n- represents the number of columns of pixels of the image and 'j' represents the index of that column
MAX_f - is the maximum signal value that exists in our original "known to be good" image.

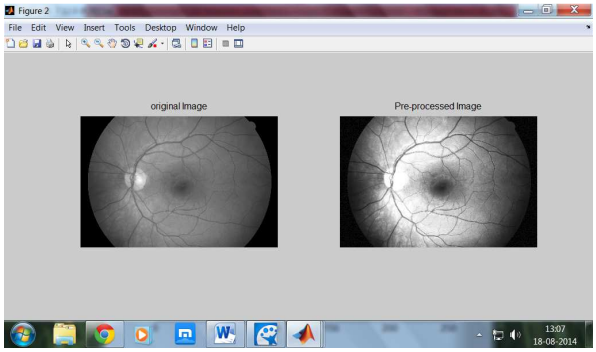

Figure 6a. Original Image and Pre-processed Image

For one of the pre-processed fundus image as shown in figure(6a), the PSNR and MSE value calculated is as shown in figure(6b).

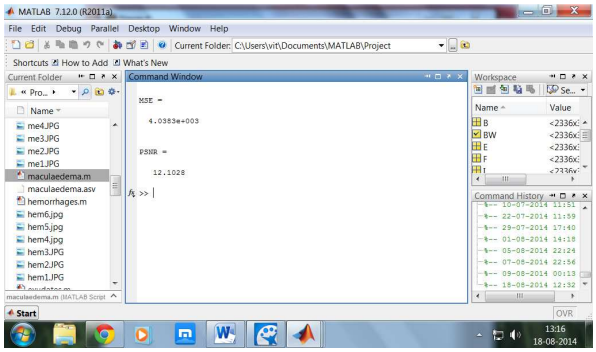

Figure 6b. MSE and PSNR calculation

3 HISTOGRAM THRESHOLDING FOR SEGMENTATION OF FUNDUS IMAGES

Image segmentation is typically used to locate objects and boundaries (lines, curves, etc.) in images. The result of image segmentation is a set of segments that collectively cover the entire image, or a set of contours extracted from the image. In this project, Histogram Thresholding technique is used in order to segment images containing Macula Edema, Hemorrhages and Exudates.

Histograms are constructed by splitting the range of the data into equal-sized bins (called classes). Then for each bin, the number of points from the data set that fall into each bin is counted. The vertical axis of histogram shows Frequency (i.e., pixel counts for each bin) and Horizontal axis shows Intensity of pixels.

In Histogram Thresholding, based on the histogram obtained for a particular pre-processed image, a threshold point is selected. This threshold value will segment the image in order to obtain the required contour (region of interest). Suppose that the gray-level histogram corresponds to an image f(x,y) composed of dark objects on the light background, in such a way that object and background pixels have gray levels grouped into two dominant modes. One obvious way to extract the objects from the background is to select a threshold 'T' that separates these modes. Then any point (x,y) for which f(x,y) < T is called an object point, otherwise, the point is called a background point.

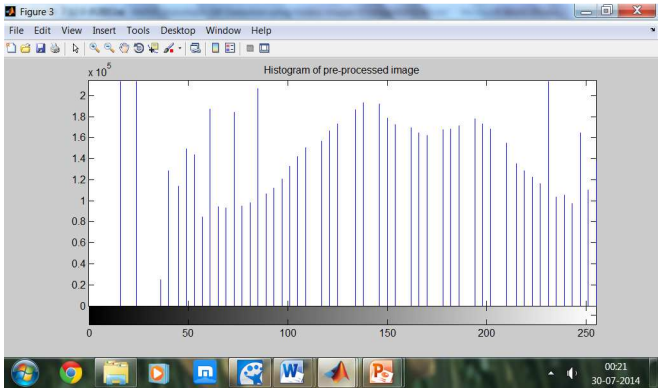

Figure 7. Histogram of one Pre-processed Fundus Image

In this paper, the Histogram Thresholding technique will segment the images to determine the region of interest, i.e., Macula Edema, Hemorrhages and Exudates.

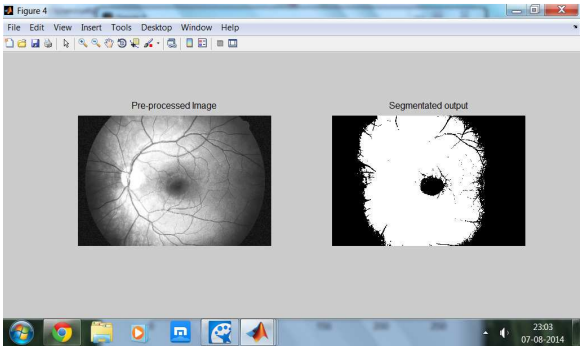

Figure 8a: Segmented output showing presence of Macula Edema

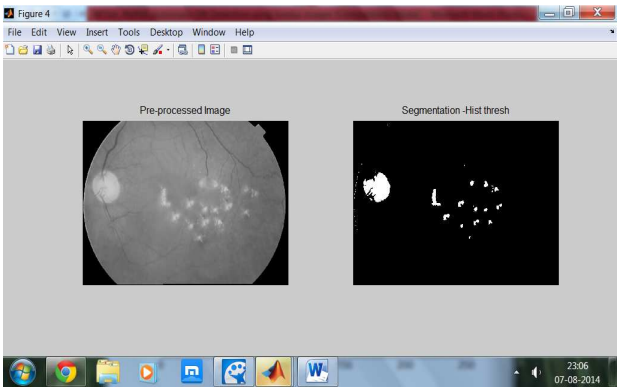

Figure 8b: Segmented output showing presence of Exudates

4 FEATURE EXTRACTION

The feature extraction is a process wherein various features of the segmented image are extracted. These features then act as the input to the classifier which can further classify the images for the presence of diabetic level.

In order to capture the spatial dependence of grey-level values, a two-dimensional dependence matrix known as a grey-level co-occurrence matrix (GLCM) is extensively used. The grey-level co-occurrence matrix P [i, j] is defined by first specifying a displacement vector d = (dx, dy) and counting all pairs of pixels separated by 'd' having grey levels 'i' and 'j'. For example, consider the simple 5 x 5 image having grey levels 0, 1, and 2 as shown in Figure 9(a). Since there are only three grey levels, P

[i, j] is a 3 x 3 matrix. Let the position operator is specified as (1, 1), which has the interpretation: one pixel to the right and one pixel below.

2	1	2	0	1
0	2	1	1	2
0	1	2	2	0
1	2	2	0	1
2	0	1	0	1

Figure 9a: A 5 x 5 image with three gray levels 0, 1, and 2.

In a 5 x 5 image there are 16 pairs of pixels which satisfy this spatial separation. We now count all pairs of pixels in which the first pixel has a value of 'i' and its matching pair displaced from the first pixel by 'd' has a value of 'j', and we enter this count in the i^{th} row and j^{th} column of the matrix P[i, j]. For example, there are three pairs of pixels having values [2, 1] which are separated by the specified distance, and hence the entry P[2, 1] has a value of 3. The complete matrix P[i,j] is shown in Figure 9(b). Note that P[i, j] is not symmetric since the number of pairs of pixels having grey levels [i,j] does not necessarily equal the number of pixel pairs having grey levels [j, i]. The elements of P [i,j] are normalized by dividing each entry by the total number of pixel pairs. In our example, each entry is divided by 16. This normalized P[i, j] is then treated as a probability mass function since the entries now add up to 1.

P (i , j)

1/16 *

0	2	2
2	1	2
2	3	2

Figure 9b: The grey-level co-occurrence matrix for d = (1,1)

The following features of the segmented fundus image are extracted and applied as an input to the classifier.

4.1 ENERGY

Energy corresponds to the mean squared value of the image typically measured with respect to the global mean value. Energy of an image returns the sum of squared elements in the GLCM.

$$Energy = \sum_{i,j} [p(i, j)]^2 \quad (5)$$

4.2 CONTRAST

The contrast function enhances the contrast of an image. It creates a new grey colour map that has an approximately equal intensity distribution. All three elements in each row are identical. Contrast of an image returns a measure of the intensity contrast between a pixel and its neighbour over the whole image.

$$Contrast = \sum_{i,j} |i - j|^2 * p(i, j) \quad (6)$$

4.3 CORRELATION

The operation called correlation is closely related to convolution. In correlation, the value of an output pixel is also computed as a weighted sum of neighbouring pixels. The difference is that the matrix of weights, in this case called the correlation kernel, is not rotated during the computation. The correlation operation therefore returns a measure of how correlated a pixel is to its neighbour over the whole image.

$$Correlation = \sum_{i,j} \frac{[(i - \mu i) * (j - \mu j) * p(i, j)]}{[\sigma_{i*} \sigma_j]} \quad (7)$$

4.4 HOMOGENEITY

Homogeneity reflects the uniformity of several pixels in an image and expresses how similar all of them are. Homogeneity of image returns a value that measures the closeness of the distribution of elements in the GLCM to the GLCM diagonal.

$$Homogeneity = \sum_{i,j} \frac{[p(i,j)]}{[1+|i-j|]} \quad (8)$$

4.5 ENTROPY

Entropy is a feature which measures the randomness of grey-level distribution.

$$Entropy = -\sum_{i,j} p(i,j) * \log 2(p(i,j)) \quad (9)$$

Note that the entropy is highest when all entries in P[i, j] are equal; such a matrix corresponds to an image in which there are no preferred grey-level pairs for the specified distance vector d.

These features are calculated for various segmented fundus images, i.e. normal fundus images and abnormal (DR) fundus images.

These features are applied as input to (Support Vector Machine) SVM classifier.

5 SVM CLASSIFIER

This unnumbered section is used to identify people who have aided the authors in accomplishing the work presented and to acknowledge sources of funding. The machine learning is a very vital step in image processing. A Support Vector Machine (SVM) performs classification by constructing an N-dimensional hyper-plane that optimally separates the data into two categories. SVM models are closely related to neural networks. In the parlance of SVM literature, a predictor variable is called an attribute, and a transformed attribute that is used to define the hyper-plane is called a feature. The task of choosing the most suitable representation is known as feature selection.

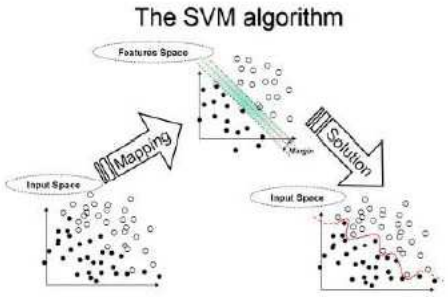

Figure 9: SVM Technique

A set of features that describes one case (i.e., a row of predictor values) is called a vector. So the goal of SVM modeling is to find the optimal hyper-plane that separates clusters of vector in such a way that cases with one category of the target variable are on one side of the plane and cases with the other category are on the other size of the plane. The vectors near the hyper-plane are the support vectors.

In this paper, SVM classifier is trained with the features of known images, i.e., images whose Diabetic Retinopathy level is already known. This process is known as Learning of SVM classifier. The test fundus image is then applied as an input to SVM classifier which provides at the output the level of Diabetic Retinopathy.

6 RESULTS AND DISCUSSION

The Diabetic Retinopathy (DR) level in humans can be detected by scanning the human fundus image for the presence of Macula Edema, Hemorrhages and Exudates. Macula Edema indicates Mild level of DR, Hemorrhages indicates Moderate

Level of DR and Exudates indicate Severe level of DR in humans. The SVM classifier is trained with 100 fundus images which show different levels of DR. The input test image fed to the classifier appropriately classifies the level of DR based on the training of SVM Classifier.

The segmented output as shown in figure (8a) shows presence of Macula Edema. The features are extracted of this segmented image and then the features are subjected to SVM classifier. The output of the classifier is as follows:

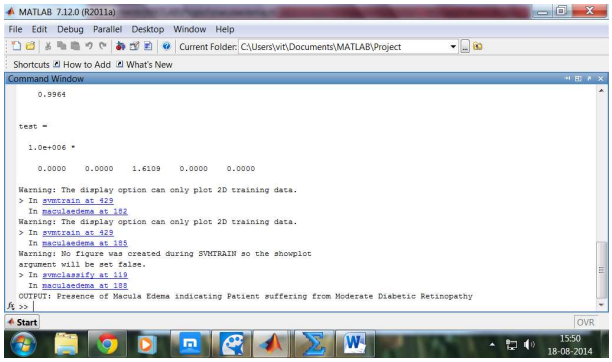

Figure 10a: SVM output indicating Moderate Level of Diabetic Retinopathy

The figure (10a) shows the output of classifier indicating presence of Moderate Level of Diabetic Retinopathy as required. Similarly the segmented output shown in figure (8b) undergoes feature extraction process followed by feeding the features to the SVM classifier. The SVM output is as follows:

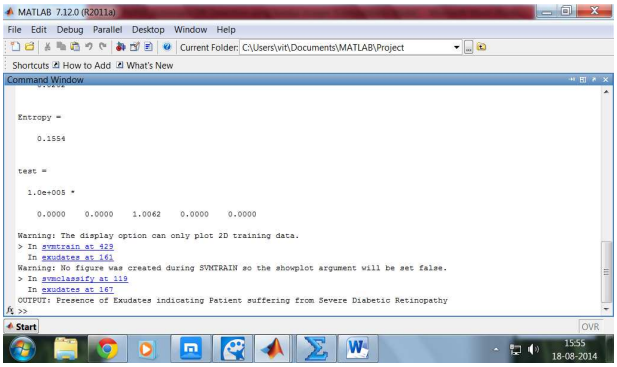

Figure 10b: SVM output indicating Severe Level of Diabetic Retinopathy

Thus figure 10(b) rightly shows SVM classifier output as Severe Level of Diabetic Retinopathy

7 CONCLUSION

The method adopted in this paper for early detection of DR disease in humans is reliable and shows accurate results.

The method implemented can be used for screening of patients eyeballs for detecting level of DR in a cost effective manner.

This technique helps in determining levels of DR in its early stage and thus preventing vision loss.

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Conception de modèles statistiques à variables hydrogéologiques pour la prévision de la profondeur limite d'arrêt de forage d'eau en milieux de socle en Côte d'Ivoire

[Design of statistical models using hydrogeological variables for predicting the depth limit stop of water drilling in crystalline and crystallophyllian rocks in Ivory Coast]

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ABSTRACT: The objective of this study is to develop statistical models to predict the depth limit stop of water drilling in crystalline and crystallophyllian rocks using physical parameters of drilling. The study was conducted using data from physical parameters (depth of drilling, depth of the first water supply significant, alteration thickness and thickness of base drilled) from geological units of Archean and Paleoproterozoïcal domains of Ivory Coast. The methodology consisted of first analyze the physical parameters from the simple statistical features and frequency class distribution of these parameters. Then, a normalized principal components analysis (NPCA) was applied for the identification of explanatory variables relevant and expressive of drilling depth limit. Finally, a calibration was performed with a sample of 1,605 wells representing two thirds of the total sample to determine the coefficients of the linear regressions and the associated standard errors. The analysis of the distribution of physical parameters of drilling shows that only the depth of drilling is homogeneous (24.50%) with an average of 68.17 m. The most relevant and expressive variables for predicting the depth limit stop of water drilling in crystalline and crystallophyllian rocks are the depth of the first significant water arrival and the thickness of alteration. The errors associated with the regression coefficients generally low (below 1%) reflect the close relationship between the dependent variables and the explanatory variables. Two models for predicting the depth limit stop of water drilling (PROLIFE models) in crystalline and crystallophyllian rocks were developed.

KEYWORDS: Statistical modeling; PROLIFE models; Productivity; Crystalline and crystallophyllian aquifers; NPCA; Calibration; Ivory Coast.

RÉSUMÉ: L'objectif de cette étude est de concevoir des modèles statistiques capables de prévoir la profondeur limite d'arrêt de forage d'eau en milieux de socle à partir de paramètres physiques de forage. L'étude a été menée à partir des données de paramètres physiques (profondeur de forage, profondeur de la première arrivée d'eau significative, épaisseur d'altération et épaisseur de socle foré) issues des ensembles géologiques des domaines archéen et paléoprotérozoïque de Côte d'Ivoire. La méthodologie a consisté d'abord à analyser les paramètres physiques utilisés à partir des caractéristiques statistiques simples et des fréquences de distribution des classes de ces paramètres. Ensuite, une analyse en composantes principales normées

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(ACPN) a été appliquée pour l'identification des variables explicatives pertinentes et expressives de la profondeur limite de forage. Enfin, un calage a été effectué avec un échantillon de 1605 forages représentant les 2/3 de l'échantillon total afin de déterminer les coefficients des régressions linéaires et les erreurs-types associées. L'analyse de la distribution des données de forage montre que seule la profondeur des forages est homogène (24,50%) avec une moyenne de 68,17 m. Les variables les plus pertinentes et expressives pour la prévision de la profondeur limite de forage d'eau en milieux de socle cristallin et cristallophyllien sont la profondeur de la première arrivée d'eau significative et l'épaisseur d'altération. Les erreurs-types associées aux coefficients de régression généralement faibles (inférieures à 1%) traduisent des relations étroites entre les variables expliquées et les variables explicatives. Deux modèles de prévision de la profondeur limite d'arrêt de forage d'eau (modèles PROLIFE) en milieux de socle cristallin et cristallophyllien ont été développés.

MOTS-CLEFS: Modélisation statistique; Modèles PROLIFE; Productivité; Aquifères de socle; ACPN; Calage; Côte d'Ivoire.

1 INTRODUCTION

En Côte d'Ivoire, 97,5% du territoire est recouverte de roches cristallines et cristallophylliennes. Or dans ce milieu, l'existence d'un horizon aquifère est conditionnée par la présence de fractures ou fissures. Pour capter l'eau de ces fractures, des campagnes d'implantations géophysiques de forage sont généralement entreprises. Une fois les forages implantés, l'on a constaté que lors de la foration de ces points d'eau, la décision d'arrêt de foration n'est pas rationalisée. Certains forages sont précocement arrêtés dès l'obtention du débit escompté. En revanche, d'autres sont prolongés jusqu'à des profondeurs au-delà des clauses techniques du projet. Ainsi, dans les bases de données des campagnes de forages, les profondeurs les plus grandes sont en général celles des forages négatifs [1]. Or, selon l'environnement géologique et hydrogéologique, il existe une profondeur au-delà de laquelle les chances de trouver un horizon aquifère s'amenuisent, notamment au sein des roches cristallines du socle, du fait de la diminution de la fréquence voire la disparition des fractures perméables. En continuant un forage dans de tels cas, on crée un surcreusement inutile. L'essentiel de la perméabilité des aquifères de socle provient de la partie inférieure du profil d'altération, l'horizon fissuré stratiforme qui est situé sous les altérites meubles [2]. L'épaisseur de l'horizon fissuré peut atteindre plusieurs dizaines de mètres. Si l'on cumule, pour chaque campagne de forage, les différents métrés considérés comme inutiles, on aboutit en moyenne à des dizaines de kilomètres qui reviennent économiquement très chers à l'Etat [1]. Il est donc nécessaire voire indispensable de rechercher une profondeur limite qui est la profondeur au-delà de laquelle il n'est plus possible d'obtenir une venue d'eau significative, puisque la base de l'horizon fissuré est atteinte.

