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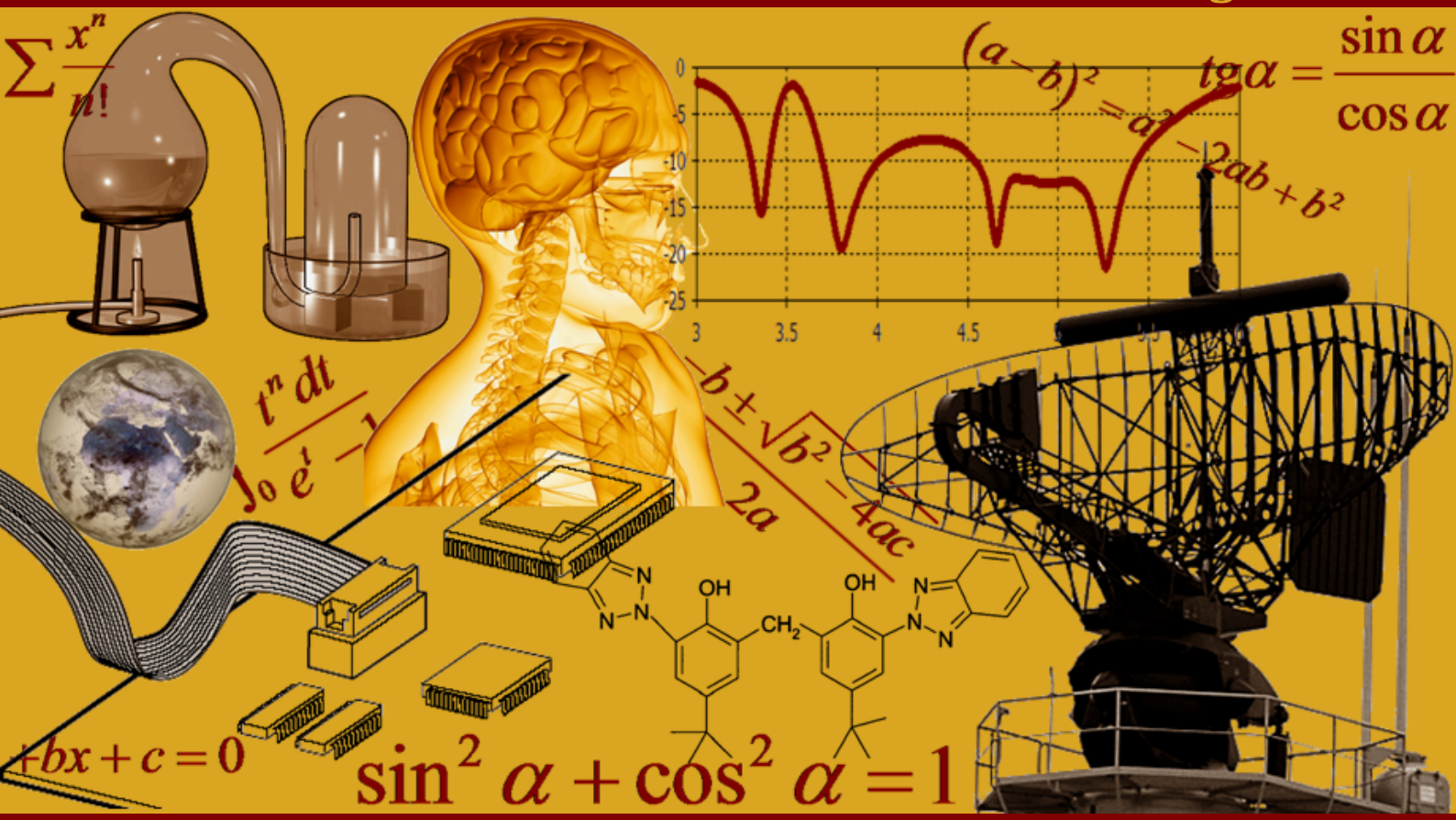

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Radio-Over-Fiber (ROF) Technology With WDM PON System

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ABSTRACT: Radio over fiber is becoming an increasingly important technology for the wireless market since it introduces a good data transmission rate and large bandwidth. We have implemented a bidirectional radio over fiber (ROF) system. It is combination of SCM-ROF and optical wavelength division multiplexing (WDM) techniques to simplify the access network architecture. The combination of two different types has been performed to provide high bit data rate and wide bandwidth in cellular communication. The system allows different Base Stations (BS's) to be fed by a common fiber. Different wavelength channels can be allocated to different BSs depending on user requirements.
This paper consists of two parts:
I. Introduction of Radio of Fiber technology & methodology
II. Quality parameter & Challenges for Implementation.
Wireless communication was one of the paramount ways in term ofhigh bandwidth data communication. Technology like microwave, wireless, optical communication & their combination are used and have improved the performance of the communication. Radio over Fiber technology (RoF), an Integration of microwave and optical communication is an essential technology for the provision of unmetered access to broadband wireless communications. For the future provisions of broadband, multimedia the radio over fibre systems are a good alternative. RoF systems are used basically because of their low loss and extremely wide bandwidth and robustness. Radio over fibre can use millimetre waves and serve as a high speed wireless local or personal area network. In this paper various parts of the Radio over fibre systems are studied, ROF is an analog optical link transmitting optical carrier modulated by the radio frequency signal. This technique facilitates to transmit radio frequency signal through the optical fiber in downlink and uplink

KEYWORDS: RoF, Intermediate frequency, Remote Based Station, EAM, WDM, MAHO, QoS, MCHO, Medium access control.

1 INTRODUCTION

With the evolution of high data rate broadband access networks, high carrier frequencies of 10 GHz and above are required for in-building broadband wireless services, resulting in the reduction of wireless cell size and the increase of the cost for antenna sites (AS). Meanwhile, fiber-to-the-home markets have recently Gbit/s link direct to the gateway in the home. Thus, the bottleneck of wireless access network has moved into the in-building environment. The emerging radio over-fiber (RoF) technology potentially provides a low-cost solution for in-building wireless access network, by centralizing microwave signal processing in the central office (CO) for the delivery of radio frequency (RF) signals to as via optical fiber, hence simplifying the antenna. In RoF systems, the transmission of radio signals over optical fiber has been vastly investigated by the means of intensity modulation/direct detection (IM/DD) and optical heterodyning methods. Next to the high capacity transmission of RoF systems, the flexible optical routing of the RoF signals should be developed as well. This will enable flexible mobility management, dynamic capacity allocation, and dynamic network dimensioning and efficient radio resource management. The Radio over fiber (ROF) communication technology combines the technical advantage of the both fiber communication and wireless communication to solve the problems of bandwidth, flexibility and electromagnetic interference. Research of the technology is drawing wide concerns around the world. But the high cast becomes a drawback of this technology. Radio over fiber (ROF) Technology an integration of wireless and fiber optics networks is an essential

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technology for the provision of unlettered access to broadband wireless communications in a range of application including last mile solving extension of existing radio coverage capacity and backhaul.The Radio over fiber (ROF) communication technology combines the technical advantage of the both fiber communication and wireless communication to solve the problems of bandwidth, flexibility and electromagnetic interference. Research of the technology is drawing wide concerns around the world. But the high cast becomes a drawback of this technology. Radio over fiber (ROF) Technology an integration of wireless and fiber optics networks is an essential technology for the provision of unlettered access to broadband wireless communications in a range of application including last mile solving extension of existing radio coverage capacity and backhaul .Hence by incorporating SCM-WDM along with the optical fiber, the RoF system can be used for both short distance as well as long-haul transmission at very high data rate. This improves the system flexibility and provides a very large coverage area without increasing the cost and complexity of the system very much. Recently, it has been proved that SCM-WDM is better compared to the conventional single carrier modulation for long haul optical transmission. Such technology is expected to play an important role in present and future wireless networks since it provides an end user with a truly broadband access to the network while guaranteeing the increasing requirement for mobility.ROF is very attractive technique for wireless access network infrastructure; because it can transmit microwaves and millimeter-waves through optical fibers for a long distance.

2 RADIO-OVER-FIBER TECHNOLOGIES

Radio over Fiber (RoF) is an optical fiber link to distribute modulated RF signals from a central location to remote antenna units (RAUs). The RoF systems are developed to replace a central antenna with a low power distributed antennas system (DAS). RoF systems are usually composed of many base stations (BSs), which are connected to a single central station (CS) (See Fig 1). RoF systems centralize the RF signal processing function in one shared location (headend), and use optical fiber link to distribute the RF signals to the RAUs or BSs. RoF based wireless “last mile” access network architecture was proposed, as a promising alternative to broadband wireless access network. In network architecture, the CS performs all switching, routing and network operations administration maintenance (OAM). Optical fiber network interconnects a number of simple and compact antenna BSs for wireless distribution. The BS has no processing function and the main function of the BS is to convert the optical signal to wireless and vice versa. This architecture assumes a centralized medium access control (MAC) located at the CS responsible for offering a reservation-based, collision-free medium access.

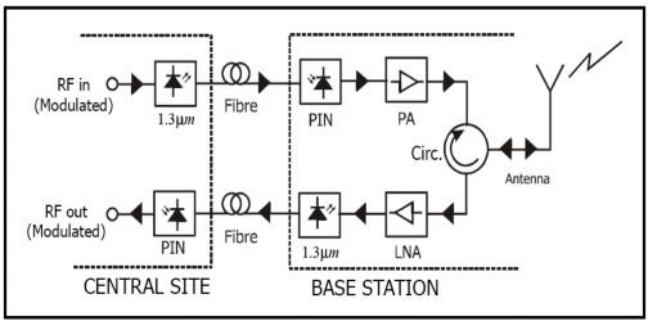

Fig.1 Radio over Fiber System

3 ARCHITECTURES OF ROF NETWORKS

Several RoF concepts have been developed. The main difference between these concepts resides in techniques used for carrier generation and data distribution over optical fiber. These concepts repose on three proposed architectures for RoF links. They are implemented according to their frequency bands as shown in Fig 2, which are: (i) Radio Frequency (RF) band; (ii) Intermediate Frequency (IF) band, and (iii) Base Band (BB).

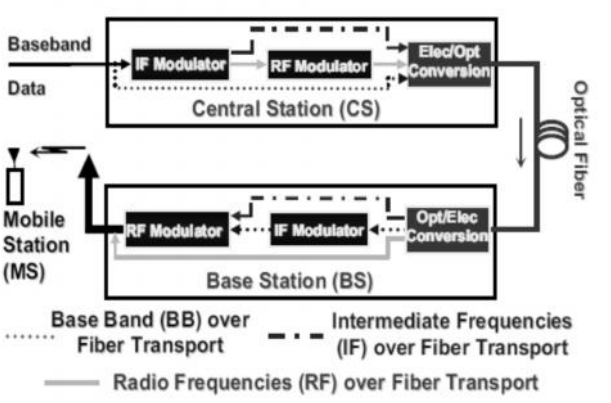

Fig 2 Transport schemes for Fiber/Wireless systems

In general, optical distribution techniques of electrical data signals can be classified according to two approaches. The first approach consists in transporting the signal in either the BB or the IF band. It leads to significant complexity reduction at the optical-link level. The BB transport method consists of a direct modulation of a laser diode by the BB data signal. Thereafter, the resulting optical signal is injected into an optical fiber and transported from the CS to the BS (downlink). Symmetrically, in the up-link, the transmitted BB electrical signals undergo the same process. For the BB transport method, only low band-width optoelectronic components are necessary. However, this optical-link simplification is accompanied by an increased complexity for the BS Fig 2 Transport schemes for Fiber/Wireless systems where BB to RF up-conversion and RF to BB down-conversion are required. Moreover, this strengthens the complexity of the problem since the BS RF equipment must be replicated by the number of hertzian network deposits. Furthermore, if new channels need to be added the complexity of the BS makes the system reconfiguration difficult. In the case of the IF transport option; the optical data transmission is performed after optically modulating the electrical signal as shown in Fig 3 below. The later should undergo a prior modulation by a common generated IF carrier. At every BS, an IF-to-RF up-conversion is necessary before the radio transmission.

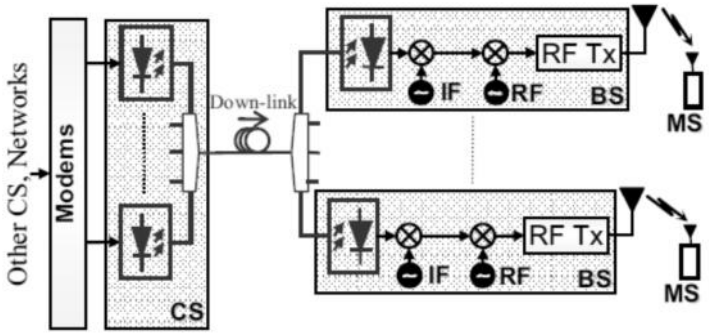

Fig.3 IF to RF up-conversion at the base stations

The second approach consists of a maximum simplification of the BS configuration, where the RF signal generation is centralized at the CS. Consequently, the BS architecture is simplified. This centralized architecture of RoF systems allows avoiding the problem of RF equipment duplications when several BSs are interconnected with the CS. This reduces the network cost and increases its flexibility. In this architecture, the BS as well as the CS should contain an external optical modulator. This component is required for operating at the millimeter-wave band frequencies (30-70 GHz). Photo detectors should also present high performances in this frequency band. Thus, the BS role is reduced to three basic functions only: RF amplification, multiplexing, demultiplexing, as well as downlink Optical-to-RF and up-link RF-to-Optical conversions.