La modélisation statistique peut apporter une contribution à une telle initiative. En effet, elle est souvent utilisée dans la résolution des problèmes de façon générale et en particulier dans le domaine de l'hydrogéologie. Les modèles les plus sollicités dans la résolution des problèmes en hydrogéologie sont les modèles linéaires de base qui englobent la régression linéaire simple et la régression linéaire multiple, les modèles linéaires généralisés qui englobent la régression logistique et la régression de Poisson, et enfin les modèles non linéaires qui englobent la régression non paramétrique, les GAM (Generalized Additive Models) et les réseaux de neurones artificiels. La régression linéaire multiple a été utilisée par plusieurs auteurs [1, 3, 4, 5], pour les simulations de paramètres hydrodynamiques en milieux de socle cristallin et cristallophyllien. En effet, plusieurs travaux ont montré qu'il existe une relation linéaire entre d'une part, la profondeur des forages et l'épaisseur de socle foré, et d'autre part, les paramètres physiques de forage tels que l'épaisseur de l'horizon altéré, la profondeur de la première arrivée d'eau, le nombre d'arrivée d'eau, l'épaisseur de recouvrement alluvio-colluvial, etc. [1, 3, 4, 6, 7, 8, 9].

Tous ces travaux ont permis de montrer que les relations mathématiques qui lient la profondeur des forages et l'épaisseur de socle foré (paramètres expliqués) à ces paramètres (paramètres explicatifs) sont des régressions linéaires multiples. Ainsi, la profondeur limite d'arrêt des forages en milieux de socle cristallin et cristallophyllien et l'épaisseur de socle foré ont été modélisées à partir de la régression linéaire multiple [1, 3, 4]. Ces auteurs sont parvenus à établir des modèles capables de prédire la profondeur à laquelle l'on devrait arrêter les forages en milieux de socle et l'épaisseur de socle foré nécessaire à l'obtention d'un débit significatif (supérieur ou égal à 1 m^3/h). L'épaisseur de socle forée reste aussi une variable à simuler en ce sens qu'elle est essentielle dans l'optimisation de la profondeur limite des forages [1]. En effet, l'épaisseur de socle foré est, en réalité, l'élément autour duquel le problème d'optimisation se pose. Elle est variable dans l'espace et fonction des formations géologiques. En optimisant ce paramètre, la profondeur totale de l'ouvrage peut être par la même occasion optimisée [10].

Cette étude vise la conception de modèles statistiques à partir de la régression linéaire multiple dont les variables explicatives sont capables de prévoir la profondeur limite d'arrêt des forages d'eau dans les formations cristallines et

cristallophylliennes. Il s'agit de concevoir des modèles avec un nombre limité de variables explicatives que ceux déjà existants, mais plus performants.

Pour atteindre cet objectif général, trois objectifs spécifiques ont été définis:

i. l'analyse des données de l'étude ;
ii. l'identification des variables explicatives pertinentes dans la détermination des profondeurs limites des forages et des épaisseurs de socle foré ;
iii. le calage des modèles à travers la détermination des coefficients de régression et erreurs-types des différentes équations.

La méthodologie adoptée a essentiellement consisté d'abord à analyser les caractéristiques statistiques et les fréquences de distribution des paramètres physiques. Ensuite, une analyse en composantes principales normées (ACPN) a été appliquée à partir des différents paramètres pour identifier les variables explicatives pertinentes pour la modélisation de la profondeur limite et de l'épaisseur de socle foré. Enfin, un calage a été réalisé pour déterminer les coefficients de régression et erreurs-types des différentes équations de la régression linéaire multiple.

2 PRESENTATION DE LA ZONE D'ETUDE

2.1 LOCALISATION DE LA ZONE D'ETUDE

La Côte d'Ivoire fait partie des pays du Golfe de Guinée. Elle s'étend sur une superficie de 322 462 Km^2, environ 1% du continent africain. Ses frontières dessinent approximativement un carré s'inscrivant entre les coordonnées de 2°30'et 8°30'de longitude Ouest, 4°30' et 10°30' de latitude Nord avec, au Sud, une façade littorale de 550 Km. Elle est limitée au Nord par le Mali et le Burkina Faso, à l'Est par le Ghana, à l'Ouest par la Guinée et le Libéria et au Sud par l'océan atlantique (Figure 1).

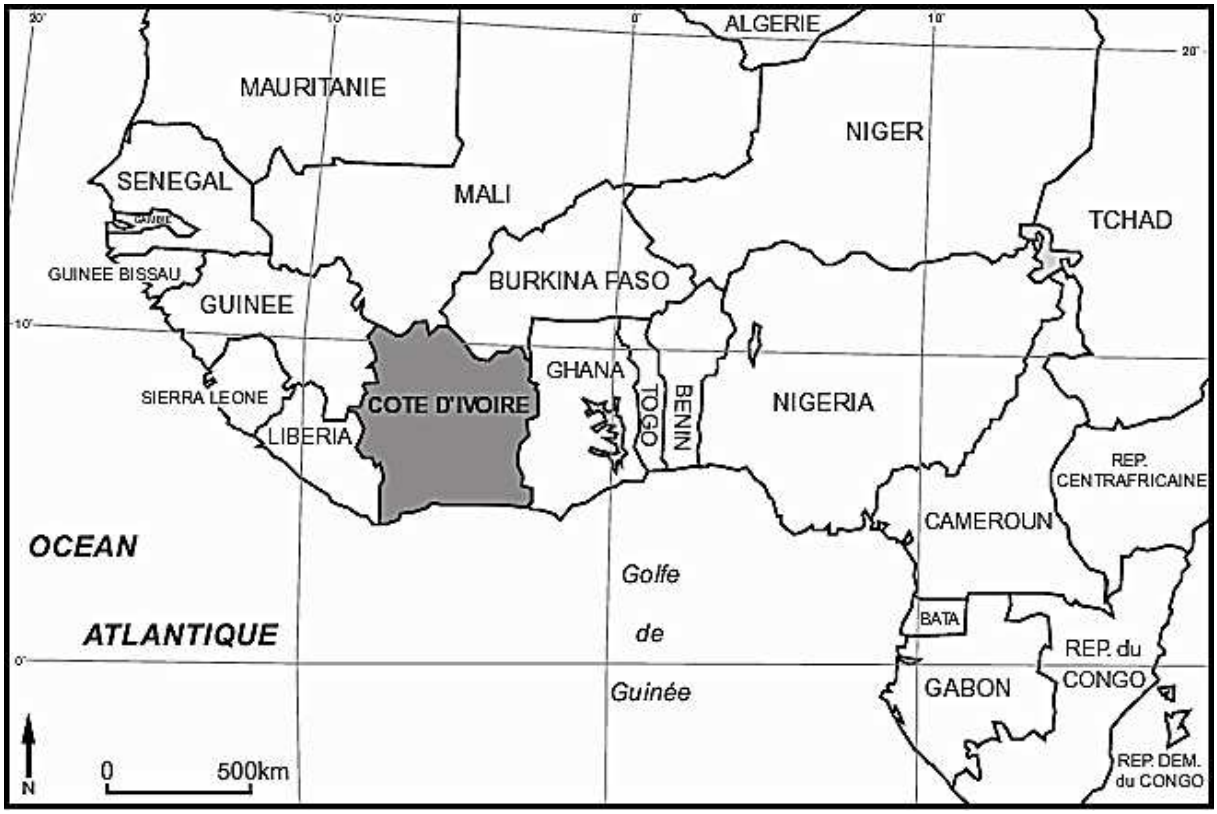

Figure 1: Localisation de la Côte d'Ivoire en Afrique de l'Ouest (Brou, 2005).

2.2 CONTEXTE CLIMATIQUE ET COUVERT VEGETAL

En Côte d'Ivoire, on distingue quatre grandes zones climatiques. Le climat subéquatorial dans le Sud (climat Attiéen) est caractérisé par des températures de faibles amplitudes (de 25 à 30 °C), un fort taux d'humidité (de 80 à 90%) et des précipitations abondantes, qui atteignent à Abidjan 1 766 mm et à Tabou 2 129 mm. Ce climat est constitué de deux saisons sèches et deux saisons humides. Le climat tropical humide (climat baouléen) couvre le Centre du pays. Les températures, à amplitudes plus importantes, y oscillent entre 14 et 33 °C, avec une hygrométrie de 60 à 70% et des précipitations annuelles moyennes de 1 200 mm. Cette région climatique connaît également quatre saisons (deux saisons sèches et deux saisons pluvieuses). Le climat tropical de transition (climat soudanais) concerne principalement la partie nord du pays. Les amplitudes thermiques quotidiennes et annuelles y sont relativement importantes, de l'ordre de 20 °C, le taux d'humidité, inférieur à celui du Sud du pays, varie de 40 à 50 %. La zone considérée est caractérisée par la présence intermittente entre les mois de décembre et février d'un vent frais et sec, l'harmattan. On y relève deux saisons: l'une sèche, de novembre à juin, ponctuée par quelques pluies au mois d'avril, et l'autre pluvieuse, couvrant la période de juillet à octobre. Les précipitations moyennes annuelles enregistrées sont généralement inférieures à 1000 mm. Un climat de type montagneux règne au niveau de l'Ouest de la Côte d'Ivoire avec des hauteurs pluviométriques annuelles dépassant parfois les 2 000 mm. Ce régime se caractérise par deux saisons, une longue saison des pluies qui s'étend sur huit mois (de mars à octobre) et une petite saison sèche qui dure quatre mois (de novembre à février). Les mois d'août et septembre sont les mois les plus pluvieux. Les températures annuelles varient globalement de 15 à 33°C avec une moyenne de 25°C. Une moyenne de 2 272 heures d'ensoleillement par an est enregistrée. L'humidité relative varie entre 61 et 99% avec une valeur moyenne de 98% à Man. Les vents de direction N-S (harmattan et alizé boréal) sont dominants en saison sèche tandis qu'en saison des pluies, c'est le vent de la mousson de direction NW- SE qui prédomine.

Deux grands types de paysages végétaux sont présents sur le territoire ivoirien : un paysage forestier et un paysage de savane. Le premier couvre la moitié sud du pays et appartient au domaine guinéen. Le second occupe la moitié nord de la Côte d'Ivoire et se rattache au domaine soudanais [11]. Le domaine guinéen a une végétation prépondérante de forêt dense humide. On y distingue 4 secteurs caractérisés par des groupements végétaux particuliers répondants à des conditions écologiques différentes [11]. La zone soudanaise au Nord de la Côte d'Ivoire se subdivise en deux secteurs : le secteur sub-soudanais et le secteur soudanais [11]. Sur l'ensemble de ces deux secteurs, la végétation se présente comme une juxtaposition de formations forestières et de formations savanicoles, la localisation de ces formations dépendant des facteurs climatiques, édaphiques et anthropiques [11].

2.3 CONTEXTE GÉOLOGIQUE

La Côte d'Ivoire se situe au Sud du craton ouest africain et son histoire géologique s'intègre à celle de la dorsale de Man. Les unités lithologiques ont été affectées par trois orogenèses : Léonienne (3,5–2,9 Ga), Libérienne (2,9–2,4 Ga) et Eburnéenne (2,4–1,6 Ga). La dorsale de Man se subdivise en deux grands domaines à savoir le domaine archéen à l'Ouest appelé «Kénéma-Man» et le domaine paléoprotérozoïque dit «Baoulé-Mossi» à l'Est, séparés par l'accident majeur de Sassandra (Figure 2). Le domaine archéen a été affecté par des déformations tectoniques très importantes attribuées à deux orogenèses, à savoir, l'orogenèse léonienne **(**3500-2900 Ma) et l'orogenèse libérienne (2900-2500 Ma). Il est caractérisé par les reliefs les plus accidentés de la Côte d'Ivoire. L'essentiel du domaine archéen (plus de 80%) est constitué par les formations libériennes qui se trouvent essentiellement dans la région de Man. Ces formations sont composées de granulites, de migmatites et d'amphibolo-pyroxénites qui sont des métas-sédiments catazonaux. Elles occupent essentiellement l'Ouest et le Sud-Ouest de la Côte d'Ivoire [12, 13]. A ces formations libériennes, sont associées de nombreuses reliques de formations léoniennes essentiellement représentées par un complexe de base cristallin constitué de migmatites et de gneiss granulitiques, connu aussi sous le nom de granito-gneiss et les ceintures supracrustales. A ces deux ensembles s'associent des granites et des charnockites sous forme d'intrusion dans le socle granito-gneissique, ou sous forme de mobilisat anatectique [13].

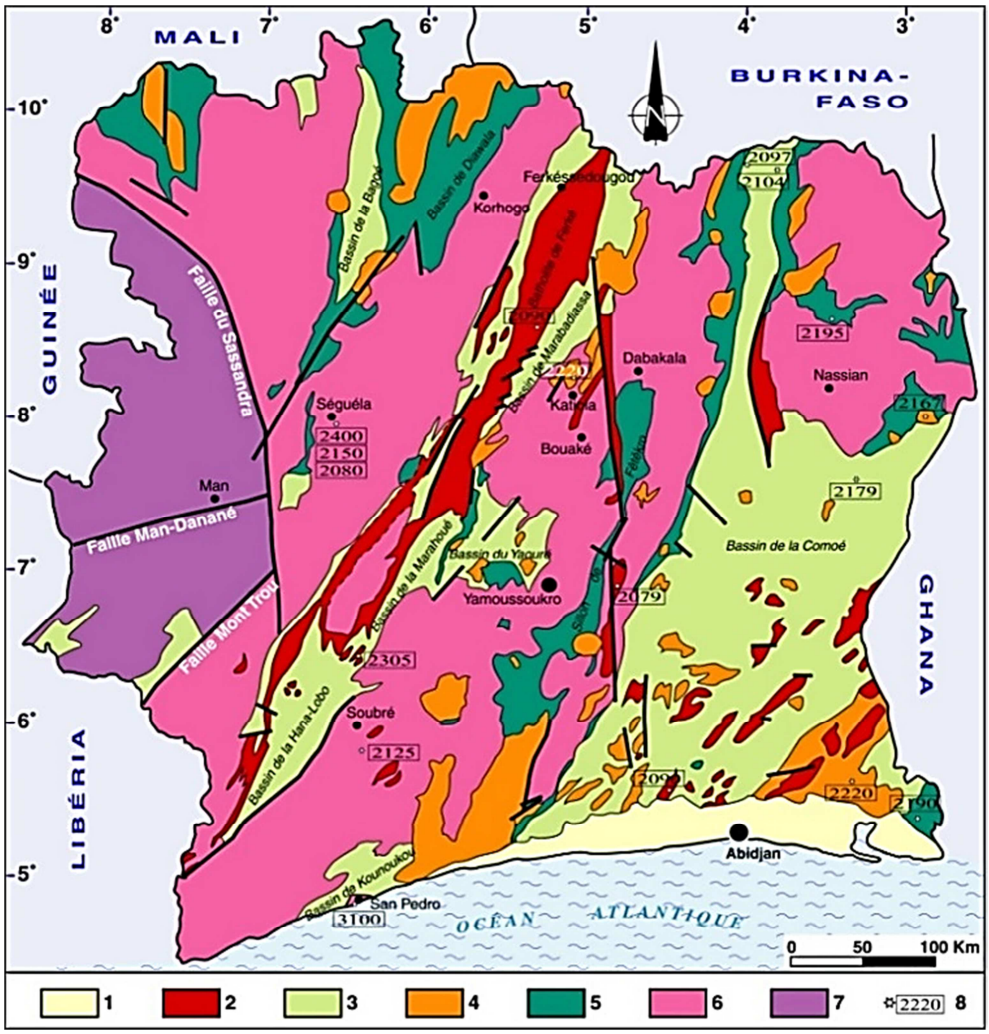

Figure 2: Carte géologique de la Côte d'Ivoire [14]

***1**. Formations post-birimiennes (bassins sédimentaire côtier). **2**. Granitoïdes à deux micas associés ou non aux structures décrochant méridiennes. **3**. Bassins sédimentaires et volcano-sédimentaires. **4**. Granitoïdes calco-alcalins localisés dans les bassins sédimentaires. **5**. Volcanisme et volcano-sédiments indifférenciés. **6**. Granitoïdes et granites rubanés gneiss et migmatites indifférenciés (âges supérieurs à 2,4 Ma). **7**. Domaine archéen. **8**. Ages.*

Le domaine paléoprotérozoïque subdivisé en deux grands sous-ensembles a été structuré au cours du mégacycle éburnéen. Ce domaine est constitué d'un socle granito-gneissique et de formations volcano-sédimentaires. Le socle granito-gneissique représente plus de la moitié des formations du domaine Baoulé-Mossi. C'est un ensemble de roches granitiques généralement foliées et migmatisées par endroits. Quant aux ceintures volcaniques, elles bordent généralement les sillons sédimentaires et sont orientées N-S à NE-SW. Les granitoïdes intrudant ces formations sont de composition tonalitique à granodioritique et sont discordants. Les formations volcano-sédimentaires 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.

2.4 CONTEXTE HYDROGÉOLOGIQUE

En Côte d'Ivoire, les réservoirs d'eaux souterraines de socle se rencontrent dans les horizons d'altérites ainsi que dans les séries volcano-sédimentaires et granito-migmatitiques. Les réservoirs d'altérites varient selon la nature du socle. Ainsi, sur les granitoïdes, ils sont composés, de haut en bas, de cuirasse latéritique, sables argileux et arènes grenues dont l'épaisseur peut atteindre 50 m. Les arènes grenues constituent les niveaux les plus productifs et donc les plus recherchés. Les réservoirs d'altérites des séries volcano-sédimentaires sont en général les plus épais et peuvent atteindre 100 m. Les séries volcano-

sédimentaires sont des complexes schiste-gréseux très hétérogènes à nombreux plis isoclinaux, dont les flancs sont généralement redressés. Ces roches se caractérisent par d'importantes schistosités pouvant augmenter la porosité des réservoirs. Elles peuvent également acquérir des potentialités en eau énormes, quand elles sont affectées par des phénomènes de fracturation. Leur perméabilité est généralement faible et donc les ressources qu'elles renferment sont limitées. Cependant, dans les cas où la roche présente une intercalation détritique ou volcano-détritique jouant le rôle de drain, ces réservoirs peuvent acquérir une importante fonction capacitive en profondeur [15]. Les réservoirs des granito-migmatites sont caractérisés par un nombre élevé des arrivées d'eau dans les forages profonds réalisés directement dans le socle. Ce qui témoigne de la richesse en eau des formations cristallines, non nécessairement altérées [15]. L'eau circule dans les roches cristallines à travers les réseaux de fractures à fonction drainante, généralement bien alimentés et capables de fournir des débits assez importants quand ils sont bien captés par les forages. En effet, le socle cristallin et cristallophyllien des domaines archéen et paléoprotérozoïque, unités géologiques qui intéressent notre étude, constituent le domaine des aquifères fissurés qui se sont formés au cours des divers évènements tectoniques qui les ont affecté en y laissant d'importants réseaux de fissures plus ou moins connectés qui sont à l'origine de la formation des nappes souterraines [16-22]. A l'heure actuelle, les forages captant les fractures sont les plus sûrs et les moins influençables par les fluctuations saisonnières. Quant aux puits réalisés dans les altérites, ils sont placés sous l'influence directe du rythme des saisons.