4 WDM SYSTEM FOR RADIO OVER FIBER COMMUNICATIONS

A powerful aspect of an optical communication link is that many different wavelengths can be sent along the fiber simultaneously. The technology of combining a number of wavelengths onto the same fiber is known as wavelength-division multiplexing or WDM.The key system features of WDM as follows:

1. Capacity upgrade.WDM can increase the capacity of a fiber network dramatically.
2. Trasparency.An important aspect of WDM is that each optical channel can carry any transmission format.
3. Wavelength routing. The use of wavelength-sensitive optical devices makes it possible to use wavelength as another dimension in designing communication network and switches.
4. Wavelength switching. Whereas wavelength-routed network are based on a rigid fiber infrastructure,wavelength-switched architectures allow reconfiguration of the optical layer.

Wavelength divisions multiplexing (WDM) can be defined as a scheme in which multiple optical carriers (which are not in phase with each other) at different wavelengths are modulated by using independent electrical bit stream and are then transmitted over the same fiber. The optical signal at the receiver is demultiplexed back into separate channel by using optical techniques. In the original form of WDM based systems, two channels in different transmission wavelength window of the optical fiber are multiplexed .One channel is near 1.3µm, and the other is near 1.55µm.Today, one hundred OC-192 channels, each at 10Gbps, can be multiplexed, and a transmission rate on the order of one Tbps is obtained. The key breakthroughs to realize WDM transmission are the fiber amplifier, tunable transmitter/receiver and wavelength multiplexer/demultiplexer.

A typical WDM system is illustrated in fig.4. Various wavelength channels are demultiplexed by the DEMUX optically, by using an optical grating or interferometer. The kind of filtering is performed coarsely, while the fine adjustment is performed by the channel selecting filter (CSF) blocks. On-zero dispersion shifted fiber (NZ-DSF) is often used in WDM based systems. Such fiber can relax the system degradation induced by fiber dispersion, without producing too much deleterious four wave mixing (FWM) effect. Since it can be suppressed effectively by the small amount of dispersion in NZ-DSF.

For each wavelength channel in WDM transmission systems, the bit rate can be up to tens of Gbps. It is much greater than the bit rate needed in most applications. So WDM techniques can be employed at the bottom level with other multiplexing or optical access techniques functioning on top of it.

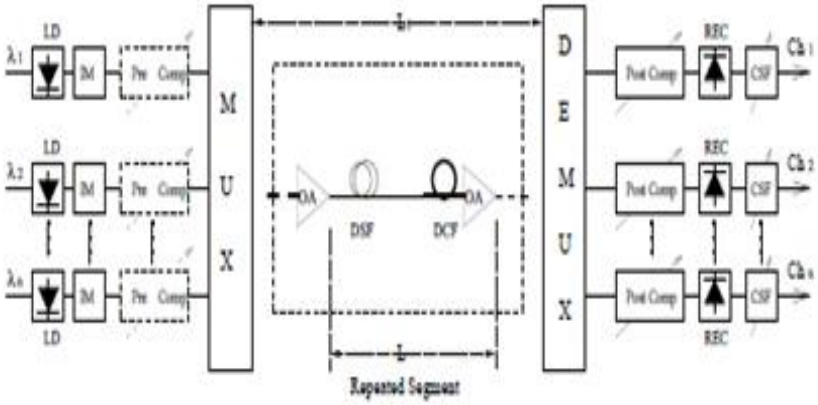

Fig 4 configuration of typical WDM transmission system including the wave

5 WDM-ROF SYSTEM MODEL

Radio over Fiber (ROF) is integration of optical fiber for radio signal transmission within network infrastructures that is considered to be cost effective, practical and relatively flexible system configuration for long-haul transport of millimeter frequency band wireless signals. Fiber optic LANs will be carrying traffic at data rates of tens of giga bits per second in the near future, whereas data rates of tens of megabits per second are difficult to provide to mobile users.

In this case, optical channels, offering terahertz of bandwidth, have many advantages. First ROF systems were mainly used to transport microwave signals, and to achieve mobility functions in the central office or exchange (CO). That is, modulated microwave signals had to be available at the input end of the ROF system, which subsequently transported them over a distance to the RS (Remote Site) in the form of optical Today ROF systems, are designed to perform added radio system functionalities besides transportation and mobility functions. These functions include data modulation, signal processing, and frequency conversion. For a multifunctional ROF system, the required radio signal at the input of the ROF system depends on the ROF technology and the functionality desired. ROF offers operational benefits in terms of operational flexibility. Depending on them microwave generation technique, a ROF distribution system can be made signal format transparent. The Intensity Modulation and Direct Detection technique can be made to operate as a linear system and therefore as a transparent system. A fiber-radio network differs from a traditional fiber-to-the-home (FTTH) access network in that the transported data is at a wireless frequency and not at baseband. One promising alternative to the first issue is an ROF based network since in this network functionally simple and cost effective Bs are utilized in contrast to conventional wireless systems. However, the second issue is still challenging and difficult to realize as the conventional handover procedures cannot easily be applied to the system. In first ROF network architecture operating at mm-wave bands with special emphasis on mobility management. Specially, our concern is how to support fast and simple handover in such networks using ROF network's centralized control capability a fiber-radio network comprises two distinct domains, one optical and one wireless. In the optical domain, Wavelength Division multiplexing (WDM) can be used to combine several wavelengths together to send them through fiber-optic network, greatly increasing the use of the available fiber bandwidth and maximizing total data throughput that in order to meet future wireless bandwidth requirements, a single CO feeds each remote radio BS and has access to a separate optical WDM involves multiplexing multiple wavelengths and transporting them in a single fiber. Current technology allows one to two hundred channels to be transported in a single fiber, achieving Tb/s total capacity If WDM is used in a fiber-radio network, and then each BS can be assigned a single wavelength. A WDM network requires wavelength selective optical components that can multiplex or demultiplex channels or that can drop or add channels These components are imperfect and cannot fully remove unwanted channels, leading to optical crosstalk, i.e. the presence of an undesired optical signal .Although optical components can reject adjacent wavelength channels by up to 30 dB or more some residual signals will still be present, particularly if channels powers are unequal. This type of unwanted crosstalk is referred to as in homodyne or heterodyne or inter- channel crosstalk, or simply as out-of band crosstalk. This type of crosstalk does not severely impair network performance as it is at a different wavelength as the desired signal and is simply added to the signal in the electrical domain. In the present study, we have investigated the propagation problems in ROF systems, in addition to its transmission properties; the insensitivity of the fiber optic cables to electromagnetic radiation is a key benefit in their implementation as the backbone of the advanced optical communication networks. Moreover, we have presented the transmission capacity of ROF systems with different transmission and multiplexing.

6 EXPERIMENTAL SETUP

The experimental setup consists of 2 channels for downstream as well as 2 channels for up-stream covering the L-band starting from 193.1 to 193.4 THz along with radio frequency using continuous wave lasers as shown in Fig. We have investigated the integration of radio communication with optical communication media. The data stream from a 10 Gbps pattern generator with a NRZ binary sequence is pre-coded and drives a sine squared amplitude modulator. The output of two way communication are received by pin-diode along with AM modulator and displayed at ber analyser quality factor approximated upto 7 to 12. At the receiver side the PIN photodetector is used with a responsivity of 0.9A/W and dark current of 10 nA.

7 RESULTS

A relation between Q factor vs input power is shown in figure.it is clearly shown in graph the down-stream indicates higher Q factor as compare to up-stream due to the effect of CO which have high power transmitter with respects to ONU transmitter. All the simulated channels almost have shown linear relation with increasing input power.The figure and shows the up-stream and down-stream eye diagram. In the result the dark circle shows the distortion in the signal which is taken from up-stream whereas in down-stream eye diagram the upper portion does not have thinner part. The eye diagrams that illustrated below as we could see most ofthe eye opening is not so wide and high. Based on the theory as explained before inthe first paragraph of this section, most open part eye means best signal to noiseratio. So this system might have some noise distortion and because of that it mighthave some modification in the future works.

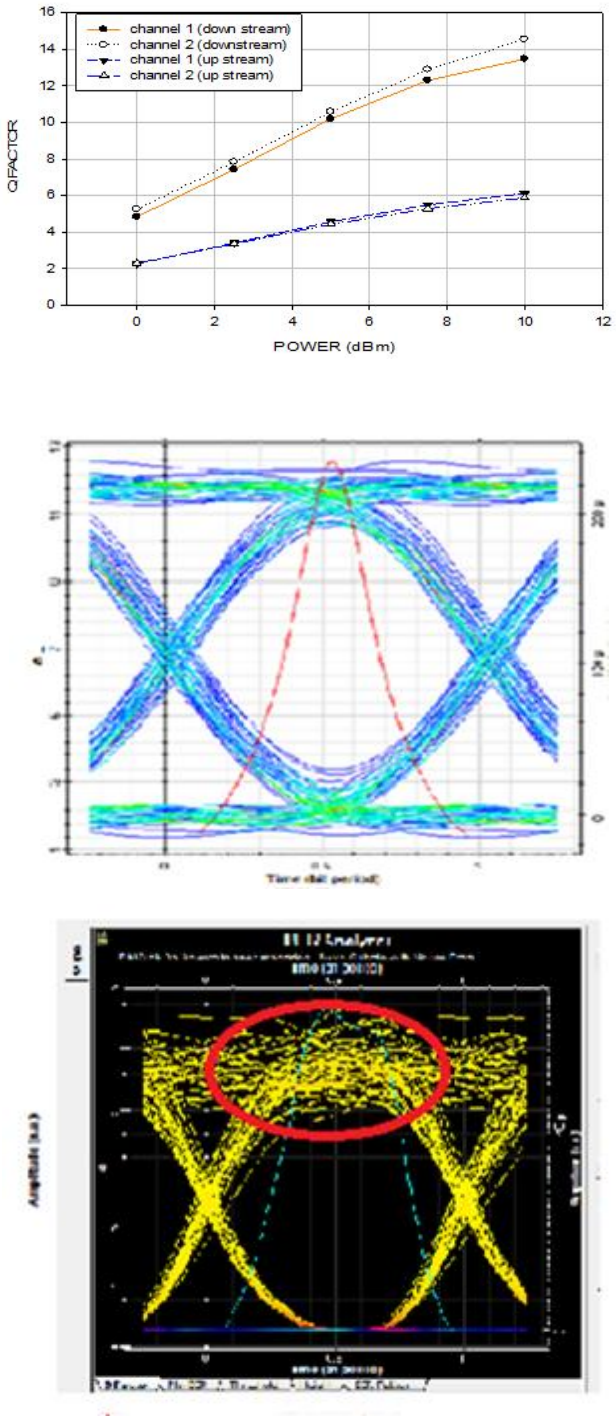

Fig 5 Outcomes in Setup

8 CONCLUSION

The study of incorporating SCM WDM modulation technique with RoF technology is essential in nowadays implementation of optical communication. With the combination of the advantages from WDM and RoF, the system can be used for both short distance as well as long haul transmission at very high data rate. This improves the system flexibility and provides a very large coverage area of telecommunication networks without increasing the cost and complexity of the system very much. Also recently, it has been proved by many researchers that SCM-WDM is better compared to the conventional single carrier modulation for long haul optical transmission. In this paper the simulation of modeling the SCM-WDM scheme for Radio over Fiber system has been completely done by using commercial software Opt system. Some consideration has

been added to system design in order to meet the applicable design for using in the reality. The system model has been design to accommodate WLAN IEEE 802.16 b/g which is using data rate 54 Mbps over frequency carrier 3.5 GHz. This paper shows that total power of the SCM-WDM signal that being carried over the fiber network is decreasing while the length of fiber is increasing from 10 to50 Km. It is observed that as distance increases, the performance is degraded due to fiber dispersion. Overall, the paper offered vast learning opportunity in the SCM-WDM and Radio over Fiber technology and how to simulate using Opti-system software. The studying of SCM-WDM modulation and radio over fiber technology became very important because both of them have been developed to support some important future wireless systems.

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TRANSCRIPTIONAL CHANGES IN SALT-RESPONSIVE GENES OF BARLEY SUBJECTED TO SALT STRESS

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ABSTRACT: Salinity is one of the major constraints for crop yield because it limits plant growth and reduces both the crop yield and the use of agricultural land. Increased salt tolerance requires new genetic sources of salt tolerance, and more efficient techniques for identifying salt-tolerant germplasm.

The DD-RT-PCR technique (Differential Display-Reverse Transcription- Polymerase Chain Reaction) is one of these techniques, which are able to compare and identify changes in gene expression at the mRNA and the cDNA levels between any pair of contrasting genotypes. It was performed using mRNA extracted from the aerial part of two contrasting Tunisian barley genotypes (Sabra: tolerant and kelibia: sensitive accessions) subjected or not to salt stress.

In this study, we have used this technique (RT-PCR) to identify cDNAs corresponding to transcripts up- or down-regulated by salt stress in barley. Within 18 primer combinations (3 Oligod(T) x 6 arbitrary primers), we have identified a total of 58 differential display products which are over-expressed or disappeared in stressed samples indicating a qualitative and quantitative difference in the gene expression.

***The up-expressed fragment were eluted and sequenced at the Pasteur Institute of Tunis and then compared to those of the bank data (Genbank Barley) to determine sequences having an optimal alignment with the query.

The result was the identification of many salt-responsive transcripts fragments corresponding to hypothetic proteins (T17F15.140-like and Mei2-like), to some proteins involved in oxidative and heat stress (GAD1= Glutamic Acid Decarboxylase) or to proteins involved in the resistance to pathogens (ß-1,3-glucanase) and to anionic flux resistance. But the most important finding is the identification of genes encoding the Na^+/H^+ antiporter which sequestrate sodium into vacuole in the tolerant barley genotype.

These two last transcripts encoding the sequestration of Na could be used as markers for selecting salt tolerant genotypes in the program of varietals improvement to salt stress tolerance.

KEYWORDS: *Hordium vulgare*, barley, differential display, salt response, gene expression, mRNA product.

1 INTRODUCTION

Agricultural productivity, in arid zone, frequently faces unfavorable growth conditions such as extreme temperatures, drought and salt stress. These adverse conditions can disrupt cellular structures and produce high levels of reactive oxygen species (ROS) that could lead to oxidative damage of structures.

Some plant species are able to survive and produce although under harsh environmental conditions, which are harmful for other plants [1]. This variable species behavior reflects a many different stress-response mechanisms which occur at all

levels of plant organization [2]. Many changes are known on response to environment stress including osmotic adjustment, modification of the plant architecture, decreases in water uptake by cytoplasmic accumulation of additional solutes through the process of osmotic adjustment [1]; [3], hydraulic limitations to leaf growth by inducing regulated decreases in root hydraulic conductivity [4], cell wall rigidity, growth reduction, leaf senescence, and other agronomic traits [5], [6].

At the molecular level, gene expression is modified upon stress [7] and epigenetic regulation plays an important role in the regulation of gene expression in response to environmental stress [8]. This regulation is characterized by a number of biochemical changes that ultimately result from a selective increase or decrease in the biosynthesis of a large number of proteins.

Several genes have been described that respond to salt stress at the transcriptional level in a variety of plant species [9], [10], [11].

Some of those genes are involved in cell structure protection such as OtsA gene (Operon trehalose synthase) which is responsible for trehalose synthesis (osmoprotectant) and which in turn, allows the proteins to retain their native configuration under environment stress without denaturation, others are implicated in ion transport or ion sequestration [12] and others are also implicated in transcription factors, protein kinases, and phosphatases [13].

Barley is one of the oldest cultivated crops in the world. It is the fourth most important cereal crop. It is used as feed of livestock, as human food and as malts or cosmetic product [14].

In Tunisia, as well as in the other African countries, barley is one of the most important cereal crop cultivated and occupies between 34% and 38% of the cereal area. Taking into account its importance and the fact that it is generally cultivated in marginal zones, it is important to analyze salt-responsive gene expression under saline and non saline conditions, as it may increase our understanding of the molecular mechanism of salt stress and the role of differential gene expression in salt tolerance genotypes.

The aim of the present study was to examine the differential expression of transcripts under salt stress and favorable conditions. We have focused on isolating and identifying the over expressed genes in saline conditions. The expression and the identification of these up-regulated transcripts in a salt tolerant genotype compared to those of susceptible ones could be used as molecular markers in screening and selecting barley genotypes for salt tolerance or as an efficient marker-assisted selection in breeding program.

2 MATERIAL AND METHODS

2.1 PLANT MATERIAL, STRESS INDUCTION AND RNA ISOLATION

To identify the most tolerant genotypes to salt stress conditions, we have carried out a trials in pots under greenhouse and at germination stage (Figure 1). All the seedling genotypes were watered regularly, every two days, with distilled water (control) or with a solution containing 200mM NaCl, during 21 days, since the sowing date.

According to some parameters (vigor, establishment rapidity, chlorophyll index, exhibition of necrosis symptoms, …), two contrasting barley genotype (“Sabra”: tolerant and “Klibia”: sensitive accessions) were selected for the molecular study.

Figure 1: Behavior of different barley genotypes under salt stress (A) or under favorable conditions (B). The circled genotype is the most tolerant to salt stress and on which the molecular study was conducted

After 21 days of sowing date, leaves were collected from salt-stressed and irrigated plants. The total RNA was isolated from 500mg of fresh leaf tissue according to Chomczynski and Sacchi, (2006)[15] method. Leaves were crunched in liquid nitrogen and homogenized in 4 M guanidine thiocyanate, 25 mM sodium citrate (pH 7.0), 0.5% sarcosyl, 0.1 M ß-mercaptoethanol, and then extracted with an equal volume of phenol: chloroform (1:1).

The RNA is subsequently precipitated by adding a double volume of absolute ethanol and centrifugation at 12,000 rpm for 10 minutes. The pellet was washed with 1 ml of ethanol 75% DEPC-treated (diethyl pyrocarbonate). After that, a second centrifugation was performed under the same conditions; the pellet was dried quickly in the air and then dissolved in 50 µl of DEPC-treated water.

The concentration and purity of RNA samples were determined by spectrophotometer at 260 and 280 nm wave lengths and then the ratio (OD_{260}/OD_{280}) was calculated. The total RNA was homogenized at 0.2 µg/µl before their use and their integrity was checked again using formaldehyde-agarose gel electrophoresis.

2.2 DIFFERENTIAL DISPLAY

Differential display of cDNA was performed using Gene hunter Differential Display Kit following the manufacturer's protocol.

To obtain the cDNA of the two barley genotypes subjected or not to salt stress, the RNA was reverse-transcribed (MMLV reverse transcriptase) using three types of anchored oligo-dT and six arbitrary primers HAP (Table 1). These three one-base anchored oligo-dT primers with 5' HindIII sites were used in combination with a series of arbitrary 13mers (also containing 5' HindIII sites) to reverse transcribe and amplify the barley RNAs.

Table 1: Primers used in the differential display technique.

Primers	Sequence
5' Arbitrary primers	
HAP1	5'AAGCTTGATTGCC-3'
HAP2	5'AAGCTTCGACTGT-3'
HAP3	5'AAGCTTGGTCAG-3'
HAP4	5'-AAGCTTCTCAACG-3'
HAP5	5'-AAGCTTAGTAGGC-3'
HAP6	5'-AAGCTTGCACCAT-3
3' Anchored oligo-dT primers	
HT11(G)	5'-AAGCTTTTTTTTTTTG-3'
HT11(C)	5'-AAGCTTTTTTTTTTTC-3'
HT11(A)	5'-AAGCTTTTTTTTTTTA-3'

The PCR was performed in 20µl mixture in a thermal cycler (Biometra UNO II). The reaction system was: 2 µl of 2 µM anchored oligo-dT primer HTllM (M=A, G or C), 0.2 µg total RNA, 1.6 µl of 250 µM dNTP in a volume of 20 µl for denaturation 5 min at 65°C and the incubation for 10 min at 37°C was followed, then the MMLV (100µM) reverse transcriptase was added for 5 min at 37°C and 5 min at 72°C.

Three independent reactions, using HTllM (M = G, A, C) as primers, were performed according to what was used by [16], [17]) and [18]. The cDNA were then amplified by PCR. The reaction mixtures (20 µl) included 2.0 µl of resultant cDNA, 2.0 µl of 10 X PCR buffer, 1.6 µl of dNTP (25 µM), 2.0 µl of HAP primer (2.0 µM), 2.0 µl of HTllM primer (2.0 µM), 0.2 µl of AmpTaq, and dH_20 10.2 µl.

The samples were subjected to 40 cycles of PCR using the following parameters: 94°C for 30 sec, 42°C for 2 min, and 72°C for 30 sec; the last cycle was followed by a 5 min extension at 72°C. The PCR products were fractionated by electrophoresis in denaturing 6% polyacrylamide gel. At the end of electrophoresis, the banding is done by soaking the gel in ethidium bromide buffer (10 mg/ml) and the photography was done in a digital documentation system (Gel-Doc).

The differentially expressed gene fragments were excised from denaturing 6% polyacrylamide gels, soaked in 100 µl dH_2O for 10 min, and then boiled for 15 min. After centrifugation for 2 min at 12000 rpm to pellet any solid debris, the supernatant was removed to another tube. The cDNA was recovered by ethanol precipitation in the presence of 10 µl of sodium acetate (3M) for overnight at -80°C and then centrifuged at 12000 rpm and 4°C for 10 min and finally washed with 95% ethanol, dissolved in 10 µl of dH_2O, kept at -20°C until use.

The eluted fragments were re-amplified again in 25 µl PCR mixture using the same set of arbitrary and anchored primers that generated the differential product. Re-amplified PCR fragments (10 µl) were resolved on a 1.5% agarose gel.

2.3 SEQUENCING OF DIFFERENTIALLY EXPRESSED TRANSCRIPTS UNDER SALT STRESS

Twelve (12) up-regulated fragments on fifty eight (58) differentially displayed bands, were isolated from the gel as indicated above, re-amplified and dissolved in a TE buffer [10:1 mM (pH 8.0)] for being sequenced and compared to a query sequence with that of database, using BLAST algorithm (**B**asic **L**ocal **A**lignment **S**earch).

3 RESULTS

3.1 DIFFERENTIAL cDNA DISPLAY BETWEEN CONTROL AND SALTED BARLEY PLANT

The differential display technique (Figure 2) showed some unique bands in both salted or control samples. However the number of bands varies according to primer combinations. For example, in the OligodT_{11}(C)/HAP4 combination (Figure 2), we observed disappearance (down regulated) of some cDNA bands in sensitive genotype subjected to salt stress conditions. In the opposite, some cDNA bands were induced (up-regulated) in tolerant genotype under salt stress conditions and some other bands are of higher intensity (Figure 3).

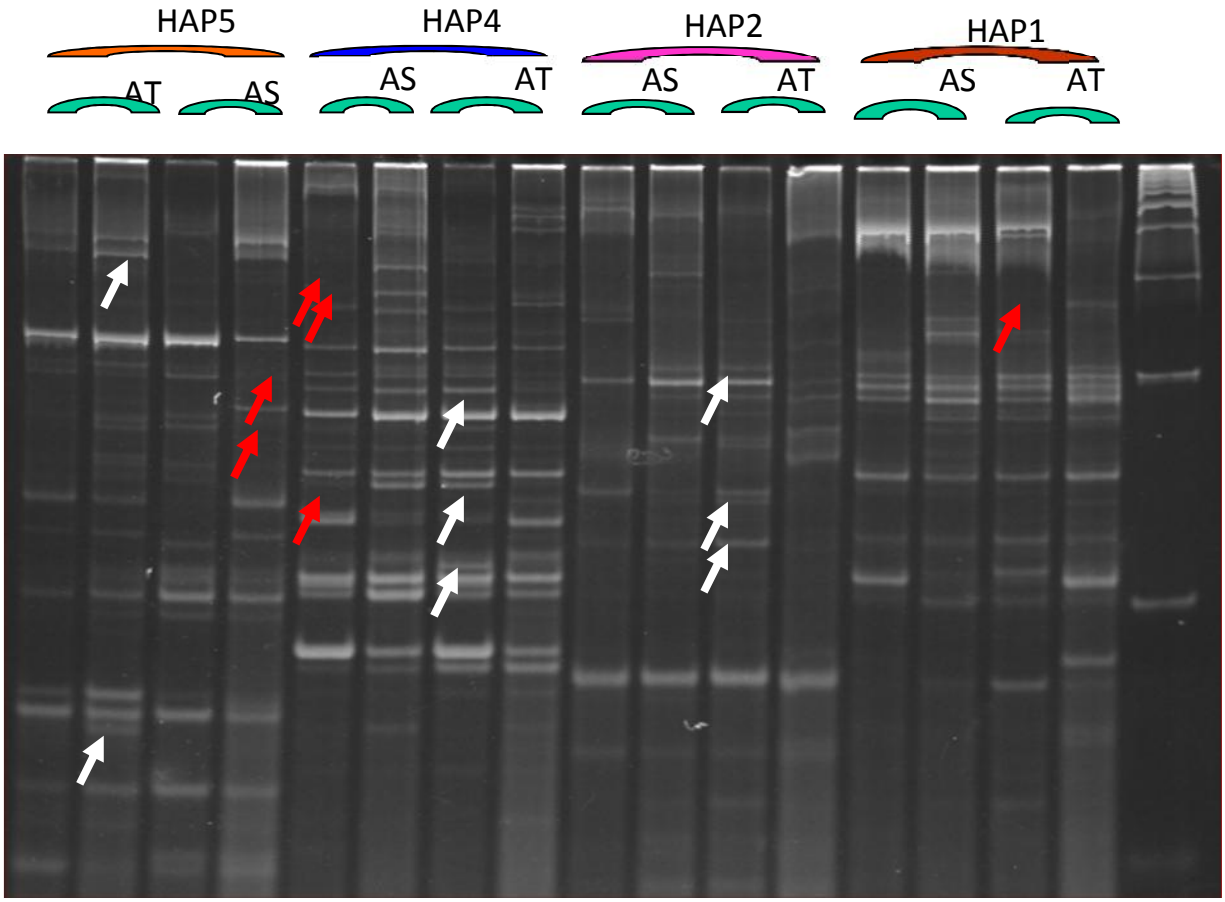

Figure 2: CDNA profile of salt-stressed and control barley genotype plants subjected or not to 200 mM NaCl and using OligodT_{11}(C) combined to 4 arbitrary primers.