3 MATERIEL ET METHODES

3.1 DONNÉES

La collecte des données sur les paramètres physiques des forages a été faite par le biais de dossiers de forage de différents projets et programmes d'hydraulique villageoise réalisés au cours de la période 1970-2010. Ces données proviennent de plusieurs programmes:

- programmes d'hydraulique villageoise réalisés au cours de la période 1970-1996 ;
- programmes financés par la Banque Arabe pour le Développement Economique en Afrique (BADEA) au cours de la période 1999 à 2000 ;
- 4ème Programme d'Urgence et de Réhabilitation (PUR-4) réalisé dans la période 2009-2010 et financé par l'Union Européenne ;
- projet du Comité d'Examen et de Suivi des Projets et Programmes de la Filière Café Cacao (CESPPCC) réalisé au cours de l'année 2009;
- projet d'approvisionnement en eau potable en milieu rural (don Japonais) au cours de la période 1999-2000.

Plusieurs fiches techniques renseignant sur les paramètres physiques des forages ont été retenues. Il s'agit notamment de la profondeur totale du forage (m), l'épaisseur d'altération (m), l'épaisseur forée dans le niveau fissuré (m) et de la profondeur de la première arrivée d'eau significative (m).

3.2 METHODOLOGIE RELATIVE A LA CONCEPTION DES MODELES

3.2.1 ANALYSE DES PARAMÈTRES ÉTUDIÉS

Les caractéristiques statistiques telles que le minimum, le maximum, la moyenne, l'écart-type et le coefficient de variation (CV=écart-type/moyenne) ont été appliquées.

Les fréquences de variation des paramètres physiques utilisés ont été également analysées. En effet, il existe des règles à respecter pour réaliser une discrétisation correcte :

i) aucune classe ne doit être vide ;
ii) les limites de classe doivent couvrir l'ensemble de la distribution ;
iii) les limites de classe ne doivent pas se chevaucher.

La discrétisation commence par le choix du nombre de classes. Suivant le nombre d'individus de la série statistique, la forme de la distribution et les contraintes visuelles, de façon générale, le nombre de classes ne devrait pas dépasser 7 à 8. En règle générale, on choisit des classes de même amplitude. Pour que la distribution en fréquence ait un sens, il faut que chaque classe comprenne un nombre suffisant de valeurs (N_i). Deux formules empiriques ont permis de déterminer le nombre de classes (C) pour un échantillon de taille n (équations 1 et 2):

- règle de Sturge: C = 1+3,3logn ; (1)
- règle de Yule: C= 2,5.$(n)^{1/4}$. (2)

L'intervalle de classe (I) est calculé par (équation 3):

$$I=(X_{max}-X_{min})/C \quad (3)$$

Dans l'équation 3, X_{max} et X_{min} sont respectivement les valeurs maximale et minimale observées sur l'ensemble des échantillons pour un paramètre donné, C le nombre de classes défini. On calcule ensuite à partir de «X_{min}», les classes successives par addition de l'intervalle de classe I, d'abord à la valeur minimale observée sur l'échantillon, puis à la borne supérieure de chacune des classes jusqu'à obtention de la dernière classe.

L'étude de la normalité des différents paramètres étudiés a été effectuée à partir du logiciel Kronostat 1.01.

3.2.2 IDENTIFICATION DES VARIABLES EXPLICATIVES DES MODELES

L'ACPN a été effectuée sur 2406 forages d'eau afin de mettre en évidence les phénomènes et partant les paramètres qui semblent influencer la profondeur de forage et l'épaisseur de socle foré. Cette méthode a déjà fait l'objet de plusieurs applications en Côte d'Ivoire [1, 18, 23, 24]. Les variables physiques des forages prises en compte dans cette étude sont la profondeur de la première arrivée d'eau significative (Pae_1) et l'épaisseur d'altération. 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 définis auquel sont liés les axes factoriels.

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. Elle a été réalisée à partir du logiciel Statistica 8.0.

3.2.3 PROCESSUS DE MODÉLISATION

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 trouver 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 régressions 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. 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 explicatifs, 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 4) :

$$Y = C_1 X_1 + C_2 X_2 + \ldots + C_3X_3 + C_NX_N + C_0 \quad (4)$$

-Y : variable expliquée ;
-X_i : variables explicatives ;
-C_i ($0 \le i \le N$): coefficients de pondération des variables xi.

En effet, Y est un vecteur de valeurs des variables expliquées, 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]:

$$C_i = \left(X_i^T X_i\right)^{-1} X_i^T Y \quad (5)$$

avec X^T la transposée de X.

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 fonctions 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 [29, 30, 31].

Les paramètres d'un modèle statistique sont liés aux données de calage, les données ont donc été prélevées en tenant compte de la géologie du socle ivoirien. Ainsi, l'échantillon constitué a été déterminé à partir de trois échantillons de même taille (802 forages), soit 2406 forages. Trois zones tests appartenant à deux grands domaines géologiques ont été retenues eu égard aux informations obtenues sur ces différentes zones qui définissent trois ensembles géologiques. Ainsi, sur le domaine archéen, on a Biankouma, Guiglo, Duékoué, Man, Danané, Bangolo, Logoualé et Bloléquin. Au niveau des granitoïdes du domaine paléoprotérozoïque, on a Korhogo, Odienné, Yamoussoukro, Bouna, Bouaké, Lakota, Divo, Bondoukou et Séguéla. Pour les formations volcano-sédimentaires du domaine paléoprotérozoïque, on a Abengourou, Agboville, Dimbokro, Bocanda, Agnibilékrou, M'Bahiakro, Bongouanou, Daoukro et Tiassalé.

Les matrices des données de calage ont été constituées à partir des 2/3 des données des trois zones tests retenues (2 406 forages), soit 1 605 forages à raison de 535 forages par zone test.

L'estimation des coefficients de pondération des variables retenues a été réalisée par calage automatique effectué à l'aide du 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 fait, l'erreur-type est au coefficient de régression ce que l'écart-type est à la moyenne d'une variable. Elle constitue donc une mesure de la variation 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.

4 RESULTATS ET DISCUSSIONS

4.1 CARACTERISTIQUES DES PARAMETRES PHYSIQUES DES FORAGES

Les caractéristiques statistiques des données des paramètres physiques des forages sont consignées dans le tableau 1. L'analyse de ces données montre que les profondeurs de forage (Pt) varient de 20 à 119 m avec une moyenne de 68,17 m et un écart-type de 16,7 m. La profondeur de la première arrivée d'eau significative (Pae_1) varie de 0,8 à 106,18 m avec une moyenne de 48,89 m et un écart-type de 17,46 m. L'épaisseur de l'horizon altéré (Ep-Alt) varie de 0,3 à 104 m avec une moyenne de 25,21 m et un écart-type de 18,59 m. L'épaisseur de socle foré (Ep_Soc) varie de 1 à 109 m avec une moyenne de 44,02 m et un écart-type de 19,46 m. La valeur du coefficient de variation des différents paramètres oscille entre 24,50% (profondeur de forage) et 73,75% (épaisseur d'altération). Tous les coefficients de variation des différents paramètres sont supérieurs à 25% sauf celui relatif à la profondeur de forage. Ces résultats montrent que la profondeur des forages est homogène alors que tous les autres paramètres sont hétérogènes. Le paramètre le plus hétérogène est l'épaisseur d'altérites.

Tableau 1 : Caractéristiques statistiques des paramètres physiques des forages

Paramètres	Minimum	Maximum	Moyenne	Ecart-type	Coefficient de variation (%)
Pt	20,00	119,00	68,17	16,70	24,50
Pae_1	0,80	106,18	48,89	17,46	35,71
Ep_Alt	0,30	104,00	25,21	18,59	73,75
Ep_Soc	1,00	109,00	44,02	19,46	44,21

Les résultats d'application des règles de Sturge et de Yule, avec un effectif de 2 406 forages ont donné respectivement 12 et 17 classes. Cependant, compte tenu de la contrainte selon laquelle le nombre maximal de classes admis dans le cadre d'une étude est de 7 ou 8, il a été retenu pour cette étude, 7 classes pour chaque paramètre étudié. Pour chacun des paramètres, le calcul de l'intervalle de classe a donné une valeur proche de 15 m. Ainsi, pour mieux comparer les résultats de cette analyse, un découpage en classes d'amplitude de 15 m a été adopté pour chacun des paramètres physiques de forages.

La figure 3 présente la distribution des fréquences de la profondeur des forages observés sur le socle ivoirien. Les profondeurs de forage les plus fréquentes sont comprises entre 60 et 75 m, et représentent 29,20% des valeurs de

profondeur observées sur l'ensemble des forages. Cette classe est suivie de celle des forages de profondeur moyenne comprise entre 45 et 60 m, représentant 28%. A côté de ces classes, il y a les forages de profondeur totale comprise entre 75 et 90 m, représentant 20,20% des profondeurs et également celle des forages ayant une profondeur comprise entre 30 et 45 m avec un taux de 16%. Les profondeurs de forage les moins fréquentes sur le socle ivoirien sont comprises d'une part entre 15 et 30 m, et d'autre part entre 90 et 120 m. Les valeurs observées pour les profondeurs comprises dans ces intervalles représentent moins de 10% de l'ensemble des profondeurs observées. Les profondeurs de forage généralement rencontrées sont comprises entre 45 et 75 m avec une fréquence totale de 57,20%. Les fréquences des différentes classes de forages suivent un profil en cloche et présentent une forme symétrique centrées sur la valeur moyenne, qui peut être décrite par une loi normale.

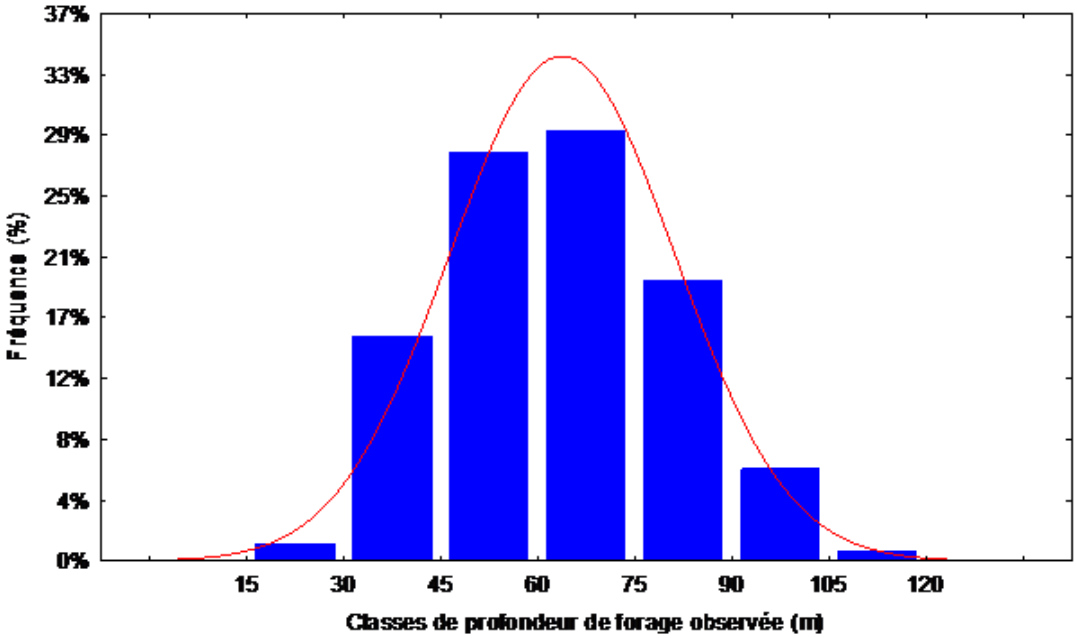

Figure 3: Fréquences des classes de profondeur de forage observée (m)

L'analyse de la figure 4 a permis de montrer que les valeurs les plus couramment rencontrées au niveau des épaisseurs forées dans le niveau fissuré représentent 78,93% des valeurs observées avec 33% pour la classe 30-45 m, 23,90% pour la classe 15-30 m et 22,03% pour la classe 45-60 m. Les forages ayant traversé le socle fissuré sur une profondeur inférieure à 15 m et supérieure à 60 m sont moins fréquents et représentent 21,07% des valeurs observées sur ce paramètre. Les fréquences des classes de profondeur forée dans le niveau fissuré augmentent jusqu'à atteindre une valeur maximale pour les forages ayant traversés le niveau fissurée sur une profondeur située entre 30 et 45 m, puis diminuent progressivement au fur et à mesure que les épaisseurs de socle foré augmentent. Ceci signifie que l'épaisseur de socle forée pourrait suivre la loi de Gauss.

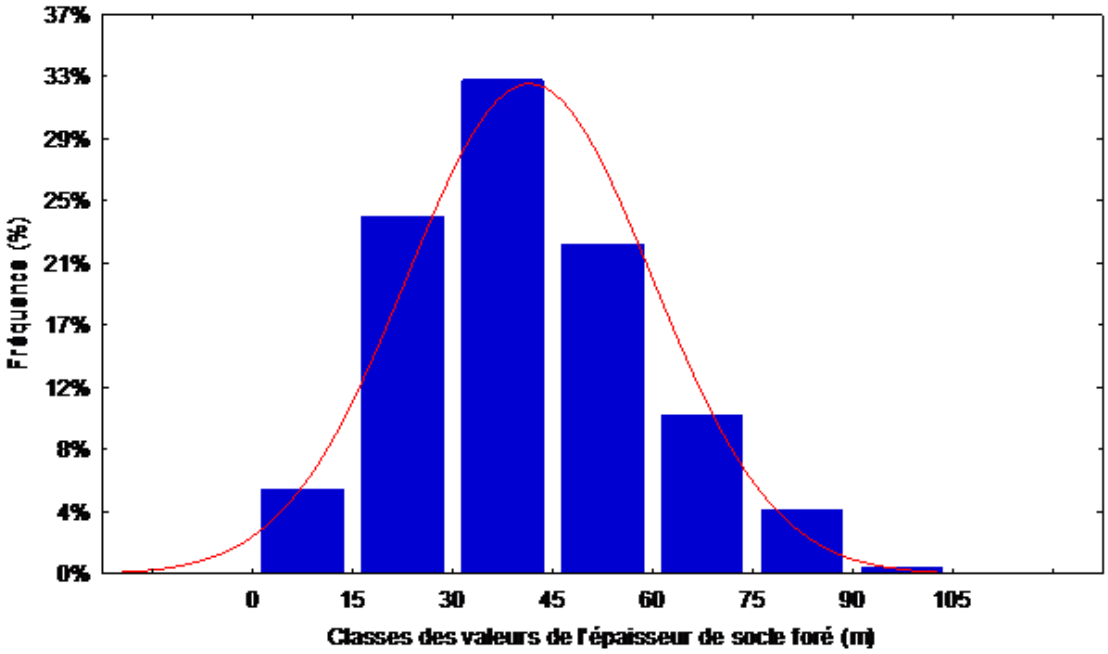

Figure 4: Fréquences des classes d'épaisseurs forées dans le socle fissuré (m)

La figure 5 présente les fréquences de classes de la profondeur de la première arrivée d'eau significative (avec un débit d'au moins 1 m^3/heure). Les profondeurs auxquelles l'on rencontre le plus souvent la première fracture hydraulique active productive sont comprises entre 30 et 45 m, et représentent 30,55% des valeurs observées. Après cette classe, les profondeurs les plus fréquentes sont comprises entre 45 et 60 m, suivies des profondeurs comprises entre 15 et 30 m et représentent respectivement 24,31% et 22,29%. Les profondeurs des premières arrivées d'eau les plus fréquentes sur le socle ivoirien sont comprises entre 15 et 60 m et représentent 77,15% des valeurs observées. Les premières arrivées d'eau sont rarement obtenues à moins de 15 m et au-delà de 75 m et très rarement au-delà de 90 m.

Les fréquences des classes de profondeur totale, de la première arrivée d'eau significative et celles des épaisseurs de socle foré présentent des profils en cloche. Les résultats de l'application du logiciel Kronostat 1.01 aux différentes données a montré que celles-ci suivent la loi normale.

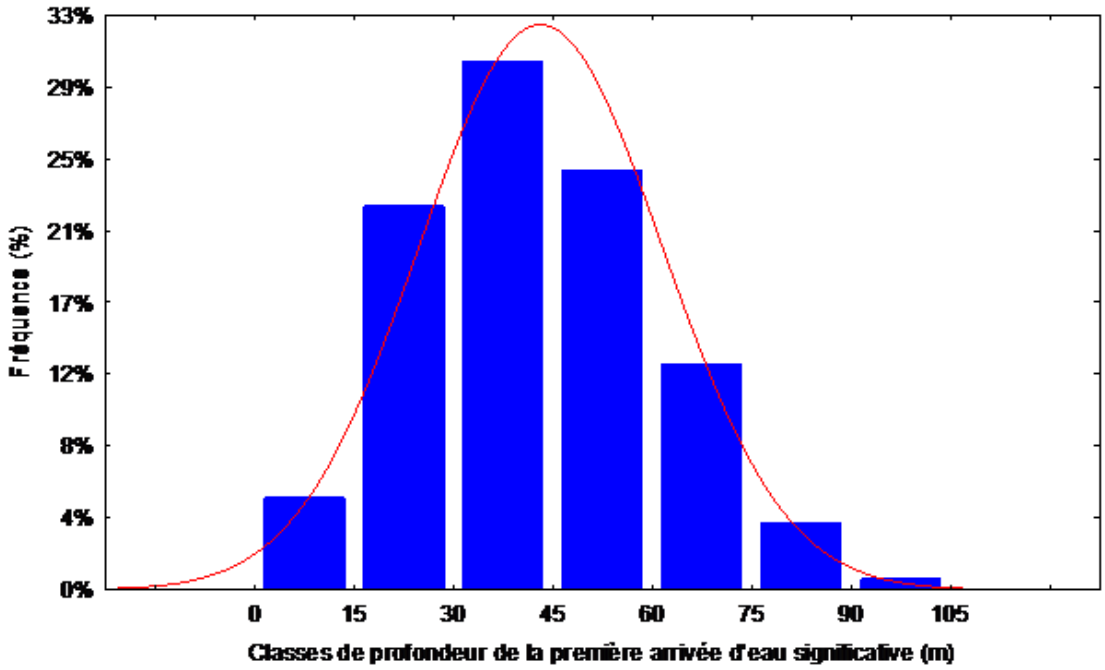

Figure 5: Fréquences des classes de profondeur de la première arrivée d'eau (m)

La figure 6, montre que les valeurs les plus fréquentes de l'épaisseur de l'horizon altéré sur le socle se situent entre 0 et 30 m et représentent 72,90% des valeurs observées. Les valeurs moins fréquemment obtenues sont comprises entre 30 et 60 m avec un taux de 27, 63%. Les épaisseurs d'altération sont rarement voire très rarement obtenues entre 60 et 105 m (4,11% des valeurs observées). Les fréquences des puissances d'altération diminuent au fur et à mesure que les valeurs de classes d'épaisseur augmentent. Ceci signifie que l'épaisseur de l'horizon altéré pourrait suivre une loi exponentielle décroissante.

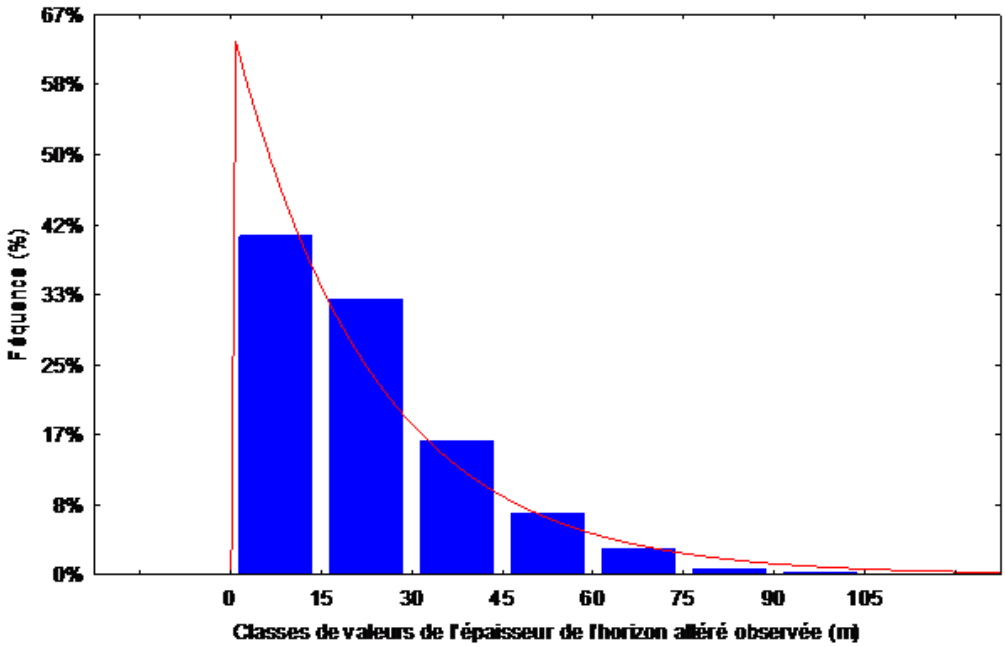

Figure 6: Fréquences des classes d'épaisseur de l'horizon altéré observée (m)

Les caractéristiques statistiques analysées ont permis de mettre en évidence l'homogénéité de la profondeur d'arrêt des forages (24,50%) suivie de la profondeur de la première arrivée d'eau (35,71%) ainsi que l'hétérogénéité de l'épaisseur d'altération (73,75%) et de l'épaisseur forée dans le socle (44,21%). Sur le socle ivoirien, les profondeurs de forages sont

homogènes et comprises entre 20 et 119 m. Ce constat confirme les résultats des travaux antérieurs [7, 15] ayant permis de montrer que la profondeur optimale des forages d'eau en milieu de socle se situe autour de 60 m, et qu'au-delà de la profondeur de 70 m, les possibilités d'obtenir de l'eau dans le socle s'amenuisaient du fait de la rareté des fractures suffisamment perméables pour donner le débit escompté. C'est la raison pour laquelle les profondeurs totales des forages observés dans le cadre de cette étude sont majoritairement comprises dans cet intervalle de valeurs et plus particulièrement entre 45 et 75 m. La relative homogénéité de l'épaisseur de la première arrivée d'eau significative (0,80-106,18 m) est due au fait qu'elle est déterminante dans la profondeur limite de forage [1, 3, 4]. En effet, au regard du débit obtenu, le forage peut être arrêté quelques mètres après ou être poursuivi afin de rechercher une seconde arrivée d'eau significative. L'obtention du débit escompté étant l'objectif à atteindre en termes de cahier de charge, les forages sont généralement arrêtés suite à l'obtention d'un débit satisfaisant cette condition. Le caractère hétérogène de l'épaisseur forée dans le socle (1-109 m) est dû au fait que les arrivées d'eau sont recherchées dans les niveaux fissurés avec des contraintes d'avoir des débits d'arrivée d'eau significatifs pouvant permettre d'aboutir à des débits de forage supérieurs ou égaux à $1m^3$/heure. L'épaisseur de l'horizon altéré est très hétérogène et varie de 0 à 104 m sur l'ensemble du socle ivoirien. En fait, l'épaisseur de l'horizon altéré est l'une des conséquences immédiates de l'altération des roches, due à leur lessivage par les eaux d'infiltration. Dans le Sud de la Côte d'Ivoire, il a été mis en évidence que l'épaisseur du niveau altéré pouvait atteindre 40 m de profondeur, alors qu'il se limitait à 11 m environ dans le Nord du pays. Cette différence étant due à l'hétérogénéité des précipitations sur l'ensemble du territoire. Or, la plus grande partie du pays (Nord et Centre) est soumise à un climat tropical. Ceci a pour conséquence la faiblesse des précipitations ainsi qu'une évaporation intense des eaux. Les faibles quantités d'eau qui réussissent à s'infiltrer ne sont pas suffisantes pour provoquer l'altération intensive des roches. C'est ce phénomène qui explique la grande fréquence des forages ayant traversé une épaisseur d'altération située entre 0 et 15 m sur le socle.

4.2 VARIABLES EXPLICATIVES PERTINENTES

La matrice de corrélation issue de l'analyse en composantes principales est représentée à partir du tableau 2. L'analyse de cette matrice met en évidence une forte corrélation entre les variables Pt et Pae_1 (0,65), et des corrélations d'intensité moyenne entre les couples Pt-Ep_Alt (0,40), Pt-Ep_Soc (0,42) et Ep_Alt-Pae_1(0,48). Ces résultats montrent que la profondeur des forages est bien corrélée avec la profondeur de la première arrivée d'eau significative, et assez bien corrélée avec l'épaisseur d'altérites et l'épaisseur de socle forée. La forte corrélation négative entre Ep_Soc et Ep_Alt (-0,62) traduit la variation inverse de l'épaisseur d'altération en fonction de celle du socle foré. En effet, lorsque l'épaisseur des altérites augmente celle du socle foré baisse. L'épaisseur de socle foré n'est pas corrélée à la profondeur de la première arrivée d'eau significative (0,04).

Tableau 2: Matrice de corrélation des paramètres physiques des forages

	Pt	**Pae_1**	**Ep_Alt**	**Ep_Soc**
Pt	1,00			
Pae_1	**0,65**	1,00		
Ep_Alt	0,40	0,48	1,00	
Ep_Soc	0,42	0,04	**-0,62**	1,00

Dans la recherche des composantes principales, quatre valeurs propres ont été obtenues (*Tableau 3*). Selon le principe de la méthode, les valeurs propres retenues sont celles qui sont supérieures ou égales à 1. Ainsi, deux composantes (facteurs 1 et 2) ont été retenues avec respectivement des pourcentages de 53,078% et 38,267%, soit un cumul de 91,345% (*Tableau 3*). Ce résultat signifie que ces deux axes factoriels détiennent l'essentiel des informations, et peuvent donc être retenus pour l'interprétation des résultats. Les facteurs 3 et 4 représentant moins de 10% de la variance totale, ne viendraient que pour confirmer les résultats obtenus au moyen des deux premiers facteurs.

Tableau 3: Valeurs propres des paramètres physiques des forages

Facteurs	**Valeur propre**	**% Variance**	**Cumul valeur propre (%)**	**Cumul variance (%)**
Facteur 1	2,123	53,078	2,123	53,078
Facteur 2	1,531	38,267	3,653	91,345
Facteur 3	0,314	7,864	3,968	99,209
Facteur 4	0,032	0,791	4,000	100,00

La représentation graphique dans l'espace des variables des différents paramètres (Figure 7) met en évidence l'organisation des différentes variables. Le facteur 1 est déterminé en plus de la profondeur de forage (Pt), par la profondeur de la première arrivée d'eau significative (Pae_1). Ces différentes variables se situent dans la partie positive du facteur. Les variables qui traduisent la présence d'eau souterraine (Pae_1 et Pt) sont préférentiellement corrélées avec l'axe 1, confirmant que la productivité est liée aux caractéristiques du socle fracturé et non altéré. Les paramètres représentatifs des épaisseurs de socle foré (Ep_Soc) et d'épaisseurs d'altération (Ep_Alt) s'opposent sur le facteur 2. En effet, l'épaisseur forée dans le socle (Ep_Soc) se situe au niveau de la partie positive alors que l'épaisseur d'altération (Ep_Alt) se trouve dans la partie négative. Du fait de sa position dans la partie positive de l'axe factoriel 2, l'épaisseur de socle foré favorise la productivité des forages en milieux de socle. Ces différents résultats confirment les différentes corrélations définies entre les variables. Le facteur F1 exprime donc la profondeur limite des forages pouvant fournir un débit significatif. Quant au facteur F2, il exprime les épaisseurs des différents aquifères à traverser afin d'obtenir un débit de forage significatif. En effet, l'aquifère est constitué d'un niveau altéré et d'un niveau fissuré. Mais, l'eau est recherchée dans le niveau fissuré d'où la traversée entière des altérites afin d'atteindre le socle fissuré. En effet, les altérites pourraient jouer un rôle prépondérant dans la productivité des forages. Cependant, elles peuvent devenir un facteur défavorable lorsqu'elles sont trop importantes (au-delà de 30 m). Le facteur F2 définit l'épaisseur de socle devant être foré après avoir traversé les altérites (Ep_Alt), afin d'obtenir des arrivées d'eau significatives voire un débit de forage satisfaisant (supérieur ou égal à 1 m^3/heure).

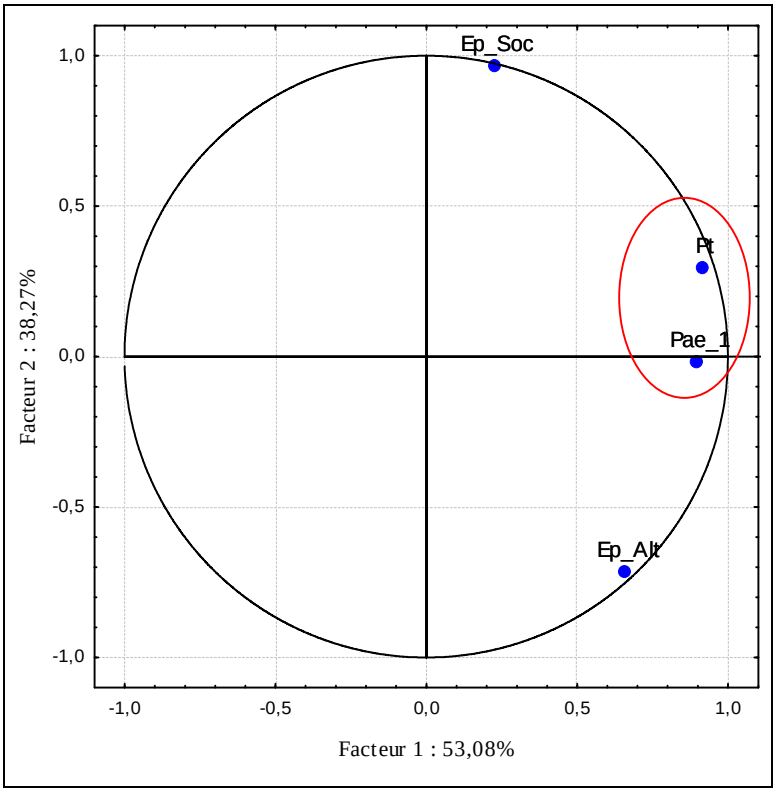

Figure 7: Espace des variables dans le plan factoriel F1-F2

Les résultats relatifs à l'identification des variables pertinentes pour la modélisation de la profondeur totale de forage et l'épaisseur de socle foré montre que les paramètres physiques étudiés ont chacun une influence plus ou moins significative sur la profondeur des forages d'eau et l'épaisseur de socle foré. Cela se confirme avec l'analyse de la matrice de corrélation qui donne un coefficient de corrélation qui varie de 0,40 à 0,65 en ce qui concerne la relation entre la profondeur des forages et les autres paramètres physiques. En effet, l'analyse de cette matrice permet d'affirmer que le paramètre le plus déterminant dans la simulation de la profondeur d'arrêt du forage est la profondeur de la première arrivée d'eau significative avec un coefficient de corrélation de 0,65.

Le coefficient de corrélation (pris en valeur absolue) entre l'épaisseur de socle foré et les autres paramètres physiques varie entre 0,04 et 0,62. Le caractère négatif de la corrélation entre l'épaisseur de socle foré et l'épaisseur d'altération traduit

le caractère limitant de l'épaisseur d'altération dans la productivité des forages en milieu de socle. L'épaisseur de socle foré n'est pas liée à la profondeur de la première arrivée d'eau. Cependant, elle a un lien assez satisfaisant avec la profondeur limite des forages. En effet, la profondeur d'un forage en milieux de socle est la somme de l'épaisseur de l'horizon altéré et de l'épaisseur de socle foré, d'où la corrélation assez forte entre les deux variables. Les deux variables expliquées sont liées entre elles, cependant, elles sont différemment liées aux variables explicatives. En définitive les variables explicatives retenues comme étant les plus pertinentes dans la définition de la profondeur limite des forages d'eau en milieux de socle cristallin et cristallophyllien et l'épaisseur de socle foré ayant servi à la conception des modèles de régressions linéaires multiples sont la profondeur de la première arrivée d'eau significative (Pae_1) et l'épaisseur d'altération (Ep_Alt).

4.3 RESULTATS DE CALAGE DES MODELES

Les résultats du calage des modèles, réalisé sur une population de 1605 forages, ont permis d'établir des modèles de simulation de la profondeur des forages et de l'épaisseur de socle foré. Les coefficients de régression produits, ainsi que les erreurs-types de chacun de ces coefficients sont consignés dans les tableaux 4 et 5. D'après le tableau 4, il y a une relation étroite entre la profondeur d'arrêt des forages en milieu de socle et les variables dépendantes que sont la profondeur de la première arrivée d'eau significative et l'épaisseur de l'horizon altéré puisque le test de Student a donné des valeurs de probabilités très faibles (inférieures à 1%). Les rapports erreurs-types/coefficients de régression des différentes variables montrent que la profondeur de la première arrivée d'eau significative (Pae_1) est plus homogène (3,4497%) que l'épaisseur d'altération (Ep_Alt) (19,588%). La constante est plus homogène que les variables explicatives avec une valeur de 2,490%. Chaque variable a donc une contribution significative sur la profondeur d'arrêt des forages mais la profondeur de la première arrivée d'eau significative a une contribution plus qualitative que l'épaisseur d'altération dans la modélisation de la profondeur limite de forage d'eau en milieux de socle.

Tableau 4: Coefficients du modèle et erreurs-types associées à la profondeur limite de forage

Variable	Coefficient de régression	Erreur-type	Erreur-type/coefficient de régression (%)
Pae_1	0,572	0,020	3,497
Ep_Alt	0,097	0,019	19,588
Constante	37,757	0,940	2,490

On déduit du tableau 4, l'équation du premier modèle de profondeur limite de forage d'eau (modèle PROLIFE 1) en milieux de socle qui se présente comme suit (équation 6) :

modèle PROLIFE 1: Pt (1) = 0,572*Pae_1 + 0,097*Ep_Alt + 37,757 (6)

Le calage du modèle de simulation des épaisseurs de socle foré sur une population de 1605 forages a produit des coefficients et leurs erreurs-types associées qui sont consignés dans le tableau 5. D'après ce tableau, il y a une relation étroite entre l'épaisseur de socle foré et les variables dépendantes que sont la profondeur de la première arrivée d'eau significative et l'épaisseur de l'horizon altéré puisque le test de Student a donné des valeurs de probabilités très faibles (inférieures à 1%). Les rapports erreurs-types/coefficients de régression des différentes variables montrent que les deux variables explicatives choisies sont homogènes. La profondeur de la première arrivée d'eau significative (Pae_1) (4,481%) a une contribution positive alors que l'épaisseur d'altération (-2,296%) a une contribution antagoniste sur l'épaisseur d'altération. La constante est aussi homogène avec une valeur de 2,350%. Ces résultats montrent que chaque variable a une contribution essentielle dans la modélisation de l'épaisseur de socle foré.

Tableau 5: Coefficients du modèle et erreurs-types associées à l'épaisseur de socle foré

Variable	Coefficient de régression	Erreur-type	Erreur-type/coefficient de régression (%)
Pae_1	0,491	0,022	4,481
Ep_Alt	-0,871	0,020	-2,296
Constante	41,965	0,986	2,350

On peut définir l'équation de l'épaisseur de socle foré comme suit (équation 7):

Ep_Soc = 0,491*Pae_1 - 0,871*Ep_Alt + 41,965 (7)

Les résultats de calage des différents modèles a permis de montrer que la profondeur de la première arrivée d'eau significative et l'épaisseur d'altération sont des variables explicatives pertinentes pour exprimer la profondeur limite de forage et l'épaisseur de socle foré. A partir de l'équation 7, un deuxième modèle de prévision de la profondeur limite de forage d'eau (modèle PROLIFE 2) en milieux de socle a été développé. Ce modèle est basé sur l'approche définitionnelle de la profondeur de forage en milieu de socle. En effet, la profondeur de forage en milieu de socle est la somme de l'épaisseur d'altération traversée (Ep_Alt) et de l'épaisseur de socle forée (Ep_Soc). Soit (équation 8):

modèle PROLIFE 2: $P_t(2)$=Ep_Alt+Ep_Soc (8)

A partir des équations 7 et 8, l'expression du deuxième modèle de prévision de la profondeur limite de forage d'eau (modèle PROLIFE 2) en milieux de socle est (équation 9):

modèle PROLIFE 2 : $P_t(2)$=0,491*Pae_1 + 0,129*Ep_Alt + 41,965 (9)

Des études antérieures réalisées par d'autres auteurs ont été menées avec d'autres paramètres [1, 4]. Dans la région du Denguélé en Côte d'Ivoire, Kouadio et *al.* [4] ont défini une profondeur limite et une épaisseur de socle foré dont les variables explicatives sont au nombre de quatre et sont composées de l'épaisseur d'altération, le nombre d'arrivée d'eau significative, la vitesse d'avancement dans le socle ainsi que la profondeur de la première arrivée d'eau significative. L'auteur [4] a également simulé la profondeur limite à partir de l'épaisseur de recouvrement alluvio-colluvial, l'épaisseur d'altération, la profondeur de la première venue d'eau, le nombre de venue d'eau et la vitesse d'avancement dans le socle au niveau du socle Tchadien. Les deux paramètres utilisés dans le cadre de cette étude se retrouvent dans l'équation déterminée par l'auteur [1]. Cependant, au niveau de l'auteur [4], seule l'épaisseur d'altération recoupe les différentes équations. L'ensemble de ces différents résultats traduit l'importance de la profondeur de la première arrivée d'eau significative et de l'épaisseur de l'horizon altéré dans la modélisation statistique de la profondeur limite d'arrêt des forages. Les erreurs-types obtenues au niveau des différentes variables explicatives ont été satisfaisantes. Ces résultats montrent le rôle joué par chaque variable dans la définition des variables expliquées. Les erreurs-types sont relativement plus faibles au niveau de la profondeur limite d'arrêt de forage. Les variables explicatives ont en général des erreurs-types plus faibles que celles de la constante quel que soit le modèle. L'épaisseur d'altération a une erreur-type relativement plus faible que celle de la profondeur de la première arrivée d'eau significative.