M= 100pb ladder (Promega); TA: Salt-tolerant genotype (Sabra); SA: Salt-sensitive genotype (Klibia), S= Stressed and C= Control

: Indicate down-regulated transcripts under salt stress

: Indicate up-regulated or new activated transcripts under salt stress.

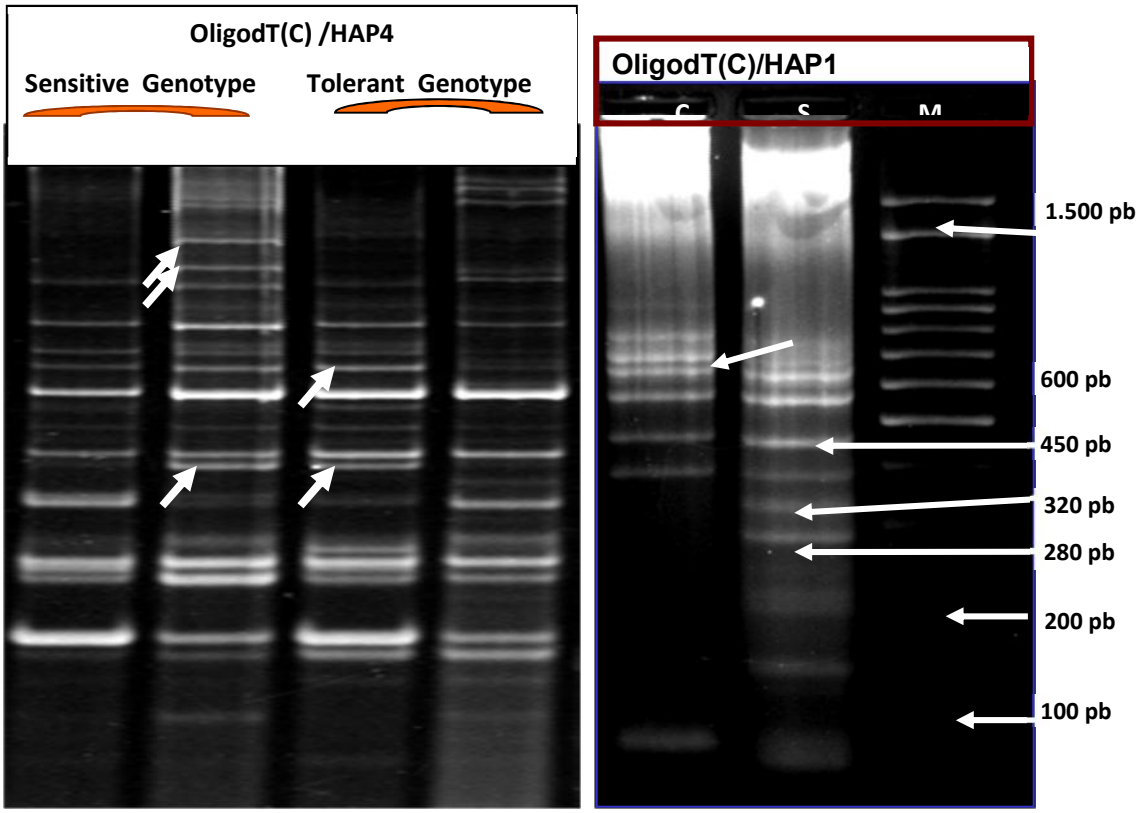

Figure 3: cDNA profile of salt-stressed and control barley genotype plants subjected or not to 200 mM NaCl and using $OligodT_{11}$(C) combined to HAP4 or $OligodT_{11}$(C) combined to HAP1.

Salt-tolerant genotype is (Sabra); Salt-sensitive genotype is (Klibia)

C = Control

S = Salted

M = 100pb marker

The size of amplified cDNA bands vary from 200 to 800 pb according to the primer combination. The comparison of band intensity between control and salted barley plants in all primer combination revealed that some bands were of lighter intensity in stressed samples as compared to their levels in control. However, salt stress induces several new transcripts as it was shown in Figure 3.

3.2 COMPARISON OF UP-REGULATED CDNA FRAGMENTS TO THAT OF DATABASE

The up-regulated cDNA fragments were sequenced and compared with that of database, using BLAST algorithm (Basic Local Alignment Search). The alignment of transcript fragment (Table 2) has revealed a common field between the different sequences which may reveal a functional significance. It classifies the up-regulated fragments into 5 functional groups, including mineral nutrition, cell defence against pathogens, production of secondary metabolites, Na anti-transportation and unknown functions

The first group revealed the presence of sequence contig which is a set of overlapping DNA segments derived from a single genetic source.

The second group contained the genes encoding certain enzymes like polygalacturonase (PG1, PG3, PG4) or proteins with unknown functions. These type of enzymes has been shown, in tomato, by [19] who suggest also that these polygalacturonases (PG) may exist in different forms (PG1, PG2a, PG2b, and PGx) commonly referred to as PG isoenzymes.

The third group contained STS (Sequence Tagged Site) which represent, according to the BLAST alignment, a flow of anionic resistance and mineral nutrition genes.

The fourth group is represented by proteins belonging to the serine carboxypeptidase family, encoding diverse group of enzymes involved in protein degradation or secondary metabolites production [20].

Finally the fifth group represented the NHX1 genes encoding proteins acting as an antiporter Na^+/H^+ and allowing the sodium sequestration into the barley vacuole.

Globally, the result obtained allowed us to identify many salt-stress responsive genes, from which most of them is unknown genes being involved in salt-stress response but some genes corresponded to that controlling the plant nutrition or Na sequestration in the barley vacuole (Table 2). This finding was supported by [21] and [22] for which Na^+ can move symplastically into an adjacent cell via plasmadesmata; or it can be transported into the vacuole through vacuolar Na+/H+ antiporters such as *NHX1.*

Tableau 2: Alignment of sequences experimentally obtained with those of the bank data "Barely Genbank DB".

Sequence Number	Sequence identification (optimal alignment)	Protein name	Gene name	Score (bit)	E-Value	Identity (%)
G1	AF474982	Hypothetic protein (T17F15.140-like and Mei2-like)		30	0.79	100
G3, G4	L44097 STS mRNA		Gene of Almt Gene of resistance to anionic flux and mineral nutrition	32	0.19	100
G5	AF474982	hypothetical protein T17F15.140-like protein, hypothetical protein, Mei2-like protein		30	0.81	100
G8	AF521177	HGA4, PG3, GAD1, PG1, PG4, HGA1	HGA5_1, HGA5_2, HGA4, rh2, pg3, gad1, pg1, pg4, hel1, HGA2, HGA1	30.2	1.4	100
G9	AY184476	Na+/H+ antiporter	NHX1	743	0.0	100
K4	AJ234533 Genomic fragment (clone MWG0604)			30	1.8	100
K7	L44097 STS mRNA		Almt	32	0.18	100
K8	Y09602	serine carboxy peptidase II, CP-MII	Cxp; 2	30	0.70	100
K13	AJ234533 DNA fragment (clone MWG0604)			30	1.5	100
K14	X00408	ATPase, beta subunit, ATPase, subunit E	atpB, atpE, tRNA2-MET	406	e-113	96
K15	AX356916,AX356915 Clone 001-044-A10					

4 DISCUSSION

The reverse transcription of mRNA has revealed many cDNA bands with variable intensity especially in the stressed plant where some bands have lighter or higher intensity as compared to their levels in control samples. This indicates that salt stress modified some mRNA synthesis both qualitatively and quantitatively, reducing overall protein synthesis, as reported in

soybean by [23] and [2]. As well, salt stress activated several new transcripts indicating variation in gene expression at transcription levels. This would suggest down regulation and up-regulation of these genes.

According to [24], the sequence contig observed corresponds to regions involved in regulation of gene expression or encoding protein called hypothetical protein (T17F15.140 and Mei2-like-like) with unknown role or with function not yet demonstrated experimentally. These regions may be involved in nutrient metabolism as it was demonstrated by [25] or in various physiological events as it was suggested by [26].

The genes encoding proteins (PG1, PG3, PG4, HGA1, HGA4, GAD1= Glutamic Acid Decarboxylase) correspond to an unidentified proteins where some of them may play role in pectin-degrading as it was suggested by [19] (PG1, PG3 and PG4). They might correspond also to pathogenicity related proteins involving the ß-1 ,3-glucanase which is the first line of defense of barley against fungal pathogens according to that was demonstrated by [27] (HGA1 and HGA4).

The GAD1 is a glutamic acid decarboxylase enzyme which is involved in the degradation process of glutamate [28] and plays an important role in the process of oxidative stress tolerance. The tissues, in which this pathway is blocked, are more sensitive to oxidative stress [28]. It was previously demonstrated [29] that salt stress induced many oxidative compounds which were prevented by an efficient antioxidative system (SOD, APX, catalase, tocopherol,…) in plant tolerant.

The gene encoding the serine carboxypeptidase's family mediates some biochemical reactions to maintain the osmotic and ionic intracellular medium stable. The omnipresence of these proteins also suggests an important role in the physiology of the cell as it was suggested by [30]. This role may be an osmotic adjustment mechanism which allows plants to reduce their leaf water potential, maintain their cells turgor, and preserve their membrane integrity and then their photosynthetic activity as it was suggested by [31]. Furthermore, this gene may play an important role in protein degradation or secondary metabolites production as it was recently demonstrated by [20].

The most important finding in this study is genes NHX1 which encode proteins acting as an antiporter (Na^+/H^+). This achievement is supported by several authors. Indeed, analysis of membrane transporters and previous biochemical studies have shown that Na sequestration in the vacuole is governed by antiporters (Na^+/H^+) localized in the vacuolar membrane [32].

Similarly, according to [33], sequencing of the Arabidopsis genome has led to the identification of genes controlling the AtNHX1 antiporter (Na^+/H^+) and subsequently five additional homologous genes of AtNHX1 sequestering sodium in the vacuole. To confirm these results [34] have over-expressed the AtNHX1 in tomato and led to improve salt tolerance of tomato. Also, [35] have identified, in rice, a NHX1 homologous (OsNHX1), who's over expression conferred an increase of salt tolerance in rice.

5 CONCLUSION

This study has shown mRNA and then cDNA differentially displayed in barley genotypes subjected or not to salt stress.

The identified genes were mainly related to plant defense (ß-1 ,3-glucanase), to oxidative stress response (glutamic acid decarboxylase), to proteins acting as an antiporter (Na^+/H^+) and to other proteins with function not yet fully demonstrated experimentally.

Our results provide evidence suggesting that tolerance to salt stress in barley and especially in "Sabra" variety is carried out mainly by enhancing the expression of many physiologically important mechanisms in which the sequestration of sodium into vacuole. The ability of the vacuole to sequestrate sodium is a key factor for this variety tolerance but it appears conceivable that more than one mechanism is responsible for gene activation under salted conditions. These genes could be involved in various physiological functions of major importance for barley tolerance to salt stress.

The cDNA fragment and their corresponding genes could serve as useful markers for the identification of salt tolerant genotype and they could be used also as an efficient marker-assisted in breeding program.

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Estimation de la mortalité totale et de la longueur asymptotique de *Istiophorus albicans* (Latreille, 1804) capturée de 1988 à 2007 en CI

[Estimating total mortality and asymptotic length of *Istiophorus albicans* (Latreille, 1804) between 1988 and 2007 in Côte d'Ivoire]

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ABSTRACT: Le coefficient de mortalité totale (Z, an^{-1}) de l'espèce *Istiophorus albicans* capturée à partir de la pêcherie artisanale maritime de Côte d'Ivoire (Afrique de l'ouest) est déterminé, grâce à la méthode des courbes de capture selon les longueurs. Ces taux de mortalité sont estimés à partir de distributions de fréquences de tailles d'une longue série de données (1988-2007). Le taux de mortalité totale le plus élevé (Z=8,97 $an^{-}1$) est enregistré durant la période 2006 à 2007, et le faible (Z=4,12 $an^{-}1$) de 1991 à 1993. Le rapport Z/K est compris entre 3,68 et 9,74. Ce résultat indique que la population exploitée est largement dominée par la mortalité. De plus, ce résultat suggère également un niveau d'exploitation élevé La longueur infinie ($L\infty$) est restée constante et égale à 231 cm de 1988 à 2005. Cependant, de 2006 à 2007 l'on enregistre une valeur de 241,5 cm.

KEYWORDS: Istiophoridae, mortalité, courbes de capture selon les longueurs, pêche artisanale.