5 CONCLUSION

Cette étude a porté sur la conception de modèles statistiques capables de prédire la profondeur limite d'arrêt de forage en milieux de socle à partir de paramètres physiques de forage. Elle a été menée à partir des données issues des ensembles géologiques des domaines archéen et paléoprotérozoïque de Côte d'Ivoire. L'analyse de la distribution des paramètres physiques de forage à travers les valeurs de coefficient de variation de ces paramètres, a permis de mettre en évidence l'homogénéité de la profondeur limite d'arrêt de forage (24,50%) suivie de la profondeur de la première arrivée d'eau significative (35,71%). Il a été également mis en évidence l'hétérogénéité de l'épaisseur d'altération (73,75%) et de l'épaisseur forée dans le socle (44,21%). Les valeurs moyennes des différents paramètres sont respectivement 68,17 m pour la profondeur limite d'arrêt de forage, 17,46 m pour la profondeur de la première arrivée d'eau significative, 18,59 m pour l'épaisseur d'altération et 19,46 m pour l'épaisseur de socle foré. La profondeur limite d'arrêt de forage, l'épaisseur de socle forée et la profondeur de la première arrivée d'eau significative suivent une loi normale. Les fréquences des puissances d'altération suivent une loi exponentielle décroissante. L'application de l'analyse en composantes principales normées (ACPN) aux paramètres physiques des forages d'eau a permis d'identifier les variables explicatives les plus pertinentes et expressives pour la conception de modèles de profondeur limite de forage. Ces variables sont la profondeur de la première arrivée d'eau significative et l'épaisseur d'altération. Cette étude a permis de concevoir une équation de simulation de la profondeur limite de forage et une équation de simulation de l'épaisseur de socle foré à partir des variables explicatives. Les deux équations ont été déterminées par calage automatique à partir des deux variables explicatives précédentes. Les erreurs-types de régressions généralement faibles (inférieures à 1%) traduisent des relations étroites entre les variables expliquées (profondeur de forage, épaisseur de socle foré) et les variables explicatives (profondeur de la première arrivée d'eau significative et épaisseur d'altération). Ainsi, deux modèles de prévision de profondeur limite d'arrêt de forage d'eau (modèles PROLIFE) en milieux de socle cristallin et cristallophyllien ont été développés. L'avantage des modèles présentés dans cette étude réside au niveau de la faiblesse du nombre de variables explicatives (2) comparativement aux modèles existants.

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Study of Load Balancing Routing Algorithm for Low Earth Orbit Satellite Networks

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ABSTRACT: Now a day's Low Earth orbit satellite networks are used for IP based services. Satellite networks are required to support multimedia services. Delivering QoS guarantees to the users of LEO satellite networks is complicated since footprints of LEO satellites move as the satellites traverse their orbits, and thus, causing frequent user handovers between the satellites. In LEO satellite networks the traffic on the inter-satellite links (ISLs) also change with changes in the user-to-satellite traffic (which in turn changes due to the mobility of the satellites).Hence, traditional terrestrial routing protocols cannot be applied to broadband LEO satellite networks. To improve robustness and for load balancing in Low Earth orbit satellite networks a Cross-layer design and Ant-colony optimization based Load-balancing routing algorithm (CAL-LSN) is designed and implemented. CAL-LSN can utilize the information of the physical layer to make routing decision during the route construction phase. CAL-LSN uses mobile agents called *ants* for gathering the information of the nodes. ACO is well adapted to decentralized systems such as constellations of satellites because of the delays incurred by signalling information as it propagates through the network. Using CAL-LSN LEO satellite network performance is improved by balancing traffic load and increasing the packet delivery rate. Meanwhile, the end-to-end delay and delay jitter performance can meet the requirement of video transmission.

KEYWORDS: Ant-colony optimization; cross-layer design; LEO satellite networks; load balancing; Quality of Service; inter-satellite links

1 INTRODUCTION

1.1 LOW EARTH ORBIT SATELLITE NETWORK

Low Earth orbit satellite networks provide short round trip delay and are becoming increasingly important. Low Earth orbit satellite networks will be an integral part of next generation telecommunication infrastructures. To provide global coverage to more diverse user population, a number of Low Earth orbit satellite systems have been proposed. The LEO systems can provide both the areas with terrestrial wireless networks and those areas that lack wireless infrastructure. In the former case satellite system could interact with the terrestrial wireless network to absorb instantaneous traffic overload of terrestrial wireless network In other words mobile users would alternatively access both terrestrial or satellite network through dual mode handheld terminals. In later application area LEO satellite could cover regions where terrestrial wireless systems are economically infeasible due to rough terrain or insufficient user population. In order to provide continuous and seamless services to users regardless of where a particular user is located, LEO satellite networks will have satellite constellations with tens of satellites. These satellites will be equipped with sophisticated technologies such as on-board processing and inter-satellite links and are expected to provide the framework for robust and efficient universal communications. A Low Earth Orbit is any earth orbit of up to approximately 1,500 kilometers in altitude. At this altitude, orbit the earth in approximately 100-120 minutes. This low altitude provides small end to end delays and low power requirement for both satellites and terminals.

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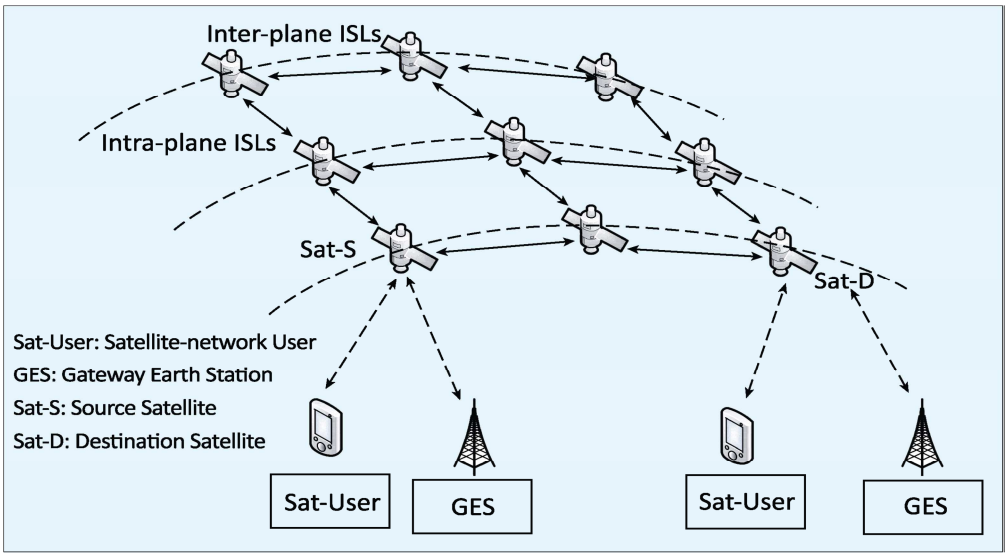

Fig.1.1 LEO satellite networks

1.2 CROSS LAYER DESIGN

Simple, yet effective, solutions which extend parts of the strict layering structure to system-wide CLD where stack wide layer interdependencies are designed and implemented to optimize overall network performance. As mentioned previously, the traditional way of designing a wireless manet or cellular network architecture, has been to identify each process or module and then assign them roles or requirements. Since each process or module has been treated separately, this approach has in many ways caused the research communities to split into different groups, where each group focus their resources on solving "their" problem the best possible way. The whole idea behind CLD is to combine the resources available in the different communities, and create a network which can be highly adoptive and QoS-efficient by sharing state information between different processes or modules in the system.

1.3 ANT COLONY OPTIMIZATION

The ant colony optimization algorithm (ACO), is a probabilistic technique for solving computational problems which can be reduced to finding good paths through graphs. In many ant species, ants walking from or to a food source, deposit on the ground a substance called *pheromone*. Other ants are able to smell this pheromone, and its presence influences the choice of their path, that is, they tend to follow strong pheromone concentrations. The pheromone deposited on the ground forms a pheromone trail, which allows the ants to find good sources of food that have been previously identified by other ants. Using random walks and pheromones within a ground containing one nest and one food source, the ants will leave the nest, find the food and come back to the nest. After some time, the way being used by the ants will converge to the shortest path.

2 ROUTING ALGORITHMS FOR LOW EARTH ORBIT SATELLITE NETWORK

As the LEO satellite moves along its orbit, it must service as many users that are in its coverage area, as possible. The effects of non-uniform geographical user traffic distributions in LEO satellite networks have not been investigated extensively. As explained in the previous sections, non-uniform user traffic load on the satellites may cause changes in the traffic on inter-satellite links, which may result in unexpected dropping of some of the user calls or packets. Which affects the delivery of guaranteed services to the users? Guaranteed services require that the packets of a call arrive within a pre-specified guaranteed delivery time and that the packets will not be discarded due to queue overflows. In a LEO satellite network, satellites and their individual coverage areas move relative to a fixed observer on Earth. To ensure that ongoing calls are not disrupted as a result of satellite movement, calls should be transferred or handed over to new satellites. Since two satellites are involved in a satellite handover, connection route should be modified to include the new satellite into the connection route. Designing an efficient routing algorithm for LEO satellite constellations is crucial for optimizing IP over Satellite (IPoS) network resources. Since there could be many shortest paths between two satellites, an efficient routing algorithm should provide better utilization of these paths. In LEO satellite networks the traffic on the inter-satellite links (ISLs) also change with changes in the user-to-satellite traffic (which in turn changes due to the mobility of the satellites). Hence,

traditional terrestrial routing protocols cannot be applied to broadband LEO satellite networks. Although sufficient bandwidth may be available on a particular route at call set-up for a particular call, the same route may become congested in time due to the changes in access traffic loads which in turn are changing due to the mobility of the satellites. The focus in research in LEO satellite networks has been in providing successful handover to users as they transition from one satellite's coverage area to the coverage area of another.

There are following routing algorithms for LEO satellite networks:

2.1 IMPROVED ANT COLONY SYSTEM (IACO)

An adaptive routing algorithm based on an Improved Ant Colony System (IACO) was made use of in LEO satellite networks. The original ant-colony algorithm in LEO satellite networks is improved with its own cyclical and regular characteristics. When IACO is made use of in the network, the end-to-end delay and delay jitter performance are poorer. When the number of users increases, IACO always tends to select the optimal path. This will make the load of the optimal path heavy.

2.2 DISTRIBUTED QOS-BASED ALGORITHM (DQA)

DQA focuses on multi-objective QoS routing based on heuristic ant algorithm. It satisfy QoS parameters delay bound and avoid link congestion [10], it considers the handover between the satellite and the ground station so as to minimize the effect on the active connections.

2.3 CROSS LAYER DESIGN AND ANT COLONY OPTIMIZATION BASED LOAD BALANCING ROUTING ALGORITHM FOR LOW EARTH ORBIT

Satellite Networks (**CAL-LSN**): This is a novel routing algorithm based on cross layer design for LEO satellite networks to improve the robustness of the networks. A multi-objective optimization model that considers the transmission delay, the residual bandwidth and the channel state is established. Ant-colony algorithm is utilized to solve this model to find the optimal path.

2.3.1 GOALS OF CAL-LSN

High Throughput: Throughput is defined as the ratio of the number of all data packets delivered to the base station to the number of all sampled data packets. CAL-LSN can improve the throughput of the networks.

End-to-end delay and delay jitter: The average time taken by a data packet to arrive in the destination is known as end to end delay. Is the difference in end to end one-way delay between selected packets in a flow with any lost packets being ignored. The effect is sometimes referred to as jitter. End-to-end delay and delay jitter is improved.

Packet delivery rate: called Packet delivery rate. When CAL-LSN is used Packet delivery rate is increased.

Link utilization: The percentage of a network's bandwidth that is currently being consumed by network traffic is known as Link utilization. The link utilization is the highest when CAL-LSN is used.

2.3.2 DESIGN OF CAL-LSN

As shown in Fig.2, Every satellite node has five modules.

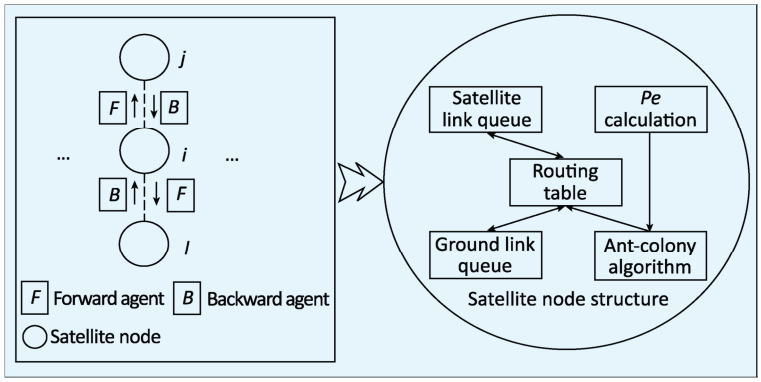

Fig 5.1 The mechanism of CAL-LSN

Ground link queue module is in charge of storing packets that interact with the ground station.

Satellite link queue module stores packets that interact with other satellite nodes in the network.

***Pe* calculation module** perceives the wireless link quality and calculates the error probability of each link.

Ant-colony algorithm module the result of *Pe* calculation module is the input of ant-colony algorithm module. This module can calculate the probability of sending data packets to adjacent satellite nodes.

Routing table module The value is saved in routing table module. There are two kinds of agents in CAL-LSN: forward agent and backward agent. The former travels through the satellite networks and collect routing information and the latter updates the routing table

2.3.3 MECHANISM OF CAL-LSN

To ensure the timeliness of packet transmission and to prevent network congestion, the cost of each link is defined as in Eq. (1).

$$\text{cost}_{ij} = \omega_1 \times \frac{PD_{\min}}{PD_{ij}} + \omega_2 \times \frac{RB_{ij}}{RB_{\max}} \qquad (1)$$

For simplification, the residual bandwidth constraint and the delay constraint are equally important indications of link cost in CAL-LSN, so ω1= ω2=0.5. *PD*min stands for the minimum propagation delay of the satellite networks. *PDij* is the propagation delay of link (*i*, *j*) and *RBij* is the residual bandwidth of link (*i*, *j*). *RB*max stands for the maximum residual bandwidth.

The propagation delay of intra-satellite links and inter-satellite links is about 13.47 ms and 11.58×cos*j*° ms respectively, according to Ref. [14] .Where *j* is the value of satellite latitude. The inter-satellite links are closed when satellites are in the Polar Regions. According to the latitude threshold for Polar Regions, the value of *PD*min can be derived. The value of *RB*max is the bandwidth of satellite links and *RB*max= *BW*. In CAL-LSN, path *P*(src, des) should satisfy the following constraints for an application to begin and progress, where src refers to the source satellite, des refers to the destination satellite.

$$\begin{aligned} &\max \sum_{(i,j)\in P(\text{src},\text{des})}^{\text{des}} \text{cost}_{ij} \\ &\sum_{(i,j)\in P(\text{src},\text{des})}^{\text{des}} TD_{ij} \leqslant De \\ &\min_{(i,j)\in P(\text{src},\text{des})} RB_{ij} \geqslant B \\ &\forall \text{ link}(i,j)_{(i,j)\in P(\text{src},\text{des})} \; Pe_{ij} \leqslant 10^{-6} \end{aligned} \qquad (2)$$

In Eq. (2), *i* and *j* stand for two satellite nodes in path *P*(src, des). According to Ref. [15], in order to ensure reliable data transmission, the error probability *Pe* should satisfy *Pe*≤10-6. *TDij* is the transmission delay of link (*i*, *j*). *De* stands for the maximum delay the LEO satellite networks can tolerant and *B* stands for the minimum bandwidth constraints. *TDij* and *RBij* can be calculated according to Eqs. (3) and (4).

$$TD_{ij} = PD_{ij} + QD_{ij} \qquad (3)$$

$$RB_{ij} = BW - Q_{ij} \qquad (4)$$

Where *QDij* is the queuing delay of link (*i*, *j*) and *Qij* is the mean queue length of link (*i*, *j*).

2.3.4 FORWARD AGENT BEHAVIOR

At the regular interval Δ*t*, a forward agent F*s*→*d* is launched at source satellite node *s* toward destination satellite node *d*. The topology of the satellite networks has the feature of regularity and periodicity. So the next hop which is near to the destination node will have a lager probability to be chosen. For node *s*, the probability to choose the next hop *j* is calculated according to Eq. (5).

$$\left(p_{sjd}\right)_{\text{agent}} = \frac{1/\text{Hop}_{jd}}{\sum_{j\in M} 1/\text{Hop}_{jd}} \quad (j \neq d) \qquad (5)$$

In Eq. (5), HOP*jd* stands for the minimum number of hops from node *j* to node *d* and *M* is the set of satellite nodes that are adjacent to satellite node *s*. Each forward agent has two lists. The $V_{v_0 \to v_m} = [v_0, v_1, \cdots, v_m]$ maintains the set of satellite nodes the forward agent passes and the list $T_{v_0 \to v_m} = [T_{v_0 \to v_1}, T_{v_1 \to v_2}, \cdots, T_{v_{m-1} \to v_m}]$ records the time the forward agent passes each node. At each intermediate node *i*, the forward agent uses the pseudo-random proportional selection rule [17], which adopts the strategy of deterministic rules combined with random selection. The forward agent *k* which is located at node *i* will choose the next node *j* through the following formula.

$$\left(p_{ijd}\right)_{\text{agent}} = \begin{cases} \dfrac{(p_{ijd})_{\text{data}}}{\sum_{j\in \text{table}_k} (p_{ijd})_{\text{data}}} & (\text{if } q \leqslant q_0) \\ 1/N & (\text{if } q > q_0) \end{cases} \qquad (6)$$

Here *q* is a random number which is even distribution in (0, 1), and *q*0 is a parameter (0<*q*0<1) whose size reflects the relative importance of using prior knowledge and exploring the new path. Table *k* represents the set of the next node which ant *k* can choose and *N* is the number of elements in table*k*. The function of table*k* is avoiding routing loops.