RESUME: Total mortality (Z, $year^{-1}$) of *Istiophorus albicans* of the artisanal fishing marine in Côte d'Ivoire (West Africa) was determined as Z , based on the length converted catch curves. Mortality estimates were based on length frequency distributions obtained from four long-term data series (1988-2007). Highest total mortality (Z=8.97 $an^{-}1$) was estimated during the period 2006-2007, and the lowest (Z=4.12 $an^{-}1$) from 1991 to 1993. The values of Z/K (3.68-9.74) indicate that mortality-dominated. Also, the results imply overfishing of *I. albicans* to the ivorian coastal waters. Asymptotic length ($L\infty$) remained constant (at 231 cm) from 1998 to 2005. However, for the period 2006-2007 a value of 241.5 cm was obtained.

MOTS-CLEFS: Istiophoridae, mortality, length-converted catch curves, artisanal fishing.

1 INTRODUCTION

La pêche est la seule source de protéines animales dans certains pays en voie de développement [1], [2]. En Afrique de l'Ouest, la pêche représente une place essentielle dans l'économie de nombreux pays. Ce poids se mesure en termes d'emplois induits et d'entrée de devises, via l'exportation d'une partie de la production et la signature d'accords de pêche avec des pays tiers. C'est pourquoi, les pays côtiers dont la Côte d'Ivoire se doivent de gérer au mieux leurs ressources afin de pérenniser les activités halieutiques. Dans les eaux maritimes ivoiriennes, une pêcherie artisanale plurispécifique existe depuis 1984 [3]. Cette pêcherie, qui est l'extension de celle du Ghana [4], [5], a connu une véritable expansion en 1988 et a été suivie de façon régulière [6] jusqu'à nos jours. Du point de vue quantitatif, elle débarque les requins (Mako, Marteau,

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Tisserand, Soyeux,..), les thonidés majeurs (Albacore, Listao), les thonidés mineurs (Thonines, Auxides, Bonites) et les poissons porte-épée (voilier Atlantique, Marlin et Espadon).

Istiophorus albicans dont le nom vernaculaire est le voilier Atlantique appartient à la famille des Istiophoridae. C'est une espèce pélagique qui fait de grandes migrations et que l'on rencontre dans les eaux tropicales et tempérées de l'océan Atlantique [7]. Le voilier est, parmi les poissons porte-épée, le plus régulièrement et abondamment débarqué au port de pêche d'Abidjan depuis 1988. Des études fragmentaires portant sur l'exploitation de cette espèce existent [8], [9]. Cependant, aucune donnée sur les mortalités, les paramètres de croissance n'existe. En effet, les taux de mortalité sont d'une importance primordiale pour les scientifiques de la pêche dans l'étude de la dynamique des populations de poissons [10], [11]. La connaissance des paramètres de croissance permet aussi d'établir certains modèles mathématiques de dynamique de population.

L'objectif de ce travail est d'étudier l'exploitation de l'espèce *Istiophorus albicans* sous l'angle des paramètres de croissance et de mortalité totale.

2 MATERIEL ET METHODES

2.1 MATÉRIEL

Les embarcations de la pêche artisanale maritime opérant sur le littoral de Côte d'Ivoire sont constituées toutes de pirogues en bois monoxyles. Ces pirogues de grande taille d'environ 15 à 17 m de long sont équipées de moteurs de 40 Cv. Avec un équipage de 8 personnes en moyenne par pirogue, les artisans pêcheurs effectuent des marées de un à trois jours. Ils pêchent de nuit au filet maillant dérivant qui a une profondeur de chute comprise entre 10 et 26 m.

2.2 METHODES

De 1988 à 2007, toutes les pirogues débarquant quotidiennement aux quais piroguiers du grand port de pêche d'Abidjan (commune de Treichville) et d'Abobo-Doumé (commune d'Attécoubé) ont été répertoriées et comptées. L'analyse fondée sur les distributions de fréquences de tailles plutôt que d'âges est utilisée car, les données disponibles se prêtent le mieux à une telle analyse.

DÉTERMINATION DE LA TAILLE ASYMPTOTIQUE $L\infty$ ET DE *K*

A partir de la distribution des fréquences de tailles, la méthode d'ELEFAN I (Electronic LEngth Frequency ANalysis) selon [12] incorporée au logiciel FiSAT II [13] est utilisée pour déterminer la longueur asymptotique ($L\infty$) et le coefficient de croissance (*K*). $L\infty$ = longueur asymptotique ou longueur moyenne maximale de la population en admettant que les poissons continuent de grossir (grandir) indéfiniment, *K* = coefficient de croissance. Il caractérise la vitesse avec laquelle le poisson croît vers la longueur asymptotique.

L'indice de performance de croissance (Φ') de l'espèce *Istiophorus albicans* est déterminé par l'équation de [14] afin de faire une comparaison globale de la croissance selon la relation :

$$\Phi' = 2\log_{10} L_\infty + \log_{10} K$$

ESTIMATION DU TAUX DE MORTALITÉ TOTALE (Z)

En biologie des pêches, les taux de mortalité sont couramment exprimés comme des coefficients instantanés [15], définis par *Z* selon l'équation :

$$N_t = N_0 . e^{-Z_t(t-t_0)}$$

où N_0 est le nombre initial d'individus au temps t_0 pris comme origine ;

N_t le nombre d'individus survivants atteignant l'âge *t* ;

Z, défini comme le coefficient instantané de mortalité totale est la somme de la mortalité naturelle (*M*) et la mortalité par pêche (*F*). Pour [16], avant d'estimer séparément la mortalité par pêche et la mortalité naturelle, il est commode d'évaluer la mortalité totale.

La méthode des courbes de captures selon les longueurs, accessible grâce à FiSAT II est utilisée. Cette méthode est une transposition de la méthode des courbes de captures par âge [17]. Elle nécessite que les histogrammes de fréquences des tailles donnent une photographie fidèle de la structure de la population au moment de la pêche. La méthode des courbes de capture avec des longueurs employée dans ELEFAN/FiSAT est destinée à permettre l'utilisation directe des histogrammes de fréquences de longueurs dans l'évaluation de la mortalité *Z* (an^{-1}).

Une autre méthode basée sur l'analyse des distributions de fréquences de taille est utilisée, la courbe de Powell-Wetherall [13], [18]. Cette méthode, contrairement à celle de ELEFAN permet l'estimation du rapport Z/K. Le logiciel FiSAT II a permis l'estimation de ce ratio ; celui-ci est utilisé pour évaluer l'équilibre entre la mortalité et la croissance [19].

3 RÉSULTATS

ESTIMATION DE LA TAILLE ASYMPTOTIQUE (L∞)

La méthode ELEFAN I a permis d'estimer la taille asymptotique (L∞). Les différentes valeurs de L∞ ainsi obtenues sont mentionnées dans le tableau I. La longueur infinie est restée constante et égale à 231 cm de 1988 à 2005. Cependant, de 2006 à 2007 l'on enregistre une valeur de 241,5 cm (tableau 1).

Quant au coefficient de croissance (K), il varie de 0,77 à 2 /an (tableau 1). La vitesse avec laquelle le poisson croît vers la longueur asymptotique a augmenté de 0,77 an^{-1} au début de l'exploitation de l'espèce (1988) à 1,4 an^{-1} en 1996. Un ralentissement de la croissance est observé à partir de la période 1997 à 1999 (0,99 an^{-1}) jusqu'à 2002 avec une valeur de 0,86 an^{-1}. Toutefois, de 2003 à 2007, une augmentation de K passant de 1,4 an^{-1} (2003-2005) à 2 an-1 2006-2007) survient.

Les valeurs de l'indice de performance (Φ') sont consignées dans le tableau 1. Cet indice varie d'un trimestre annuel à un autre. La moyenne de Φ' est égale à 4,78.

L'ajustement des courbes de croissance superposées aux histogrammes de fréquences de tailles restructurées ayant permis la détermination des différents paramètres (L∞, K et Φ'), selon le modèle de von Bertalanffy est présenté par la fig. 1.

Tableau 1 : Paramètres de croissance (L_∞ et K) et indices de performance (Φ') de l'espèce Istiophorus albicans pêchée dans les eaux maritimes ivoiriennes de 1988 à 2007 (moyenne de Φ' = 4,78)

	Périodes						
Paramètres	1988-1989-1990	1991-1992-1993	1994-1995-1996	1997-1998-1999	2000-2001-2002	2003-2004-2005	2006-2007
L∞ (cm)	231	231	231	231	231	231	241,5
K (an^{-1})	0,77	0,81	1,4	0,99	0,86	1,4	2
Φ'	4,61	4,64	4,87	4,72	4,66	4,87	5,07

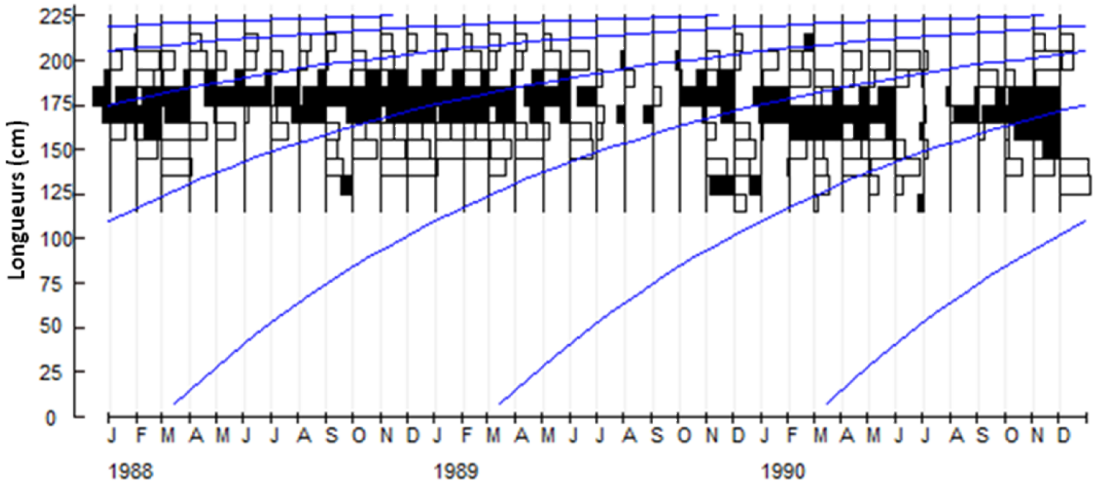

Fig. 1 : Exemple de courbe de croissance selon von Bertalanffy chez Istiophorus albicans des années 1988, 1989 et 1990 (L∞=231 cm ; K=0,77 an^{-1})

COEFFICIENT DE MORTALITÉ TOTALE (Z)

Les valeurs de Z estimées et les paramètres de la régression linéaire obtenus à partir de la courbe de capture selon les longueurs à l'aide du logiciel FiSAT II sont consignés dans le tableau II. Le taux de mortalité totale varie entre 4,09 an^{-1} (de 1997 à 1999) et 8,97 an^{-1} (2006-2007) soit 2 fois celui de la première période.

Tableau 2 : Estimation de coefficients instantanés de mortalité totale (Z) de Istiophorus albicans à partir de la courbe de capture selon les longueurs de 1988 à 2007

Périodes	Paramètres estimés						
	a	SD/a	b	ES/b	Z (an^{-1})	R^2	Z/K
1988-1989-1990	18,71	0,83	- 4,5	0,25	4,5	0,99	5,27
1991-1992-1993	16,96	0,44	- 4,12	0,14	4,12	0,99	7,23
1994-1995-1996	17,39	0,59	- 7,03	0,33	7,03	0,99	**9,74**
1997-1998-1999	15,05	1,30	- 4,09	0,51	**4,09**	0,98	4,62
2000-2001-2002	16,14	0,08	- 4,20	0,03	4,20	1	8,89
2003-2004-2005	16,12	0,22	- 5,99	- 5,99	5,99	0,99	5,07
2006-2007	15,36	1,86	- 8,97	1,47	**8,97**	0,97	**3,68**

R^2 : coefficient de détermination ; ES : Erreur standard ; Z/K, déterminé par la méthode de Powell-Wetherall

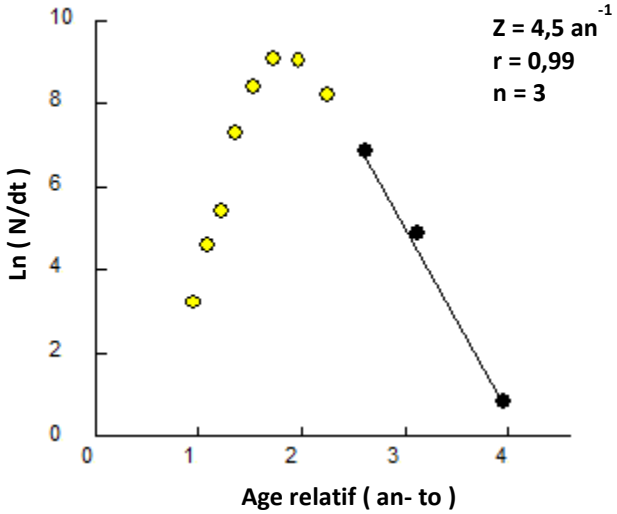

Fig. 2 : Estimation de Z à partir de la courbe des captures linéarisée chez Istiophorus. albicans de 1988 à 1990

ESTIMATION DE Z/K

Les valeurs de Z/K varient d'une période à une autre et oscille entre 3,68 et 9,74.

4 DISCUSSION

Le modèle de croissance utilisé est celui de von Bertalanffy. Il s'adapte bien au cas étudié et la qualité de nos données ne permet certainement pas sa remise en cause. La longueur asymptotique est la plus grande longueur théorique que les individus d'une espèce peuvent atteindre dans un habitat compte tenu des particularités écologiques de ce milieu et K est la vitesse à laquelle ils croissent pour tendre vers cette longueur finale. Même chez une espèce, un stock peut croître plus vite lorsqu'il est constitué d'individus assez jeunes et plus lentement lorsque les individus sont relativement plus âgés [20]. Ainsi, une comparaison de la croissance doit prendre en considération à la fois le taux de croissance (K), la longueur asymptotique ($L\infty$) et l'indice de performance de croissance Φ' qui intègre les deux premiers paramètres [21]. K peut varier entre 0 et 1 par an pour les espèces de poissons à longue durée de vie [22].

Le test utilisé pour comparer les paramètres de croissance de la même espèce du même stock ou stock différent est le test phi prime (Φ') [21]. Les espèces apparentées présentent des valeurs similaires de Φ' et chaque taxon peut avoir une distribution particulière des valeurs, différente des autres taxons, et peut être décrit par sa valeur moyenne [21], [23]. La référence [24] montre que les espèces de la même famille devraient avoir des valeurs de Φ' similaires. Ainsi, nos résultats sont similaires à ceux de la littérature [25], [26], [27].

Toute estimation de la mortalité totale est associée à des incertitudes qui sont prises en compte par le logiciel [28]. Dans la présente étude, Z varie de 4,09 à 8,97 an^{-1}. Toutefois, les estimations de Z présentent une incertitude. Parce que la mortalité totale (Z) a été estimée à partir d'une courbe de capture selon la longueur dont, l'entrée des différents paramètres de croissance pourrait évidemment modifier la forme de la courbe et par conséquent les estimations de Z [29], [30].

La mortalité et la croissance sont deux phénomènes antagonistes. En règle générale, si le rapport Z/K < 1, il y a prédominance de la croissance sur la mortalité de la population, s'il est > 1, alors la mortalité prédomine sur la croissance; quand il est égal à 1, donc la population est dans un état d'équilibre où la mortalité s'équilibre avec la croissance [19]. Le rapport Z/K est compris entre 3,68 et 9,74. Ainsi, la mortalité prédomine très largement sur l'espèce. De plus, ce résultat suggère également un niveau d'exploitation élevé.

5 CONCLUSION

Le voilier de l'Atlantique *Istiophorus albicans* est une ressource hautement surexploitée par la pêcherie artisanale maritime de Côte d'Ivoire. La mortalité totale a été estimée grâce à la méthode des courbes de capture selon les longueurs. Il apparait que le coefficient instantané de mortalité a varié considérablement après 19 années d'exploitation.

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Foreign Language Teachers' Beliefs about School in Algeria within a Context of Curriculum Reforms

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ABSTRACT: This paper reports on a qualitative study which explored the beliefs of a sample of foreign language teachers about school in Algeria within a context of curriculum reforms. It was found that the participants believed that the Algerian school was generally a site of power and domination; that there was a drastic lack of resources; that students were unmotivated; that parents were disengaged; and that school administration was bureaucratic. The paper concludes that curriculum reforms in Algeria were not paralleled with social, economic and political reforms of educational institutions. It is suggested that there is an urgent need to equip schools with resources to make them adequately prepared for the effective implementation of the new curriculum. However, in the long term, it is suggested that policy-makers should promote a culture of active participation of all those involved in education, mainly the teachers and parents, towards improving the current situation of schools in Algeria, and ultimately, of the educational system.

KEYWORDS: Teachers' beliefs; curriculum reforms; foreign language teaching; school in Algeria; policy and power in education

1 INTRODUCTION: THE CONTEXT OF CURRICULUM REFORMS IN ALGERIA

Following a period of political unrest in the 90s, a process of peace and reconciliation was initiated in early 2000 in the hope of bringing back stability to the country. A series of political and economic reforms were consequently launched to meet the objectives underlying the process of reconciliation. These reforms involved the sector of education, as the Algerian government saw it as an important element towards any political and economic prosperity (Toualbi-Thaalibi, 2006, Tawil, 2006). The need for reform also emerged from the political efforts of Algerian leaders to adapt to globalisation because it was assumed that globalisation had an inevitable impact on new conceptions of education in the world (Tawil, 2006; Toualbi-Thaalibi, 2006). The Ministry of Education (2006a) notes for instance that:

Recent social changes that were triggered by the new political and economic visions of our country, the need of the Algerian society for development and progress, the opening on the world through modern technology, lead us to define new strategies…this cannot be achieved without a full reform of the educational system. (p. 17-18) [translated from French]

This initiative was paralleled by a series of meetings between Algerian and UNESCO officials, leading to a contract signed on 2nd October 2003, in which the UNESCO accepted to fund these educational reforms (Tawil, 2006; Ministry of Education, 2006b). The project, called the Programme of Support for the Reform of the Algerian Educational System (PARE), was followed by a series of meetings and conferences between Algerian and UNESCO officials in the period of 2003 and 2006 to assess the progress of these reforms and to put forward future directions (Tawil, 2006). Other international agencies also contributed to the funding of the project, amongst which were the French Agency for Development (AFD), the European Union, and the United States Aid (USAID).

In this respect, the Algerian government appointed a National Commission for the Reform of Education (CNRE) in 2000, the task of which was to evaluate the then situation of the educational system and to provide some recommendations on the necessary reforms in line with the country's new philosophy of democracy, reconciliation and economic development. The CNRE gave their report back in 2001. The report confirmed the need to reform the educational system to meet the challenges of the 21st Century (Tawil, 2006). The main issue highlighted by the CNRE was a deterioration of the educational system reflected primarily in: a) a decline in the number of students who pass their national examinations, b) an increase in

the proportion of students who re-take their levels, and c) a considerable proportion of students who drop-out from school before the age of 16 (Tawil, 2006). Furthermore, the commission raised concerns over the quality of teachers, who were criticised for not having the necessary teaching qualifications to undertake their jobs in an efficient way (Tawil, 2006). The proposed curriculum reforms centred round three platforms:

- Platform 1: Reforming the school structure which involved: a) introducing a pre-school level for 5 year old pupils, b) restructuring the duration of primary school from 6 to 5 years, and middle school from 3 to 4 years, and c) restructuring the post-compulsory education in secondary school (lycée) into three streams: general, technical, and vocational.
- Platform 2: Reforming teacher training which involved: a) improving the knowledge and skills of teachers and inspectors, and b) coordinating and evaluating teacher training and development.
- Platform 3: Reforming teaching syllabuses and textbooks which involved: a) elaborating and introducing new teaching programmes for all school levels, b) providing and evaluating new teaching resources and materials, c) introducing new teaching methodologies to meet the programmes' objectives, and d) setting up systems for information and communication technology in schools.

The government felt optimistic towards these reforms; although some studies conducted by the ministry of education as an initial evaluation of the process found that the reforms had not been met with great enthusiasm by teachers, parents and students (Toualbi-Thaalibi, 2006). However, these studies did not make explicit the factors behind this lack of enthusiasm. The study reported in the present paper formed part of a larger research which explored the beliefs of foreign language teachers about these curriculum reforms in order to find some possible answers to this lack of enthusiasm from the point of view of teachers. With particular relevance to the scope of the paper, the study aimed to explore the teachers' beliefs about school in Algeria. It sought to provide answers to the following questions:

1. What are the beliefs of a sample of foreign language teachers about school in Algeria?
2. What issues of policy and power underpin these beliefs?
3. What conclusions can we draw for teachers' beliefs in Algeria?

2 THEORETICAL FRAMEWORK

This study is premised in the area of research which suggests that a better understanding of teachers' practices can be achieved by an understanding of the beliefs underlying those practices (Pajares, 1992; Ballone and Czerniak, 2001; Schmidt and Kennedy, 1990). The underlying assumption is that teachers' classroom decisions do not happen at random, but are guided by systems of beliefs which "greatly impact on their instructional decisions in the classroom" (Farrell and Lim, 2005: 1). Hence, recent years have witnessed a growing body of research in the field of teachers' beliefs (Fives and Buehl, 2005), although at the same time, it is argued that still little is known about teachers' beliefs and that no consensus was reached as to the exact nature of this construct (Rueda and Garcia, 1994). The reason for this, as it is argued, is the fact that beliefs are complex and abstract in nature, which makes them difficult to research (Pajares, 1992).

Nevertheless, there is a general consensus that teachers' beliefs derive partly from the teachers' personal and professional experience (Anderson, 1998; Farrell and Lim, 2005; Richards and Lockhart, 1994) and from their school experience as learners (Farrell and Lim, 2005; Schmidt and Kennedy, 1990). The literature indicates that teachers' beliefs generally fall under three main categories: (a) personal beliefs, which are teachers' beliefs about themselves and how they should be, and which derive from personal experience as a learner (Raths, 2001, Richards and Lockhart, 1994); (b) beliefs about teaching, learning and curriculum, which stem from different sources, mainly the teachers' personal experience as learners and their professional experience as teachers (Richards and Lockhart, 1994; Calderhead, 1996); and (c) epistemological beliefs, which are beliefs about the nature of knowledge and how knowledge is acquired and are closely interrelated with beliefs about learning and teaching (Fives and Buehl, 2005). It is argued that such a categorisation of teachers' beliefs can give researchers some insights about teachers' practices, but also about teachers' lives and work (Filisetti and Fives, 2003).

Furthermore, the literature on teachers' beliefs generally argues that educational innovations would not succeed if the objectives of these innovations are incompatible with the beliefs of its users and implementers (Rueda and Garcia, 1994; Fives, 2003; Anderson et al., 1991). Matese et al. (2002: 3) posit that teachers see "innovation through the lens of their existing knowledge and beliefs". Ballone and Czerniak (2001: 7) point out that "the teacher is the critical change agent in paving the way to educational reform and that teacher beliefs are precursors to change". Schmidt and Kennedy (1990: 2) posit that introducing any curricular innovations "is not likely to significantly alter teaching practices if teachers either do not understand or do not agree with the goals and strategies implicit in these new devices". Hence, Richards et al. (2001) warn

that curriculum innovations usually fail when there is a mismatch between the ideologies underlying the innovation and the teachers' beliefs.

3 METHOD

The study was positioned in the qualitative framework, defined as the one that "produces findings not arrived at by statistical procedures or other means of quantification…[and] can refer to research about persons' lives, lived experiences, behaviours, emotions, and feelings as well as about organizational functioning, social movements, cultural phenomena, and interactions between nations" (Strauss and Corbin, 1998: 10-11). It aimed at investigating teachers from an 'emic' perspective (Schwandt, 1998; Ellis, 2006), which involves "understanding the complex world of lived experience from the point of view of those who live it" (Schwandt, 1998: 221); in contrast to an 'etic' perspective, which views reality in a more objectivist stance and researches individuals from an outsider's point of view (Schwandt, 1998). More specifically, the study embraced a 'constructivist paradigm' (Guba and Lincoln, 1998; Schwandt, 1998), which can be briefly defined as the paradigm where the "world of lived reality and situation-specific meanings that constitute the general object of investigation is thought to be constructed by social actors" (Schwandt, 1998: 221).

The sample of participants comprised twenty teachers who taught either French or English as foreign languages at different school levels in Algeria. The sampling of participants depended on their professional circumstances and the context of the study, and as such adopted a 'purposive convenience' sampling strategy (Flick, 1998; Punch, 1998; Kumar, 1996) "where advantage is taken of cases, events, situations or informants, which are close at hand" (Punch, 1998: 193). Individual semi-structured interviews were conducted with eight teachers, and group interviews were held with four groups of teachers. All interviews were audio-taped and all the participants were allocated a pseudonym. Table 1 below provides an overview of participants' profiles and the methods of data collection.

Table 1 Summary of participants and data collection methods

Method of data collection	Participant name (pseudonym)	Age	Gender	Curriculum Subject	School level	Years of teaching	Data Ref in text
Individual interviews	Jamila	41	Female	French	Primary	20	jamila/int
	Mohamed	46	Male	French	Primary	26	mohamed/int
	Salima	47	Female	French	Middle	22	salima/int
	Karim	37	Male	French	Middle	15	karim/int
	Zohra	35	Female	English	Middle	12	zohra/int
	Nabila	33	Female	English	Middle	13	nabila/int
	Omar	49	Male	English	Secondary	26	omar/int
	Hakim	47	Male	Inspector of English	Middle	22	hakim/int
Group interviews	Bassim Salim	38 42	Male Male	English	Middle	16 20	pem/eng/gr/int
	Dalila Wassila Latifa	46 48 53	Female Female Female	French	Middle	20 30 34	pem/fr/gr/int
	Ahlam Tariq Amin	36 44 48	Female Male Male	French	Secondary	14 16 22	pes/fr/gr/int
	Malika Samia Nabil Rafik	37 33 45 39	Female Female Male Male	English	Secondary	17 14 21 16	pes/eng/gr/int

The study used 'grounded theory' as a procedure for data analysis and followed the procedure as discussed in Strauss and Corbin (1998), Boulton and Hammersley (1996), Punch (1998), and Flick (1998). The procedure generally entailed three stages: (1) open coding, where data were translated into categories, (2) theoretical (or axial) coding, which entailed the process of taking the data from open coding to a higher level of abstraction, and (3) selective coding, which involved "finding

a higher-order concept, a central conceptual category at the second level of abstraction" (Punch, 1998: 218) towards developing 'theory' (Strauss and Corbin, 1998).