2.3.5 BACKWARD AGENT BEHAVIOR

Once the forward agent *Fs*→*d* reaches the destination satellite, it is terminated and the backward agent *Bd*→*s* is created. *Bd*→*s* copies the two lists from *Fs*→*d* and follows the identical path in the reverse direction. At each satellite node *Bd*→*s* passes, the probability for data packets to choose the next hop is updated. In Figure 2, suppose that one backward agent arrives at satellite node *i* from satellite node *j*. For satellite node *i*, the number of links accords with the number of ports. In the original ant-colony algorithm, the pheromone of the link between these two satellites is increased. Suppose that *r* is an arbitrary satellite node that is adjacent to satellite node *i* and *M*1 is the set of satellite nodes that are adjacent to satellite node *i*. The set *K* in CAL-LSN is defined as

$$K = \left\{r, (Pe)_{ir} < 10^{-6}, r \neq j, r \in M_1\right\} \qquad (7)$$

That is, *K* is the set of satellite nodes that satisfies (*Pe*)*ir*<10-6 except node *j*. *l* is one element of set *K* and *l* satisfies:

$$l \in K \cap \text{cost}_{il} = \max\left\{\text{cost}_{ir}, r \in K\right\} \qquad (8)$$

The probability for data packets to choose the next hop is calculated according to Eqs. (9) and (11). Suppose that *T*update stands for the routing table update cycle. *h* is the number of backward ants one satellite node receives during this update interval. The value of *h* in Eqs. (9) and (11) returns to zero every fixed time interval.

$$P_{ijd})_{\text{data}}|_{h+1}=\begin{cases}\rho\times(P_{ijd})_{\text{data}}|_h+(1-\rho) & \\ \qquad (Pe)_{ij}|_h<10^{-6} & \\ \rho\times(P_{ijd})_{\text{data}}|_h & \\ \qquad (Pe)_{ij}|_h\geqslant 10^{-6} & \end{cases} \quad (9)$$

$$(p_{ijd})_{\text{data}}|_{h=0}=\frac{1/\text{Hop}_{jd}}{\sum_{j\in M_1}1/\text{Hop}_{jd}}\ (j\neq d) \quad (10)$$

$$\left(p_{\substack{ird\\ r\neq j}}\right)_{\text{data}}|_{h+1}=\begin{cases}\rho\times(P_{ird})_{\text{data}}|_h+(1-\rho) & (Pe)_{ij}|_{h+1}\geqslant 10^{-6}\cap r=l\\ \rho\times(P_{ird})_{\text{data}}|_h & (Pe)_{ij}|_{h+1}\geqslant 10^{-6}\cap r\in K\cap r\neq l\\ \rho\times(P_{ird})_{\text{data}}|_h & (Pe)_{ij}|_h\geqslant 10^{-6}\cap r\notin K\\ \rho\times(P_{ird})_{\text{data}}|_h & (Pe)_{ij}|_h<10^{-6}\end{cases} \quad (11)$$

$$\left(p_{\substack{ird\\ r\neq j}}\right)_{\text{data}}|_{h=0}=\frac{1/\text{Hop}_{rd}}{\sum_{r\in M_1}1/\text{Hop}_{rd}}\ (r\neq d) \quad (12)$$

In Eqs. (9) and (11), ρ is the pheromone evaporation coefficient. In order to ensure that data packets will choose the link that its probability is strengthen, the value of ρ is discussed in this paper. Suppose that at the time satellite node *i* receives the *h*-th backward agent, the probability for data packets to choose link (*i*, *j*) and link (*i*, *l*) is *P*1 and *P*2 respectively. When node *i* receives the (*h*+1)-th backward agent, the value of (*pijd*) data is strengthen, so according to Eqs. (9) and (11)

$$(P_{ijd})_{\text{data}}|_{h+1}=\rho\times P_1+(1-\rho) \quad (13)$$

$$(P_{ild})_{\text{data}}|_{h+1}=\rho\times P_2 \quad (14)$$

In order to ensure that data packets will choose the link that its probability is strengthen, the following conditions should be satisfied.

$$\rho\times P_1+(1-\rho)>\rho\times P_2 \quad (15)$$

That is,

$$\left(\frac{1-\rho}{\rho}\right)>|P_2-P_1| \quad (16)$$

If $\frac{1-\rho}{\rho}$ satisfies $\frac{1-\rho}{\rho}\geqslant 1$ Eq. (16) can be tenable regardless of the value of *P*1 and *P*2. $\frac{1-\rho}{\rho}\geqslant 1$ is equivalent to $\rho\leqslant 0.5$. So we can conclude that data packets will choose the link that its probability is strengthen if the value of ρ satisfies $\rho\leqslant 0.5$. n the basis of Ref. [12], we define an interval [min, max]. *x* satisfies even distribution in [min, max]. The relationship between *Pe* and *x* is as follows,

$$Pe=\lambda\times e^{-\lambda x} \quad (17)$$

where λ=1. In this paper, the value of *Pe* is made as the external input, $a = \ln\frac{1}{10^{-6}} \in$ [min, max]. The interval [min, max] is defined considering satellite constellation characteristic In the light of the latitude of the satellite at time *t*, we define three areas. Let λ*u* reflects the probability of *Pe* larger than 10-6 in each area and lat*u*(*t*) denote the latitude of the satellite at time *t*, the definition of λ*u* is shown in Eqs. (18) and (19).

Inter-plane satellite links:

$$\lambda_u = \frac{\max - a}{\max - \min} = \begin{cases} 0.05 & -90^\circ < \mathrm{lat}_u(t) \leqslant -60^\circ \\ 0.1 & -60^\circ < \mathrm{lat}_u(t) \leqslant -30^\circ \\ & \vee\ 30^\circ < \mathrm{lat}_u(t) \leqslant 60^\circ \\ 0.15 & 60^\circ < \mathrm{lat}_u(t) \leqslant 90^\circ \end{cases} \quad (18)$$

Intra-plane satellite links

$$\lambda_u = \frac{\max - a}{\max - \min} = 0.15 \quad (19)$$

The average link utilization is calculated according to Eq. (20).

$$\mathrm{link\_uti} = \frac{\sum_{i=1}^{H}\sum_{j=1}^{4} S_{ij}}{4 \times H \times 1 \times 10^7} \quad (20)$$

Where *Sij* is the *j*-th port's actual transmission rate of satellite node *i*. *H* is the number of satellites over the whole constellation. An Iridium-like satellite constellation is considered for our study, so the value of *H* is 66.

3 CONCLUSION

The characteristics of the satellite links are discussed to improve the robustness of the LEO satellite networks. In order to perceive the conditions of the time-varying satellite channel, and improve the robustness of the network, CAL-LSN was proposed. In CAL-LSN, mobile agents are being used to gather routing information actively and cross-layer architecture is used. The network layer can make routing decisions based on link quality. Then, the optimization model was given. The model considered the minimum bandwidth constraint and the maximum delay the LEO satellite networks can tolerant as well as the error probability of the link. Thirdly, In order to make sure that data packets will choose the link on which the probability was strengthen, we are giving the update formula of the probability when data packets transmitted and discussed its key parameters. Finally, CAL-LSN can be compared with IACO and DQA. The simulation tool NS2 will be used. The performance of packet delivery, link utilization, the end-to-end delay of the network and delay jitter was compared respectively.

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Managing Education for Sustainable Development

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ABSTRACT: UNESCO being the lead agency for the UN Decade of Education for Sustainable Development (2005-2014) has continually reiterated that education remains the vehicle to achieving sustainable development. McKeown (2012) observed that proponents of sustainable development realize that there can be no sustainable development in the world if teachers are not trained in skills that enhance sustainable utilization of finite resources in the universe. This paper puts forth a proposition for the use of a conceptual approach of Education for Sustainable Development (ESD) for the planning and design of curricula to ensure that educational opportunities in sustainable development are holistically and effectively provided to secondary school students. It addresses how the internal and external environments could influence the prospects of a school to address curriculum development and an implementation process in ESD. In addition, due to concerns of many researchers that any strategies pertaining to sustainable development should consider the surrounding environment and geographical location, this study addresses what such a 'localization' process would mean in practice through a case study of selected secondary schools in Kenya. Working from stated definitions of 'Sustainable Development' and 'Education for Sustainable Development,' the author developed a theoretical process for achieving curricular reform in secondary education. This paper explores current awareness and attitudes towards sustainable development; explores the inclusion of sustainable development in the secondary school curriculum and investigates possible barriers to incorporating sustainable development in secondary school curriculum. In-depth interviews and questionnaire tools are key in data collection for this study. Findings are presented descriptively in form of cumulative frequency counts and percentages. The study establishes that awareness levels of sustianble development among secondary school students are low and their attitudes negative. There are opportunities for inclusion of sustainable development in the secondary school curriculum albeit notable barriers; an already flooded secondary school curriculum as well as inadequate teachers required for implementing the curriculum. It is recommended that the Ministry of Education needs to undertake a 'Phased Strategy' in order to systematically and holistically develop a curriculum in ESD in secondary schools. Universities need to start training teachers of Environmental Studies and that there is a critical need for a 'localization' strategy for a ESD curriculum development process in Kenyan secondary schools. Besides, UNESCO should focus more on ESD sensitization, public awareness and education through establishing a portal and creating caucuses which would map ESD implementation in universities.

KEYWORDS: Managing Education, Sustainable Development.

1 INTRODUCTION

Education, both formal and non-formal, public awareness and training are key processes by which human beings and societies can reach their fullest potential. In a bid to respond to educational needs, Education for Sustainable Development (ESD) has been enhanced. In December 2002, resolution 57/254 of the United Nations Decade of Education for Sustainable Development (UNDESD) 2005-2014 was adopted by the United Nations General Assembly and UNESCO was designated as lead agency for the promotion of the Decade. The vision for Education for Sustainable Development is about:

Learning to recognize, respect, value and preserve the past achievements; appreciate the diversity and uniqueness of the peoples of the earth; live in a world where resources are distributed in a way that no one is denied what they need to live happily for a healthy and productive life; assess, monitor, evaluate, care for, rehabilitate and restore the state of our planet; create and enjoy a better, safer, more just world; be caring citizens who exercise their rights and responsibilities locally,

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nationally and globally. Quality education is a prerequisite for Education for Sustainable Development (UNESCO Nairobi Cluster, 2006, p.4).

The Plan of Implementation recognizes two key aspects of education in relation to sustainable development:

First, education is the foundation for sustainable development and much of the work on Education for Sustainable Development (ESD) must be closely linked to the pursuit of Education for All (EFA). Second education is a key instrument for bringing about changes in values and attitudes, skills, behaviours, and lifestyles consistent with sustainable development within and among countries. Education is then meant to address such issues as gender equality, environmental protection, rural development, human rights, health care, HIV/AIDS and consumption patterns as these intersect with the sustainable development agenda (UNESCO Nairobi Cluster, 2006, p.3).

Education has kept on changing with time to meet the needs of a dynamic society. There are concerns all over the globe on the education offered; the changes in education; the curriculum and the content in relation to the challenges that face our society, hence the call for Education for Sustainable Development. Education remains the basic tool of transformation towards sustainable development. This is because education redefines, refocuses, and re-orients people's capacities, activities and perspective to transform their visions to produce the society of their make. Education provides scientific, technological skills, the motivation and quite paramount the justification, ethical dimension and social support for pursuing and applying them. This therefore means the only way to make a world that we want we have to pass through education as it is the most appropriate means. The teacher therefore has a responsibility of instilling ESD to the learners for a sustainable society. The international community understands the role of education in modeling individuals who consequently make the society. The world today is threatened by lots of ills like destruction of the ecosystem/biodiversity, pollution, terrorism, heightened poverty, unfair trade and so on. Through education, the attitudes, values, behaviour, skills, technology and lifestyles required for a sustainable future can be fostered. ESD is a process of learning how to make decisions that consider the long-term future of the economy, ecology and equity of all communities. Building the capacity for such future-oriented thinking is a key task of teachers and the teacher educators should prepare teachers for this daunting task. ESD is a holistic approach that wants to make up for the ills of man and enhance a life supporting world as opposed to the already existing life-threatening situation in the world. The international community wishes to use education to transform the society to a balanced one which enhances equality and that which supports life.

Higher education has a central role in the development of knowledge based economy. Thus the overall mission of the universities according to Kurapka and Vaitkus (2012) is to prepare individuals for the labor market; to prepare for life as active citizens in a democratic society; to contribute to personal growth; and to maintain and develop an advanced knowledge base. The sole person charged with this responsibility is the teacher. Educational institutions, particularly the ones educating or training teachers, stand out as the vehicles to instilling knowledge and training the teacher with the desirable knowledge on Sustainable (SD). According to UNESCO (2006) education at all levels and in all its forms should help people of all ages to understand the world in which they live and the complexity and interrelationship of problems such as poverty, wasteful consumption, environmental degradation, urban decay, population growth, gender inequality, health, conflict, and the violation of human rights that threaten the future. ESD is fundamentally about values, with respect at the centre for others, including those of present and future generations, for difference and diversity, for the environment, for the resources of the planet we inhabit.

Education enables us to understand ourselves and others and our links with the wider natural and social environment, and this understanding serves as a durable basis for building respect. Along with the sense of justice, ESD aims to move us to adopting behaviours and practices which enable all to live a full life without being deprived of basics. The three key areas of concern to ESD are society, environment and economy with culture as an underlying dimension (UNESCO Nairobi Cluster, 2006). The Faculties of Education in different universities and teacher training institutions have a key role to play to enhance sustainable education. They form a link between knowledge generation and transfer of knowledge to society in two ways. They prepare the future decision makers of society for their entry into the labour market. Such preparation includes education of teachers, who play the most important role in providing education at both primary and secondary levels. Secondly, they actively contribute to the societal development through outreach and service to the society (UNESCO, 2006).

2 OBJECTIVES OF THE STUDY

This paper presents findings of a study that aimed at achieving the following objectives:

1. To assess students' and lecturers' knowledge of Education for Sustainable Development in the Faculty of Education in Catholic University of Eastern Africa.
2. To establish the extent to which students and lecturers in the Faculty of Education in Catholic University of Eastern Africa in Kenya engage in community-based activities.
3. To evaluate the relevance of research carried out by students in the Faculty of Education in Catholic University of Eastern Africa in solving societal educational challenges.
4. To find out relevant components of Education for Sustainable Development not being offered in the Faculty of Education in Catholic University of Eastern Africa in Kenya.

3 METHODS

The study employed case study research design. The research concentrated on students in the undergraduate programmes in the Faculty of Education: that is the ones taking the school focused and fulltime/regular program and the lecturers teaching the undergraduate students in the Faculty of Education. The study targeted 814 students and 13 lecturers in the Faculty of Education. The students' population was not homogenous. Therefore, the researcher used stratified random sampling which is one method of Probability Sampling (Kombo and Tromp, 2006) to divide the students' population into homogeneous subgroups and then took simple random sample in each subgroup. Simple random sampling was employed in selecting lecturers who participated in the study. There were two groupings in the undergraduate programmes offered in the Faculty namely B/Ed Fulltime and B/Ed School Focused; simple random sampling was then used taking 10% to ensure that the sample was representative in proportion to their number in population. This is because for descriptive studies 10% of the population is adequate for sampling (Gay, 1996). The researcher therefore distributed questionnaires to 81 students and intended to interview 13 staff lecturers. Nevertheless, only 67 students returned their filled up questionnaire. 2 lecturers were not available for interview, thus only 11 lecturers were interviewed.

4 RESULTS

Knowledge of Education for Sustainable Development among Students and Lecturers

The first question in the students' questionnaire sought to find out students overall feeling towards the coverage of the following components of ESD: Peace, Environment, Development, Entrepreneurship, Information Communication Technology (ICT) and HIV/AIDS Education. Table 1 presents a summary of students who felt CUEA did offer education in the ESD selected areas, those who felt it did/did not and those who gave no response either due to hurry to finish filling in the questionnaire or they did not have an idea/response.

Table 1: Students' Opinion on inclusion of key components of ESD

Selected ESD areas of concern to Africa at CUEA	**Students N=67**						**Total**	
	n	**%**	**n**	**%**	**N**	**%**	**N**	**%**
Environment	63	94	3	4.5	1	1.5	67	100
Development	57	85.1	7	10.4	3	4.5	67	100
ICT	45	67.2	18	26.9	4	6	67	100
Peace	41	61.2	22	32.8	4	6	67	100
HIV/AIDS	32	47.8	31	46.3	4	66	67	100
Entrepreneurship	64	95.5	2	3	1	1.5	67	100

Source: *Field data, 2014*

When asked if they had taken ESD or ESD related courses, 10 out of 11 lecturers interviewed said they had taken ESD related courses. Those who had taken ESD related courses mentioned courses like HIV/AIDS, gender, environment, ICT and education psychology/counseling psychology. Some had researched or presented papers in ESD related courses. Asked who organized these studies, 5 lecturers said it was personal initiative, 3 learnt as part of the graduate studies, 1 as personal

initiative and part of graduate studies and 1 said it was part of training in the convent. From the findings it was clear CUEA did not have a conceptual framework on ESD. Most lecturers admitted that ESD was a new concept to them and had not heard about it before and it was only after explanation on what ESD addressed that they pointed out some studies they had taken which were of concern to ESD; they posited that they took initiative to take those studies out of the necessity to be up to date with contemporary educational challenges. It was also observed that the lecturers interviewed were not aware of the African module for the ESD studies. All the lecturers agreed ESD concerns in education were vital to teacher training and that CUEA and other universities needed to adopt ESD fully as it offered answers to most challenges in teacher training and achieving of overall education objectives in line with sustainable development.

Extent to which Students and Lecturers Engage in Community-based Activities

Students were asked to list the community based activities they engage in and which were organized by the Faculty of Education. Table 2 presents a summary of students' responses on this attribute.

Table 2: Community-based Activities that Students Engage in

N=67		
Activities	**N**	**%**
Teaching/Visiting Schools Activities	19	28.4
Community Service Day	17	25.4
Environmental club Activities	15	22.4
Awareness and Seminars	11	16.4
Donations	11	16.4
Guidance/Counseling/Peer counsel	10	14.9
Project Writing/ Youth Projects	9	13.4
Visiting the Sick, Assisting Needy	8	11.9

Source: *Field data, 2014*

Lecturers were asked to indicate how often they engaged in community service. Seven lecturers said they engage in community service spontaneously and in an ongoing process, two once a semester, one sporadically and another when opportunity arises. Some activities they identified included environmental conservation, educating the community, mobilizing the community to tackle the problems in the neighborhoods like collecting litter, clearing the drainage etc. The participation of the lecturers in community service seemed to be in line with the ESD expectations. One ESD perspective is that educated people in the society should dedicate themselves to serving the community and improving the living standards. Lecturers indicated that they were involved in many community activities.