Finally, issues of ethics and trustworthiness were addressed throughout the study in order to establish confidence and consistency of the findings (Lincoln and Guba, 1985; Flick, 1998). In particular, the study referred extensively to Revised Ethical Guidelines for Educational Research (British Educational Research Association, 1992) and Recommendations on Good Practice in Applied Linguistics (British Association for Applied Linguistics, 1994), but also used the strategies discussed by Lincoln and Guba (1985), Flick (1998), Miles and Huberman (1994) and Boulton and Hammersley (1996).

4 FINDINGS

4.1 BELIEFS ABOUT THE ROLE OF SCHOOL

The participants tended to perceive the role of school in terms of the objectives it was believed to achieve. In this respect, they believed that school should "form the citizen of tomorrow…to be committed and disciplined…to be organised…in all aspects…the perfect citizen…" [omar/int]. Furthermore, they also perceived school from a parental perspective. That is, they looked at school as the students' second home, as the following teacher explained:

The role of school is a second home…the student has a first home and school is the second… [jamila/int]

However, the participants described the reality of Algerian school as being deficient. One teacher, Mohamed, for instance, believed that:

School in Algeria has become like in the street…the same thing…there's no more respect for the teacher…there is a total anarchy…there are a few parents who are interested in their children's progress, but most of them do not care…the most important for them is that their children go to school…and at the same time the teacher has been marginalised a lot…by the government and society…those at the top do not care about school anymore…look at this classroom, look at the board, look at the walls… [Mohamed/int]

Another participant, Nabila, believed that the actual role of school in Algeria had become to "make children sleep…as if [they were]...giving sleeping tablets…" [nabila/int] whereas she felt that the actual role of school in particular and education in general should ideally be to open up students' eyes towards the world.

Another participant, Omar, believed that the Algerian school in reality had become deficient because it had been influenced by a corrupt political system, and that it had become a means of indoctrination, rather than emancipation. This indoctrination, according to Omar "…is present in the textbooks that [teachers] use in the classroom, and in the curriculum and in the educational system" [omar/int]. He explained that teachers were implementing orders, and that they did not have any power to change.

Hakim, for instance, believed that school in Algeria did "…not even exist because there [was] actually no culture of education in this country" [hakim /int]. He believed that those involved in education must start first by defining what learning is because in Algeria they did not know what learning is.

4.2 BELIEFS ABOUT RESOURCES

In terms of resources, the teachers believed that resources were important for efficient learning to take place. One teacher, Nabila, for instance believed that the ideal school was where "there [were]...less students in the classroom and also where there [was]...a specially-designed language classroom" [nabila/int] to teach foreign languages appropriately.

However, the participants believed that in reality there was a drastic lack of resources, which according to them had contributed to the deterioration of foreign language education in Algeria. Two issues the teachers highlighted were overcrowded classes and lack of textbooks. In this respect, they believed that overcrowded classes represented a barrier to any curriculum development and innovation, as the following groups of teachers explained:

The new curriculum is good, but it does not suit the current situation…you can't work with a classroom of 40 students…there should be a class of 25 students maximum…because in the current situation, you are only able to work with a small group of students at the expense of the others…so only a few will be able to learn and progress… [pem/eng/gr/int]

The participants also pointed out that to raise standards, decision-makers would need "to provide textbooks and pedagogical documents" [Mohamed/int].

4.3 Beliefs About Students

The participants noted that students' standards had fallen in their language classes because of a heavily-loaded curriculum, which did not usually reflect students' social environment and needs. This, according to them, led to the "...students' loss of motivation" [karim/int] in the sense that they had become "...passive and over-reliant on the teacher" [karim/int].

Another point expressed by all the participants, was their concerns over students' behaviour. They believed that students in the past were better than in the present. This was reflected, according to the participants, in their students' behaviour inside and outside school. The following French teachers expressed her disappointment of the situation:

I have been really disappointed to see children's education…in decline…my students are all right, but I see other students who disrespect their teachers…this is disappointing… [pem/fr/gr/int]

4.4 Beliefs About Parents

The participants believed that parents should be involved in their children's education. They believed that education was not only limited to the classroom but extended to the students' homes as well. They believed that parents' follow up was very important for the progress of their children. However, they believed that in reality "…a few parents…[were] interested in their children's progress, but most of them [did] not care…the most important for them [was] that their children go to school" [Mohamed/int]. The participants believed that parents had become passive, which in turn impacted on students learning, and hence, the deterioration of students' standards and lack of discipline. In general, they believed that there was a break up between family and school in Algeria. Jamila explained the issue of parents' detachment from school in the following quote:

The children's environment plays an important role in education… parents don't show any interest to their children's education anymore, and it is rare to see parents coming to the school to enquire about their children's progress… [jamila/int]

4.5 Beliefs About The Administration

The participants reported that there was a continuous conflict between an autocratic and bureaucratic administration and the teacher. They believed that they worked in a culture of oppression and that this had led to "...injustice...and to a breach of equal opportunities policy" [hakim/int]. They noted that teachers lived "…in constant fear from the administration" [jamila/int]. They believed that this state of affairs was one of the main causes behind the deterioration of education in Algeria.

The participants also explained that the Ministry had never consulted them before innovations were implemented, as Zohra noted:

…we have a problem in Algeria…they never ask our opinion when there is an innovation…unfortunately everything is imposed from the top, even the BEF examination, a national examination full of mistakes…because those who decide and plan are not aware of their responsibility…and they usually have nothing to do with the teaching profession… [zohra/int]

5 Discussion

5.1 Politically-Dominated School

The first key finding the data reveal was that the participants believed the Algerian school as a place for political indoctrination rather than emancipation. This view comes within a current educational debate on the effectiveness of school and the latter's position between, on the one hand, narrow political objectives, where politicians define the role of school according to their political aims for power and control; and on the other hand, social aspirations, where the civil society decides on the role of school as a place for teaching social justice, equality and democracy for the benefit of society as a whole. In this respect, Morgan (1998) for instance notes that there are many perspectives through which organisations can be viewed, amongst which are on the one hand the view of organisations as 'socio-cultural systems', and on the other as 'systems of political power and instruments of domination'. A socio-cultural systems perspective views organisations as the embodiment of society with its shared "values, rituals, ideologies, and beliefs" (Morgan, 1998: 111). These organisations are regulated by a system of shared objectives and meanings, or 'realities', which stem from the enactment of its actors. More specifically, schools according to this view can be seen as a reflection of the students' home and society. This view allows for

a continuation and reciprocity of education between informal and formal institutions, in the sense that school complements home and society, and reciprocally home and society complement school. A 'political power and instruments for domination' perspective, however, views organisations as arenas of competition for power and domination towards the fulfilment of personal or group interests, where conflict is created to shape people's beliefs according to hidden political agendas (Morgan, 1998). Authority and control are some key characteristics of these types of organisations. The school in this perspective can be seen as a place for political indoctrination towards serving a system governed by political power and economic interest. School, according to this view inculcates a political ideology of submission to a system created by politicians towards maintaining their power and privileges.

The participants viewed school within a 'political power and instruments of domination' perspective. They believed that the Algerian school was a place for political indoctrination and control deliberately intended by the Ministry. These beliefs seem to concur with the political reality of Algeria. In fact, the Algerian political system is generally characterised by a top-down and bureaucratic culture inherited from the French colonial period (Bouhouche, 1998; Zoubir, 1998; Bouakba, 2006). This system has impacted negatively on the educational system and its institutions (Brahimi, 1991), and although different governments have made several attempts to 'democratise' the educational system and its schools, the structure and culture remained to a large extent bureaucratic and top-down (Bouakba, 2006). Brint (1998) explains that schools in most developing countries have generally inherited a traditional system from their former colonial powers, which consequently led to their decline and their inefficiency in meeting their societies' needs and demands. Brint also notes that other problems that contribute to the decline of schools in the developing countries are lack of political stability, insecurity, and poverty, which Algeria is known to have been suffering from (Garon, 2003; Bouhouche, 1998; Zoubir, 1998; Ciment, 1997; Malley, 1996), and although a process of peace and reconciliation has been initiated lately, schools in Algeria seem to still live the repercussion of this instability, which may possibly explain the participants' beliefs.

5.2 SOCIALLY-DISTANT SCHOOL

Another issue that seems to add to the decline of the Algerian school and that the data reveal is the absence of communication between schools and parents. The participants explained that there was a detachment of parents from school in the sense that parents do not take an active role by liaising with schools for the follow up of their children's education. These beliefs are congruent with the literature on parents' relationship with school, which suggests that parents' involvement in the education of their children is crucial. Parents' involvement, as it is argued, increases students' performance and achievement (Tableman, 2004), and benefits children at all stages of their educational pathway (Kreider,2002). In foreign language learning, Sung and Padilla (1998: 2) for instance note that it "is commonly noted that for young learners, parents' involvement in and attitudes towards language learning are two important factors in second language development". Furthermore, from a policy perspective, the data indicate that there was an absence of 'a culture' of parents' involvement in schools, and reversibly of school accountability towards parents. The literature generally argues that parents' involvement in schools can also give "parents the opportunity to take part in decision-making" (Cotton and Wikelund, 2001: 1), which could potentially create a balance of power and reduce governments' control on schools (Cotton and Wikelund, 2001). The participants, who were also parents, seemed to suggest that one way of reducing government control and central authority over school was by involving the parents. Like this they could ensure a less dominant and more democratic educational system.

5.3 UNDER-RESOURCED SCHOOL

Other key beliefs related to describing the current state of schools in Algeria and that the data reveal were about lack of resources. The teachers explained that schools in Algeria were unable to provide adequate resources in order to facilitate students' learning. This situation has created what seems to be an endless conflict between the Ministry, and its administration, on the one hand, and the teachers on the other. Brint (1998) points out that some major characteristics of schools and education in developing countries, which Algeria is part of, are the presence of a centralised authority and lack of resources. The picture of the Algerian school that the data provide is somewhat similar to what Brint describes.

The participants believed that resources were important to meet the challenges of the new curriculum. With respect to foreign language teaching, in particular, these beliefs are compatible with the literature which stresses that the provision of resources is vital because learning a foreign language with appropriate resources would create a more authentic experience within a communicative language teaching curriculum (Murphy; 2000; Yalden, 1987; Richards and Rogers, 1986). This could potentially enhance students' motivation, and therefore may increase their learning and achievement (Ballone and Czerniak, 2001; Murphy, 2000). Another important benefit of an adequate provision of resources is the fact that it can help teachers to diversify their teaching styles in order to meet the needs of all their learners (Ballone and Czerniak, 2001). This is particularly

necessary where teachers deal with large classes (Ballone and Czerniak, 2001; Sarwar, 2001), which the data also revealed. Reversibly, it is argued that a lack of resources may lead to a difficulty in meeting all the learners' needs and learning styles, and this generally results in students losing their motivation and interest in their learning (Ballone and Czerniak, 2001). This may partly explain why the Algerian students were reported to have lost motivation in learning foreign languages.

6 CONCLUSIONS AND RECOMMENDATIONS

The conclusions we can draw for the study is that curriculum reforms in Algeria were not paralleled with social, economic and political reforms of the educational system, in particular school institutions. The teachers' beliefs presented in this study seem to provide a warning call directed to the ministry of education, that school was inadequately prepared for the proper implementation of the new curriculum. They explained that in the absence of a democratic culture of education, of an adequate provision of resources, and of an active participation of parents and society, any curriculum reforms were ineffective. It was discussed above that any attempt to introduce curriculum reforms without full consideration of teachers' views and beliefs would lead to a failure of the innovation (Anderson et al., 1991; Richards et al., 2001; Schmidt and Kennedy, 1990; Ballone and Czerniak, 2001). In this particular case, the ministry seemed to have dumped the new curriculum on the teachers without taking their views and without ensuring schools are appropriately prepared for the innovation. As a consequence, the teachers seemed to have developed negative beliefs about the innovation and its context. It is important, however, to highlight that one cannot take the participants' beliefs at face value; rather this paper only attempted to provide possible interpretations to these beliefs as they are constructed in the participants' systems of truth; there may well be other interpretations.

The recommendations that can be put forward can be summarised into two objectives: a) a short-term micro objective, which involves the provision of adequate resources and the improvement of schools' situation in order to make them appropriately equipped for the demands of the new curriculum, and b) a long-term macro objective, which involves the priority for policy-makers to promote a culture of active involvement of all those involved in education, mainly of teachers and parents, in all educational matters. The purpose fro that will be to create opportunities for dialogue and communication towards sharing experiences and knowledge for the benefit of education and society.