They provided civic education on many societal challenges like HIV/AIDS, democracy, and environment. Secondly, they participated in policy formulation to develop policies that enhance sustainability. Some offered counseling services to the community, participated in church and women groups, held leadership positions in community welfare groups etc. They also conduct research aimed at solving societal problems. Thus they initiate change through research, writing and mobilizing community to development.

Relevance of Students' Research in Solving Educational Challenges

In the interview all the lecturers observed that the research carried out by students in the Faculty was relevant to ESD. All the same, they observed that there was over concentration in some areas (e.g. performance) whereas others have not been researched on (like the role of education in enhancing poverty alleviation). They felt there was need to research on areas of other problems on SD under economic, social and environmental realms. The following were some areas the students had been conducting research in and the lecturers felt address issues of ESD: drug and substance abuse, Reproductive health, environment, Performance, Alcoholism among youth and Causes of crime among boys. Other areas were on adolescents, Gender, Culture and influence on education of girl child, Discipline, guidance and counseling, HIV/AIDS, Special education, Free primary education, counseling and peer counseling, Environment, Public relations, How parents could be involved in education of children, Problems facing mentally handicapped people in learning in integrated (mainstreamed) schools, visually and physically challenged, Strikes and disadvantaged groups in the society especially women and children. There was need for curriculum implementation to try and address the critical issues in education, segregation in schools-the private and public schools, Globalization and IT.

Lecturers made several suggestions on the relevance of research conducted by students in enhancing Education for Sustainable Development. They indicated that research conducted by students' enhanced awareness on sustainability matters. Research was seen as being of invaluable contribution in education in regard to reevaluating and understanding a country's national goals of education and their relevance globally. There were those who felt research would tailor the education offered to immediate region challenges so that teachers and instructors would teach with emphasis in relation to their places of work. They observed that research conducted by students would help in highlighting those most immediate and urgent issues in education that need to be emphasized on development such as politics and economy.

Lecturers indicated that research conducted by students would enable the nation to have a sound curriculum that could be practical and market oriented addressing for emerging issues such as HIV/AIDS, crime, clashes and globalization; result to a curriculum that is acceptable in other parts of the world. Research would lead to new innovations in methodology to teaching. Research would help in unearthing the problems facing the sector of education; research would assist in making. Therefore, research conducted would help the researcher to come to terms with the needs of the country and capitalize on those needs when suggesting intervention measures. In addition respondents felt research was also a tool of education in that it would help unearth evils in the society and try to offer remedy.

At the same time the lecturer respondents felt that research helped in planning for the future and management of available resources. It educated stakeholders and equipped learners with relevant skills. Helped to know the causes of most problems, helped in suggesting ways of eradicating such problems, made an individual to acquire the right knowledge, skills and attitude for enhancing sustainable development. In improving the economy, the respondents were of the view that research would help in fair distribution of resources, help people acquire skills to be self-employed and instill values of hard work to create wealth. At the same time the respondents believed that research on environment areas of concern would help the present generation realize that they were the care takers or trustees of the environment. This would hence lead to using the environment resources in a sustainable manner; without jeopardizing chances for the future generation.

Suggested Fundamental ESD Courses that need be included in Teacher Training

Lecturer respondents were asked to indicate relevant components of ESD that were not being offered in the university curricula to teacher trainees and which they felt were significant. Table 3 summarizes the opinions gathered from the lecturers.

Table 3: Suggested Fundamental ESD Courses

Suggested ECD Course	Frequency	Percentage
Peace and conflict resolution	9	81.8
School financial resource mobilization	11	100
Corruption and its consequences	11	100
Health issues in education	10	90.9
Gender education and development	6	54.5
Nationalism and patriotism	11	100

5 SUMMARY

The study sought to establish the extent to which the Faculty of Education in Catholic University of Eastern Africa incorporates Educational for Sustainable Development components in a bid to manage education for sustainability. This conviction was driven by realization that the faculties of education train and produce teachers and that these teachers develop policies in education realm in curriculum. Knowledge of ESD therefore remains indispensable in developing education curriculum that would enhance ESD. UNESCO (2006) postulated that education is the tool for transformation and the teacher is the instrument of achieving the desirable changes in relation to sustainable education, hence the great need to train teachers on ESD. The study employed a case study design, targeting lecturers and students in the Faculty of Education. The researcher employed stratified probability and simple random sampling to select 81 teacher students and 13 lecturers in the sample. It was established that the curriculum of the Faculty of education covered ESD attributes minimally and that more needed to be incorporated in the curriculum. It is recommended that UNESCO should focus more on ESD sensitization, public awareness and education through establishing a portal and creating caucuses which would map ESD implementation in universities.

6 CONCLUSIONS

Students and lecturers demonstrated knowledge in ESD. Key areas that are incorporated in the Faculty of Education curriculum include: environment; entrepreneurship; development; ICT; peace and HIV/AIDS. Students and lecturers were reported to be engaging in community-based activities. These activities were: teaching/visiting schools; organizing community service days; engaging in environmental club activities; organizing environmental awareness seminars; donations; offering guiding and counseling services to community members; assisting the concerned with project writing particularly for youth projects and visiting the sick and the needy.

Lecturers provided civic education on many societal challenges like HIV/AIDS, democracy, and environment. Secondly, they participated in policy formulation to develop policies that enhance sustainability. Some offered counseling services to the community, participated in church and women groups, held leadership positions in community welfare groups etc. They also conduct research aimed at solving societal problems. Thus they initiate change through research, writing and mobilizing community to development. Lecturers observed that research carried out by students in the Faculty was relevant to ESD. All the same, they observed that there was over concentration in some areas (e.g. performance) whereas others have not been researched on (like the role of education in enhancing poverty alleviation).

Lecturers felt there was need to research on areas of other problems on SD under economic, social and environmental realms. It was observed that the curriculum in the Faculty of Education did not fully address components of ESD. It was therefore suggested that the following attributes be included in the curriculum: peace and conflict resolution; school financial/ resource mobilization management; corruption and its consequences to the environment; health issues in education; gender education and development; and nationalism and patriotism. It is recommended that UNESCO should focus more on ESD sensitization, public awareness and education through establishing a portal and creating caucuses which would map ESD implementation in universities.

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Embedding ICT in English Second Language Teacher Professional Development: Challenges and Prospects for Kenya

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ABSTRACT: In this age of globalization, the use of technology is advancing at an exponential rate and is taking root within many fields including education. The changed face of education predisposes pressure to the modern teacher due to a sense of knowledge and skills inadequacy. Apart from content and pedagogical knowledge, today's teacher requires knowledge, skills and expertise in the use of information communication technology (ICT) in order to enhance the instructional process. This calls for a deliberate paradigm shift in the manner in which the teacher is prepared and taken through various teacher professional development (TPD) programmes. Professional growth of a teacher is a life-long process of development beginning with pre-service training and climaxing in retirement. Theories of TPD show that teachers exhibit needs at different times in their professional lives. An analysis of these needs prompts a differentiated approach to their professional development. The teacher has to contend with various changes and therefore needs education in addition to initial pre-service training, thus the need for revitalized TPD programmes. Educationalist at all levels of learning must acknowledge and realize that the adoption, utilization and infusion of ICT in education is fundamental to effective teaching and consequently, successful learning. Teacher education as a component of education therefore requires to be revolutionized to suit the trends and needs of the modern society through the nature of training and professional development the teacher trainees and already practicing teachers are exposed to respectively.

It is from this perspective that we do in this paper argue for the infusion of ICT into English language TPD processes, both at personal and institutional levels. This will enable the teachers of English in Kenya to operate within new and modern educational trends thus modelling life-long learning strategies that are closely linked to facets within facets of TPD. We do believe that the infusion of ICT into TPD will enable the skills and knowledge of the older teachers of English to evolve into a rich tapestry of knowledge that can only serve to create inclusive, richer and innovative teaching styles that will ultimately promote language learning among student.

KEYWORDS: English Second Language, teacher professional development, Information Communication and Technology.

1 INTRODUCTION

TEACHER PROFESSIONAL DEVELOPMENT

The teacher has to contend with various changes throughout his professional life. To cope with these changes, he needs to develop professionally. This development is a life-long process that spans from training to retirement. Professional development is much more than training, though technology training may be one part of TPD. Professional development—including the ongoing workshops, follow-up, study, reflections, observations and assessment that comprise TPD—accommodates teachers as learners, recognizes the long-term nature of learning, and utilizes methods that are likely to lead teachers to improve their practice as professionals. Professional development takes many forms, such as: when teachers plan activities together; when a master teacher observes a young teacher and provides feedback; and when a team of teachers observes a video lesson and reflects on and discusses the lesson. These methods of TPD are all more effective models of teacher learning than simple training. Teachers need a wide variety of ongoing opportunities to improve their skills. TPD (also known as "in service" or "teacher education") is the instruction provided to teachers to promote their development in a

certain area (e.g., technology, reading instruction, subject mastery, etc.). TPD is the tool by which policymakers' visions for change are disseminated and conveyed to teachers. Though the recipient of TPD is the teacher, the ultimate intended beneficiary is the student. There is general agreement that learning to teach is a lifelong process, and teachers must be equipped with sufficient knowledge, skill, and awareness in order to carry out their jobs (TESL-EJ 10.2, Sept. 2006 Atay).

The crux of this paper concerns supporting continuing professional development (CPD) of teachers. Lee (2007) posited that PD systems can largely be categorized into two major forms based on the principles and characteristics underpinning them, i.e., a dominant form that is 'knowledge and skill transmission-oriented' (KSTO), and an alternative form that is 'community-of-practice oriented' (CPO). Briefly summarized, KSTO PD systems can be summarized as involving teachers in essentially private, individual activity; sessions are typically brief, often one-shot; an external 'expert' presenter is often relied on; topics are offered in a disconnected fashion; teacher listeners are cast in passive role and little provision is made for teacher interaction; skill development is emphasized; quick, visible results are expected; and, in general, teaching methods are dealt with in a theoretical way. The main principles and characteristics of the CPO PD system, on the other hand, can be summarized as those that emphasize substantive, school-related issues; stress the why as well as the how of teaching; expect teachers to be active participants; involve learning that is shared and public; promote sustained interaction; rely on internal expertise; articulate a theoretical research base; and anticipate that lasting change will be a slow process (Lee, 2007).

ESL teacher development is informed by one model to English second language teacher education referred to as the 'person-centred approach' which highlights the need to focus on the teacher developing their own personal theories of teaching, exploring the nature of their own decisions-making and classroom practices and developing strategies for critical reflection and change. These perceptions of the ESL teacher we believe can be enhanced through provision of ICT blended TPD programmes. Teacher education in Kenya is not in particular offered using ICT which would expose teachers to the practical aspects of ICT integration across their curriculum. ICT skills for teachers of English are not simply about how to use technologies but also about why and when to use them in transforming their teaching practices, subsequently the language instructional process. Therefore, without capacity building of the teachers of language through TPD, the potential benefits of ICT in enhancing development of communicative competence among learners in the education system will not be realized.

Kafu suggests that to better the face of teacher education programmes, teaching profession and school teachers respectively, there is need to adapt to and adopt new educational communication and technology materials. That is design, develop and use modern educational technology to prepare school teachers. This will improve the training and instruction of teachers and teacher-trainees. These packages (computers, satellite technologies, etc and their accessories) will educate, inform and expose these individuals to the needs and challenges of the modern Kenyan society that they are expected to serve. The initial costs of adapting to and adopting these systems may be high but the eventual benefits are rewarding. Indeed the infusion of ICT into TPD will enable the skills and knowledge of the older teachers of English to evolve into a rich tapestry of knowledge that can only serve to create inclusive, richer and innovative teaching styles that will ultimately promote language learning among students.

2 HOW ICT CAN BE EMBEDDED INTO TPD

As pointed out above, there are various ways through which the teacher develops. In this paper we emphasize on the ESL teacher development through ICT. ICT use in general terms is any use of "computing devices such as desktop computers, laptops, software, or Internet for instructional purposes" (Hew & Brush, 2007, p. 225). However, more specifically it refers to the use of technology by teachers for instructional preparation, instructional delivery, and technology as a learning tool for students (Inan & Lowther, 2010). The use of ICT in foreign language (FL) education, has developed from the earliest stages in audio tapes, word processing, and CD-ROM (Becker et al., 1999; Evelyn & Oliver, 1987) to Internet browsing, online interaction with peers and people of similar interests using Computer Mediated Communication (CMC), synchronous and asynchronous, such as chat, video teleconferencing, whiteboard, discussion forum, social networking sites, email and other forms of technology including blogs, wikis, IPod, and MP3s (Murray, 2005). The extensive use of Web 2.0 components, Internet, blogs, e-groups, emails, socializing portals, e-dictionaries, e-encyclopaedias, PowerPoint presentations, webcasting, and audio-video, as teaching tools has emerged in the classroom. Combining several of the previous tools and integrating multimedia services one can create a virtual learning environment (VLE) that offers not only content management and exams servicing but also an innovative teaching method that can increase the active role of student in the classroom. How then can ICT be manipulated to enhance TPD? The Internet, particularly, has become a useful tool for communication, a venue for experiencing different cultures and a mediator in diverse political, social and economical situations. Along with the impact of the Internet worldwide, the extensive use of computers at schools has had a critical influence on educational environments. This is where the teacher draws his beliefs from.

Action research is one way of developing the teacher. Studies have shown that teacher research has a profound effect on those who have done it, in some cases transforming classrooms and schools. It has been found to facilitate teachers' critical thought, boost teachers' self-esteem, and increase their awareness of students' needs. However, because of inadequate time and training to conduct research it has been observed that neither pre- nor in-service teachers of English can do much research Thus, this paper suggests that teachers can use ICT to carry out research. Data collection tools such as postal questionnaires and document analysis could yield a rich knowledge base. More so the teachers can carry out the research from the comfort of their schools by merely clicking their computers. If pre- and in-service teachers all over the world are encouraged to collaborate for research, there would be a lot of benefits.

In-service education and training (INSET) intended to stimulate the professional competence and development of teachers (Kennedy, 1995) can improve classroom teaching practices and/or implement educational innovations decided upon at governmental level and provide teachers with continuous education throughout their teaching career . A general look at current INSET practices reveals the training orientation as "one shot" programs, in which knowledge is usually transmitted by an outside expert (Craft,1996). The popularity of these programs lies in what Widdowson (1987) calls the "social and professional intensity of the event" (p. 2). Thus, teachers have a break in routine, a chance to meet new colleagues, and to discuss their professional problems. In addition, they are exposed to stimulating new ideas and experience the novelty of being students again. Despite their popularity, one-shot, knowledge-transmission INSET programs have serious limitations, and do not achieve their aims of effecting a change in teacher behavior (Hayes, 1997). One significant reason is that the participants are passive recipients of knowledge, and their existing knowledge, beliefs, and are not acknowledged by the trainers. According to Cochran-Smith and Lytle in-service teacher education programs are typically organized to disseminate a knowledge base constructed almost exclusively by outside experts. This means that through their careers teachers are expected to learn about their profession not by studying their own experiences but by studying the findings of those who are not themselves school-based teachers. (1993, pp. 1-2) The constructivist pedagogies of today, however, emerge from an intellectual world in which knowledge is seen as constructed rather than received (Von Glasersfeld, 1991), and explored rather than remembered as a uniform set of ideas (Rorty, 1979). Influenced by Dewey's line of inquiry, Schön (1987) believes that by questioning, discussing, and checking beliefs and practices with others, teachers make implicit knowledge explicit and progressively gain or improve control of their own teaching. Within this framework, educational research is no longer used only as a way to prescribe teachers' actions. Instead, teacher education programs include opportunities for teachers to become aware of their own practices and the beliefs that underpin them, and teachers are encouraged to construct their knowledge and become active participants in research (Tom, 1985; Cochran-Smith & Lytle, 1993; Zeichner, 1994). Collaborative action research as a form of inquiry requires teachers to engage in a cycle of questioning, planning, acting, observing, reflecting, pre-planning, and often questioning further (Kemmis & McTaggart, 1988), and invites them particularly to question the common assumption that knowledge for and about classroom teaching should first be generated at the university and then used in schools (Lewin, 1946; Stenhouse, 1985; Ogberg & McCutcheon, 1987; Kraft, 2002 Other studies indicate that participation in research promotes continuous learning (Rock, 1999), revitalizes teachers' practice and motivates them by improving their self-confidence as professionals (Lomax, 1995). Case studies involving pre-service teachers and their cooperating teachers have further revealed strong evidence to support collaborative research as a professional development tool (Catelli, 1995; Friesen, 1994; Levin & Rock, 2003.

Another way that teachers can truly develop is through exploration of their teaching. There are a variety of ways to explore teaching. Some of the ways are: (1) self-oservation, (2) observation of other teachers, and (3) talk with other teachers about what we observe in a nonjudgmental and non prescriptive way. This exploration can be enhanced through ICT use**.** As Bailey, Curtis and Nunan (1998, 2001), Richards and Farrell (2005), and Gebhard,(1992), show elsewhere, there are a variety of ways that teachers can explore their teaching. They can read professional books and journals on teaching and learning languages. We can establish a mentoring relationship with a more experienced teacher. They can also learn another language. By doing this they can gain a deeper understanding of the challenges that the learners face. Keeping a teaching journal is another way to explore, especially if they take time to read and think about what they have written. Bailey, Curtis, and Nunan (2001) point out that self-observation is the cornerstone for all professional development. It is through the process of observation that teachers can have something to say in journals, work through action research projects, and talk about their teaching with others. But, self-observation as a way to explore their teaching for the purpose of seeing their teaching differently has its own unique approach separate from other professional development activities. Teachers can explore their teaching by describing, analyzing, interpreting, and generating teaching alternatives in a nonjudgmental systematic way through self-observation. To make self-observation possible, teachers can collect samples of their teaching, and this can be done in a variety of ways. Parts of classes taught can be audio taped because an audio recorder is easy to use. If one is interested in learning about how to treat language errors, one might make and study short transcripts of the times errors are treated. If the interest is on learning about the accuracy of the students' language during group work, one can transcribe and study short sections of interaction among students during group work activities. It is also possible not to focus

on a specific observation objective. For example, it is possible to tape a class, view the tape, and while doing this, make short one minute transcripts of classroom interaction five, ten, and twenty minutes into the class. These transcripts could then be studied simply to see what is going on. After doing an analysis, one can stop to make sense of the descriptions of classroom interaction. Other teachers can also be observed**.** At first the idea that teachers can explore their own teaching by observing other teachers may seem contradictory. However, as Fanselow (1988) points out, as teachers, we can see our own teaching in the teaching of others. When we observe others to gain knowledge of self, we have the chance to construct and reconstruct our own knowledge. Fanselow articulates this in another way: "I came to your class not only with a magnifying glass to look carefully at what was being done, but with a mirror so that I could see that what you were doing is a reflection of much of what I do" (p. 2). While observing other teachers, it is possible to collect samples of teaching in a variety of ways. Fast notes can be taken, sketches drawn, behaviors tallied, and short transcript-like samples of interaction jotted down. As with collecting samples in our own classes, it is possible to audio- or video-tape other teachers' classes and photograph interaction. These can be used later to analyze classroom behaviors. It would be good to encourage observers and the observed teacher to get together to look at photos, listen to tapes, view videos, study short transcripts, and talk about the class. By doing so, exploration will be enhanced for all. Observing self and observing others can be varied through the use of ICT. Videos of oneself in the process of teaching can be taken and later shared and viewed with others. The same could apply to observing others classes. These experiences, knowledge and skills can be shared through an online platform in order to develop learning opportunities for each other. This can be done through (a) sharing text-based narratives of perceived good lessons through blogs. Teachers can select and comment on teaching episodes, which they considered to have been successful and another which they considered to be less so and post them in the blogs, (b) sharing of video clips of good lessons through the ViP (Virtual interactive Platform).This can enable them to share video clips of their classroom activities online, and (c) forum discussions of lessons.

TeacherTube (www.teachertube.com) is another useful video repository for trainers. TeacherTube is the educational equivalent of YouTube – anyone can upload videos related to education. A lot of the videos available on TeacherTube showcase class work, or are produced by classes themselves, which means that one needs to search through the content to find useable videos, and they are of varying quality. However, uploaded videos have 'tags' (or key words) assigned to them, so the search function is fairly effective. A search for 'ESL class' takes you to several demo classes to see with trainees. There is a handy 'refine your search' function which allows you to add more tags to your search terms too. Jeremy Harmer's recently reprinted teacher's resource book 'How to Teach English' (Longman 2007) has a DVD of experienced teachers teaching EFL classes in the UK, good for demonstration purposes with trainees.

In addition, there are an ever-increasing number of video tutorials available on the Internet, which train viewers in how to use a range of ICT tools. This is a second area that trainers could find useful in their work, not only to get up to speed on how to use ICT tools themselves, but to show in training sessions, or to ask trainees to watch out of class time. There are tutorial sites that have mainly been developed by individual EFL/ESL teachers and trainers. They are all early adopters of technology, and have been exploring ICT tools themselves in their teaching and training for years, so these videos provide good, clear step by step accounts of how to install and use ICT tools, always with the language teacher and trainer (and by extension the learner) in mind. One of them is the (www.teachertrainingvideos.com). Russell Stannard's site includes general teaching and EFL teaching videos. The general teaching videos show you how to use blogs, wikis, PowerPoint, Delicious (a social bookmarking tool) among other useful products. The EFL training videos focus more directly on EFL as well as more on blogs and wikis. Videos show you how to use video from the Internet with EFL classes, how to make worksheets fast, and several sites are recommended for teachers to use with learners – the videos show you how to exploit these.

Another is the Learning Technology Teacher Development Blog (nikpeachey.blogspot.com). Nik Peachey's blog site aims to help English language teachers use technology in their teaching – as such it is of interest to both trainers and trainees. If you browse through the monthly archives on the right hand side of the site, you'll find a wealth of information on a wide range of tools with not only videos on how to install and use these tools, but useful practical tips and ideas of how they can be used in class. Topics covered in the video tutorials and demos include a look at free online pronunciation software, creating simple audiovisual materials with learners, using Second Life to teach English, and how to create an interactive online cloze test, among others. The recent teachers' resource book 'How to Teach English with Technology' (Dudeney & Hockly 2007), in the same Longman series as the Harmer book mentioned above, also includes a DVD with a number of video tutorials on ICT tools for wikis, blogs, and podcasts, as well as how to use RSS, Skype. simple authoring tools, and MS Word functions like 'track changes'.

Computers, TV, the Internet and especially older (and currently unfashionable) technologies with proven track records of cost -effective deployment, such as interactive radio, can help to meet the challenges associated with training and supporting the large numbers of teachers necessary required for achieving EFA targets. The combination of ICTs and TPD has given rise to a wide range of approaches—from radio programming that "walks" teachers through lessons alongside their students, to

the use of computer-aided instruction to improve teachers' math skills, to teachers videotaping each other in action in their classrooms. The many uses of technology in relation to TPD can be grouped in three categories: i)A delivery system providing teachers with information to improve pedagogy and content mastery; ii)A focus of study that develops teachers' abilities to use specific tools, such as computers; and iii) a catalyst for new forms of teaching and learning, such as inquiry-based learning, collaborative learning, and other forms of learner-centered pedagogy.

In conclusion, to be effective and successful, teacher professional development must be of high quality and relevant to teachers' needs. No amount of ICT can compensate for TPD that lacks these characteristics. TPD is the tool by which policymakers convey broad visions, disseminate critical information, and provide guidance to teachers. Effective TPD begins with an understanding of teachers' needs and their work environments—schools and classrooms. TPD then combines a range of techniques to promote learning; provides teachers with the support they need; engages school leadership; and makes use of evaluation to increase its impact. Essential techniques include mentoring, teamwork, observation, reflection and assessment. TPD programs should engage teachers as learners—typically involving the process of "modeling." When computers are involved, TPD programs must address not only teachers' technical skills, but also their concerns about logistics, about how to use computers with students, and about risks to their status in the classroom. Successful computer-supported or computer-focused TPD provides teachers with hands-on opportunities to build technical skills and work in teams while engaging them in activities that have substantial bearing on their classroom practices or on other aspects of the school workplace.

3 WHY EMBED ICT?

Lam and Lawrence (2002) found that using computers in a communicative classroom brings about the shift of traditional teacher-student roles. In the technology-enhanced environment, learners could manage their own learning process by gathering information and negotiating meaning themselves. The classroom became more learner-centred, that is, learners were able to make their decisions and became responsible for their work more independently. The teacher, on the other hand, became a "facilitator, a resource person and a counselor rather than the only authority and decision-maker" (p. 305). Bancheri (2006) also asserts that the role of teachers in the new era of technology is not only to transmit new knowledge, but to give students tools to acquire knowledge and recognize the value of what they see in books and software as well as on the Internet. In addition, Jeong (2006) emphasizes that the role of teachers in EFL settings is more crucial than ever before because teachers are able to motivate students and try to create language learning environments which are non-threatening, meaningful and affectively supportive by using Web technology.

It is natural to use computers in the classroom. Using technologies in the classroom has many benefits to teachers and students alike. It is helpful for increasing students' motivation with effective audio-visual materials. it is possible for learners to experience more real situations in a technology-enhanced environment. Using computers brings changes in the way of teaching and presentation methods. For example: When teaching with computers, one need not bring a cassette player from classroom to classroom. It saves time for teachers because we don't need to write on the blackboard. By using computers, we can offer students interesting lessons full of real pictures, images, animations and video clips. Computer technologies, especially the Internet, provide non-native speakers of English with a rich learning environment. Thus, students can improve their English skills through the use of the Internet. They can practice the activities as many times as they wish. It is very good for developing writing, reading and listening skills on-line. I know most institutes have their own homepages and teachers upload useful listening, reading and writing materials for their students. As a result, students can review and practice their tasks on-line at home.

In summary, computer technologies can positively contribute to the quality of teaching, mode of presentation and learners' motivation and cross-cultural awareness. Use of computers in the classroom can contribute to the development of students' language skills as well as cultural understanding. For instance, to be good speakers, students should be exposed to the target language as much as possible. Computer technologies, especially the Internet, provide non-native speakers of English with a rich learning environment. Technological aids such as CD-ROMs, audio CDs, DVDs and the Internet are helpful for the development of listening and reading skills. The simultaneous presentation of sound and real images via the World Wide Web could make language input more comprehensible.

The Internet also provides authentic communication with other speakers who have different social and cultural backgrounds. On the Internet, people can access language materials and resources without time restrictions at home, offices and schools. They can communicate and interact with other people all over the world in the target language.

Students can be exposed to the target language and interact with native speakers of English over the Internet in a Korean EFL situation. They can also experience foreign cultures indirectly and they are encouraged to communicate with other people all over the world.

In addition, teaching EFL with technologies is helpful for promoting students' writing. Students who have limited linguistic skills in EFL contexts can discuss ideas and develop their writing abilities by means of the networked computer. Asynchronous e-mail exchanges encourage students to explore ideas and express themselves at their own pace in the target language. E-mail exchanges can be a great way to share information and foreign cultures with native speakers around the world. Through those activities, students can develop their reading and writing skills. Similarly, students can improve their expressions with various kinds of language samples on the Web and eventually their composition in the target language: Writing and reading skills will be improved together. With numerous authentic resources and samples on the Web, students can review and compose their writing. This process encourages them to use the target language with less anxiety.

In summary, it is obvious that the use of computers in the classroom can facilitate the improvement of students' language skills such as listening, speaking, reading and writing. The Internet, in particular, is an invaluable source for providing students with authentic language contexts and materials that contain important cultural aspects of the target language. Such innovative tools for language learning, as MOODLE and Webinar, enable the management of online learning, provide a delivery mechanism, student tracking, assessment and access to resources (JISC, 2008). These tools brought about a more learner-centred approach and an increased focus on interaction among students and teachers. Warschauer (1996) considers that their use creates authentic learning environments and allows the combination of reading, writing, speaking and listening in a single activity. Thus, ICT contributes in creating authentic learning environments.

Studies in English as a Foreign Language (EFL) education have shown that the main benefits of ICT use in the classroom are pupils' motivation for both language learning and linguistic proficiency (Lee, 2000) as well as increased learning competencies (Jorge et al., 2003). The students display an enhanced sense of achievement and increase in self-directed learning, with the ability to communicate, conduct research and present ideas effectively beyond the confines of the class (Shetzer & Warschauer, 2000). Key findings under ImpaCT2 (www.becta.org.uk) show that the use of ICT tools in teaching and learning has positive effects on learning as it gives pupils greater enjoyment and interest, enhanced self-esteem and an increased commitment to the learning task. In this area previous studies have also shown that teachers have positive attitudes toward online learning and web-enhanced language learning resources (Demetriades et al., 2003; Dogoriti, 2010). However, the need for teacher involvement is necessary to avoid leaving the technology to control the lessons. ICT can be effective only with the teacher's role as a "facilitator" who plans and guides the lesson (Brandl, 2002). The ELT teacher must also be prepared to assume new roles (McLaren et al., 2005). The complex role of a FL teacher using ICT is described by Cañado (2010), who asserts that the teacher functions as counsellor, tutor, motivator, facilitator, and observer (Yunus, Lubis, &Lin, 2009). The use of technology as a tool to develop the different language skills has received great attention (Dudenney, 2000; Chapelle, 2001; Young, 2003; Yunus, 2007) so that FL teachers are exposed to new practices. A number of different ICT tools and applications may be integrated in teaching and learning.

4 CHALLENGES

There are a number of challenges that face the use of ICT in TPD and classroom. Institutional Barriers pose one of the challenges. The main institutional barrier facing teachers attempting to use online tools could include lack of support from the schools. The teachers could have heavy workloads and access to computers is not made more convenient. Besides, their work environment may not be conducive for them to spend more time to work on the online tasks. The teachers may also frustrated by technical problems.

The other includes Psychological Barriers.Psychological barriers are individually held beliefs, values, attitudes, or perceptions that inhibit participation in organized learning activities. Computer anxiety is the prime psychological concern facing online learners. There can be anxiety related to general use of computer and computer-related technology. Some teachers are negative with regard to the advantages of learning and using ViP before they are even introduced to it. They fear it would be too complicated and difficult to learn. This arises from the fear of technology. Research shows that many teachers lacked confidence as far as using technologically-related programmes is concerned. As for equipment anxiety it is used to refer to anxiety related to the online tools. The Teachers lack the basic knowledge regarding the computer and this makes them approach the ViP with fear and apprehension. Teachers also lack the interests and motivation to want to learn, experiment and try out new methods of teaching. If teachers are unwilling to actively work towards conquering their fear and inhibitions regarding computers and ICT-related technology, most change initiatives will unlikely to take off as envisioned.

According to Atkins and Vasu (2000), teachers' attitudes or concerns have a significant influence on the use of computers in the classroom. Lam (2000) also emphasizes that teachers' personal beliefs of the advantages of using technology for language teaching influence teachers' decision regarding technology use. Similarly, Kim (2002) points out that critical factors affecting successful integration of technology into the classroom are associated with teachers themselves, such as teachers' perceptions and attitudes. She adds that teachers' perceptions and attitudes toward teaching and technology can be regarded as a facilitating or inhibiting factor, giving them more confidence or a major barrier of technology use. Redmond, Albion and Maroulis (2005) also reported that teachers' personal backgrounds such as personal confidence, interests in using ICT and willingness to try something different are significant factors that might promote ICT integration in the classroom.

However, Egbert, Paulus and Nakamichi (2002) assert that a positive attitude toward computer technology does not guarantee that teachers will be able to use the technology in the classroom. Kim (2002) found that teachers' actual use of Web-based lessons was limited, frequently delayed, avoided or withdrawn. They encountered some unexpected difficulties or barriers due to lack of sufficient knowledge and computer skills, lack of experience, insufficient time, computer anxiety and lack of confidence, although all participants in her study had positive attitudes toward the use of technology and strong intrinsic motivation such as personal curiosity and interest. Shin and Son (2007) also found that Korean teachers of English had difficulties in using CALL in the classroom. The most common reasons for not using computers included limited class hours, inconvenience of using computer facilities and technical problems such as slow Internet connections. In addition, they had problems related to integrating authentic materials into their textbooks.

External factors such as time constraints (Lam, 2000; Smerdon et al., 2000), limited computer facilities (Shin & Son, 2007), lack of financial or technical support (Lam, 2000; Shin & Son, 2007; Smerdon et al., 2000; Toprakci, 2002), inadequate teacher training and inflexible curricula (Lam, 2000; Smerdon et al., 2000) may lead to failure to technology use. Other external barriers related to individual contexts or work environments are poor Internet access, limited capacities of school network and inadequacy of technical support. The limitations stemming from those external factors seem to focus on computers and work environments, not on teachers. Internal factors, on the other hand, stemming from teacher-related problems include teachers' lack of ICT knowledge and resources, lack of experience with ICT as a learner and no access to appropriate materials and models of teaching with ICT (Kim, 2002; Lam, 2000). Since teachers somehow tend to teach in the same manner they were taught in the past, teachers' own previous experiences with technology are critical factors determining CALL implementation (Egbert, Paulus & Nakamichi, 2002). The characteristics of internal factors are invisible and unnoticeable when compared to external factors which are easily recognizable. In addition, it is important to consider that there are other barriers related to teachers' perspectives, personal attitudes, beliefs, confidence, motivation and awareness of the advantages of technology. Atkins and Vasu (2000) regard teachers as one of the most important factors influencing technology use and argue that teachers' attitudes or concerns have a significant impact on the integration of the computer into the classroom. Kim (2002) also agrees that a teacher as an individual with complex internal variables is a key element affecting the use of the computer in the classroom. These studies suggest that teachers who have basic computer competencies are more confident in using computers and are more likely to integrate computers into their teaching than those who have not.

Apart from affecting TPD It is also reported that external factors such as lack of time, insufficient computer facilities, rigid school curricula and textbooks and lack of administrative support negatively influence the implementation of CALL in the classroom. Internal factors such as teachers' limited computer skills, knowledge about computers and beliefs and perceptions of CALL also seem to significantly affect teachers' decisions on the use of CALL. Teachers need more time and efforts to create or find teaching materials. For example: It takes much time for preparing teaching materials and activities. They need to surf the Web, find appropriate materials and modify them according to the levels of their students.

The integration of ICT in education in Kenya is more recent and on a smaller scale. This is due to resource and infrastructural constraints. In addition, unlike in previous generations, students today can easily adapt to new technological innovations and they come to schools, colleges and universities expecting to use technology just as they do in their personal lives. As already pointed out, it is unfortunate Kenyan Educators lack skills to cope with the youngsters who are always a step ahead. It is high time educators re-thought the chalk and blackboard , book and paper teaching methods being replaced by technology. Yet the level of IT literacy within the teaching fraternity is miserably low.Few teachers appreciate technology's special place in their profession.

5 PROSPECTS

Prospects for teacher development in Kenya can be mirrored and highlighted from the status of distance education. Distance education in Kenya has made great leaps which we believe can be made by ELT teacher education. We agree with Ndiege (D.N) who argues that there is need for our education system to adapt to the changes in technology, commerce,

politics and demographics. He argues that with traditional instructional methodologies fast being replaced by modern innovations, technology and education have never been intertwined. Social media, for example, can greatly enhance the learning experience outside the classroom. He adds that a greater percentage of learning takes place outside the classroom. Many students are connected to Facebook and Twitter, and these can be exploited to create a more interactive learning experience. Others like Evernote, Google Education, Dropbox and slideshare can help teachers stay connected, organized and make lessons more fun. Indeed teachers can connect with each other, their mentors and educators through these same platforms.Empowerment should start with educators as no meaningful education can be achieved without a technologically literate faculty.

TPD through ICT has great potential for growth in Kenya if what has been done in distance education can be roped in and improved. The African Virtual University programme for example would be one avenue through which TPD could be enhanced. This is perhaps the most recent and probably the fasest expanding programme in institutions for higher education. Kenya has tremendously embraced virtual initiatives in post secondary education institutions such as in her public Universities. The ODEL has greatly increased access to higher education in many parts of Africa in an affordable, cost-effective, flexible and sustainable manner by allowing universities to use e-learning portal to collaborate in content development and delivery practices and further promote group interaction, institutional interaction and self-learning (Muhirwa, 2009). AVU's architecture is designed to use mixed models of delivery such as video conferencing, use of the internet, CD-Rom and cassettes and print-based materials and mobile learning. ELT educators and other stakeholders may only need to technologically connect and have professional development go on on-line.They could focus on encouraging, applying, synchronizing and smoothing the progress of the use of information and communication technologies (ICTs) to enhance the development of ELT teachers.

In the policy **Framework for Education *Aligning Education and Training to the Constitution of Kenya (2010) and Kenya Vision 2030 and beyond* DRAFT APRIL, 2012, it was observed that *a***s the Kenyan population providing labour force increased in size, structure, diversity and complexity, its educational provision to improve skills, competences and proficiency demanded that knowledge delivery must extend beyond the habit of continuous contact with the instructor . (Khan, 2007).

WAY FORWARD

For TPD programmes to be successful it requires the stakeholders to ensure:

1) The development of a comprehensive induction programme of the educators, mentors, teachers, and administrators and all who are involved,
2) Effective and efficient ICT facilities and resources; and a well developed network system of ICTs accessible by teachers at their respective locations
3) The development of detailed, well updated and self-training modules for the teachers by the inducted educators, and
4) The development of a unique but a credible, efficient and effective monitoring and evaluation secretariat to ensure access, equity, quality, affordability and relevance of the programme. This therefore requires a heavy investment (in terms of human, monetary, e-learning and physical resources).
5) There is need for the government to develop a supportive and comprehensive national policy framework at the national level.
6) There is also the need to incorporate ICT in education to improve access to quality education and respond to the challenges of globalization.
7) There is need for Kenya to link with other countries who have developed ODL programmes.

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