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Women Groups: A Pathway to Rural Development in Nyamusi Division, Nyamira County, Kenya

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ABSTRACT: Despite their fundamental socio-economic responsibilities, rural women still have less access to knowledge, assets, services and participation in decision-making. These inequalities affect their ability to carry out critical roles in their communities leading to rural poverty. In Kenya, women groups form the majority of local initiatives. Although women groups are the solution to the local problems, there is little support they receive from the government and other development stakeholders, hence their inability to address rural problems. Besides, there are limited studies particularly in Kenya on women groups' contribution to rural development. This paper is a portion of the outcome of an empirical descriptive study conducted in Nyamusi Division in Nyamira County by the authors. The sample was drawn from ten registered women groups and fifteen informal women groups in the study area. The unit of analysis was a women group. This paper critically examines the relationship that exist between rural community-based approaches (in this case-women groups) and rural development. It also looks at the barriers that hamper women's development efforts in community interventions. This paper concludes that if given opportunity, women have the potential to change their own socio-economic status as well as that of the communities in which they live in for the reason that women groups act as an effective instrument for rural development. Once women groups have sufficient solidarity, experience and unity of purpose in their undertakings, rural development is achieved. This paper recommends policy frameworks that not only promote community-based approaches for rural development, but also encourage sustainability and equal participation of all genders in development.

KEYWORDS: Women Groups, Rural Development, Kenya.

INTRODUCTION

Over the past four decades countries have witnessed a steadily increase in the global understanding of the quandary of poor women in developing countries. Most poor rural women living in the rural peripheries throughout the world shoulder the burden of the world's poverty, particularly in the Least Developed Countries and sub-Saharan Africa (UNIDO, 2003).Women make essential contributions to the rural economies worldwide. However, Women's contribution to local and community development is significant, but rural women everywhere are in a minority in decision-making and planning, particularly at regional and national levels. This is in part due to women's multiple roles and workload, but is also due to the persistence of traditional views about women's and men's roles in society (EC, 2000). Women perform 66% of the world's work, produce 50% of the food, but earn 10% of the income and own 1% of the property (UNICEF, 2007). Their poverty level is worse than that of men as clear gender disparities in education, employment and decision making power exist (UNIDO, 2003) thus, the need for social, economic, political and gender equity on women and development.

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Women's lives have been deprived for too long from participating in the opportunities and benefits of economic growth and globalization. The low level of participation by women in decision making inevitably leads to biases in the priorities and policies pursued by development organisations (EC, 2000). Due to socio-economic challenges that women have been facing in their communities, these situations have forced them to form women self help groups (Chitere, 1988), that act as an instrument to articulate their concerns through various interventions employed by them. From a socio-cultural perspective, the emergence of self-help groups can be seen as a response to industrialization, the breakdown of the kinship system, and the decline of the community (Katz & Bender, 1976; and Kessler et al. 1997), although, other scholars see it as a manifestation of an ineffective, inefficient and de-humanizing formal system of care (Gartner & Riessman, 1977). The increasing interest in providing services that are family-centered is also contribute to the increased number of self-help groups' worldwide (Rosenbaum et al., 1998).

In India for instance, self help groups is a major breakthrough in improving lives of womenfolk and alleviating rural poverty. They represent a unique community based approach to rural development through team building, self management and financial intermediation (Manjunatha, 2013). In the United states of America, self-help groups are not only purely about individual gains and self-empowerment but also about policy changes and collective empowerment (Chesler, 1991), and have been in the vanguard of social change in the community. In Kenya, women self-help groups are famously known as merry-go-rounds (MGRs). According to Kenya Nokia Research Centre (NRC) Merry Go Rounds are informal groups of people who come together usually for purposes of saving together and borrowing from one other in a rotational manner but also for sharing news, knowledge, ideas, tradition and also helping each other out in times of need. In Kenya, informal groups are usually referred to as 'chama', which is a Kiswahili word for 'association'. They typically allow their members to save and borrow in a rotational manner.

Hypothetically, the efficacy of self-help groups predominantly for women has been widely documented worldwide. For instance, the 'helper-therapy principle' as postulated by Riessman (1965) points to the process by which helping others has a therapeutic effect on the helper, and the self-help group provides the context for members to gain the unique benefits that may arise from helping someone who has the same problem as the helper. According to Rappaport (1993), self-help groups offer the venue for shared experience, emotional support and social learning which help to constitute a social identity among members of a group. On the same note, Yalom (1995) contends that self-help groups provide a unique opportunity for growth, social experimentation and change. Self help groups (women groups) provides a balanced participation by women and men in decision making and create a platform for local democracy and for the quality of decisions taken on developments that affect the life and future of rural communities and economies (EC, 2000).

However, studies indicate that as women self-help groups strife for success in community development activities, they face some barriers hinder their development. For instance, societal beliefs continue to hinder progress in women's empowerment in many aspects (Cohen, 2006). Women are socialized to internalize subordination, which in turn shapes their destinies and psyche (Ghorayshi & Belanger, 1996). The patriarchal social relation also provides the ideological foundation for women's problems. According to Kandiyoti (1988), patriarchal relations exert a powerful influence on the shaping of women's gendered subjectivity and impact on sub-ordination of women.

In response to women subordination, countries have shown their commitment to addressing gender issues with the goal of improving the status of women. For example, Kenya is one of the countries that are signatories to the Vienna Declaration on Human Rights, the Convention on the Elimination of All Forms of Discrimination Against Women and the Beijing Platform for Action and the international human rights instruments that recognise the strong links between rapid population growth, high fertility, ill-timed pregnancies, weak health systems and poverty. Kenya is also integrating women's socio-economic empowerment into national development strategies aimed at achieving development targets such as the Millennium Development Goals (MDGs).

In spearheading the integration process, efforts by the government and various development agencies have been put to increase women's' contribution to sustainable development. According to UNDP (1994) sustainable development is development that not only generates economic growth but distributes its benefits equitably, generates environment rather than destroying it and that empowers people rather than marginalizing them. It gives priority to the poor, enlarging their choices and opportunities and providing their participation in decisions affecting them. Srivastava, (1998) asserts that sustainable development is development that is pro-poor, pro-nature, pro-jobs, pro-women and pro-children.

In Kenya at both grass-root and national levels, more women groups have been formed since the beginning of the 1990s, taking advantage of the new political openings to assert their socio-economic and leadership roles in rural development. They have also advocated for an expansion of women's' development opportunities and the advancement of women's rights in the country. By

improving womens' own positions, they are simultaneously strengthening communities as well as enhancing the country's broader development prospects (Manu, 1998). Pala (1974) demonstrates that women are the major participants in rural economies. However, more often than not, women's economic contributions go unrecognized and their work under-valued.

Dating back to the colonial days, women were encouraged and also mobilized their energies for self and community development. Their tradition for collective and mutual assistance has always been traced within the traditional division of labor framework inherent in most societies. This situation developed women to family roles and performance of other domestic duties. However, most Kenyan women contributed labor on collective basis to fellow women in various development activities. Karega (1995) notes that in African traditional society, women formed welfare oriented associations to assist each other in several aspects such as labour saving activities particularly in farm work. This means that they collectively engaged in rural economic activities. Boserup (1970) argues that women take charge of many agricultural activities and carry out activities such as planting and preparing the land, and harvesting equally with men. They also have extensive knowledge in household and community's needs for the reason that the community's well-being depends on them.

Masinde (1987) shows that women are major actors in development activities in rural Kenya. They dominate in the agricultural sector in most rural areas, a situation created by massive absenteeism of men in those areas. Both traditional and current population dynamics have tended to give a dominant role to women not only in the farming systems but also in other sectors in rural economy. This collective response to needy situations by women has been the driving force behind the formation of informal women groups, which have played a dominant role in the rural economy. However, most of the rural women groups' activities are invisible to the realm of national development. Lockwood (1992) observes that invisibility of rural women activities have been due to informality and the fact that they are headed by women who are supposed to occupy a private domain.

Evidence has shown that group formation and the mobilization of women has to go hand in hand with consciousness raising among men. The achievement of gender equality is not the sole responsibility of marginalized women, men and political leaders (both men and women) must be engaged as champions of equality and women's empowerment (IFAD, 2003). Women's contribution to community development has come about as a result of women's own energetic efforts to organize, articulate their concerns and make their voices heard. However, the growing recognition of women's contributions has not translated into significantly improved access to resources or increased decision-making powers. Neither has the dynamism that women display in the economic, cultural and social lives of their communities through their groups and informal networks been channeled into creating new models of participation and leadership (Manu, 1998). Despite their many responsibilities, women have significantly less access to the resources and services they need to increase their productivity and their income and ease their burden of household duties (IFAD, 2011). It is this situation that women have responded to as individuals or organized entities in an effort to improve their conditions and that of their families by forming groups to articulate their concerns (Budlender, 1999). It is against this background this paper examines how empowerment of rural women through formation of women groups can be a breakthrough to rural development. The paper also gives a critical analysis on the extent to which such groups can mitigate rural poverty situations and how group sustainability of their interventions can be enhanced.

RESEARCH METHODOLOGY

This paper is based on a study conducted between March and June 2013 in Nyamusi Division in Nyamira County located in South Nyanza by Genesis of Development Foundation. The division has three locations namely Magwagwa, Bokeira and Bomwagamo. The main economic activity in the region is agriculture and the climatic conditions are hot and wet. Data collected was both quantitative and the research adopted a cross-sectional survey design, supplemented by qualitative in-depth interviews and participant observation. The design was used because it is suitable for obtaining insights of contributions of women groups in rural development in the Division. Questionnaire and interviews were the methods for data collection from ten formal and fifteen informal women groups. The criterion for selecting the area for study was based on the data available at District beaural of statistics in Nyamira district, which rank the Division as one of the poorest regions in the country prompting international agencies such as World Vision, USAID among others to launch various rural development programmes in the region. The sample was drawn from fifteen registered women groups and thirteen informal women groups in the study area. The unit of analysis was a women group. It critically examines the relationship that exist between Women Groups and rural development and how community-based approaches (in this case-women group) positively impact rural development. The paper concludes by giving recommendations to the government, women groups and other relevant development stakeholders for policy making to promote and strengthen women activities in rural areas.

FINDINGS AND DISCUSSIONS

WOMEN GROUPS AND RURAL DEVELOPMENT

Women make important contributions to the rural economies of all regions of the world. However, the exact contribution both in terms of magnitude and of its nature remain unrecognized hence, often difficult to assess and shows a high degree of variation across regions of the world. Women based groups have played a major role in the process of rural development in their communities in the country. Women groups have played a vital role in the shaping and implementation of initiatives aimed at community progress. Their credibility lies in the responsible and constructive role they play in society. Findings from the study indicate that women have moved from individual levels to formation of groups that address issues that affect them and their communities. This means that when women are in groups they share ideas and come up with various interventions that address community problems holistically. This implies that women groups have a pivotal role in the socio-economic advancement of their rural communities

The groups have made fundamental contributions in their households, and community livelihoods and national development. As a result, women's socio-economic empowerment is increasingly viewed as the most important contributing factor to achieving equality between women and men. The study found that most of the women groups were dominated by women of over thirty five years and forties. Only a few groups had women below 30 years. This implies as women grow old, they realize that there is need to work as a team and through that they can achieve more than working as individuals. Low number of young women in the group was attributed to lack of interest of the group of women in collective activities. They are more individualist in their undertakings. The study found that as women formed groups, these groups have resulted to unity of purpose. This has brought about the necessity for organizing themselves into group by which they set the benefit of collective perception, collective decision-making and collective implementation of interventions for common benefits. The study found that in Nyamusi Division there are two types of women groups, which include formal and informal groups. The two categories of women groups in the Division are discussed below.

FORMAL GROUPS AND INFORMAL GROUPS

According to Gupta & Gupta, (2006) Self Help Groups are significant tools to adopt participatory approach for the economic empowerment of women. It is an important institution for improving the life of women on various social components. It acts as the forum for members to provide space and support to each other. In this study formal women groups refers to a socially and economically group of between 9-20 people voluntarily coming to achieve common objectives. The group formulates formal rules and regulations, a formal organizational structure and leadership that guide their day to day activities and eventually become registered by the District Social Development office. Whereas informal groups are locally formed, informal in nature and operate with informal rules, they are short-lived and their activities are informed by certain situations to address particular problems at a given time and do not last for long. Srivastava (2004) says that these groups start with savings and not with credit, the group then uses its savings to give loans to members to meet their emergency and other needs. The interest rates on the loans are market driven. The members decide on savings per member, maximum size of loans, guarantee mechanisms in loan sanction.

The study found that most of the women groups in Nyamusi Division are informal compared to those women groups that are registered and most groups were formed to improve the livelihoods of the members. The study also found that occasionally some groups were formed to respond to challenging situations such as a prolonged famine, or at times of socio-economic stress. The study revealed that nearly all women groups both formal and informal are in groups of 10-25 people and have a leadership structure. The role of the leadership in many respects is about managing social relations and the management of the day today affairs of the group. The study found that most of the leaders in the women groups were either the pioneers of the group or the most literate. This implies that most of the decision of the group to a larger extent depended on the most literate and founders of these groups.

DEVELOPMENT ACTIVITIES UNDERTAKEN BY WOMEN GROUPS IN NYAMUSI DIVISION

The study sought to understand the development activities undertaken by women groups in the Division. The study found that both formal and informal women groups in the Division engage in various development activities. Figure 1 below gives responses on the type of activities and/or projects undertaken by women groups in the Division.

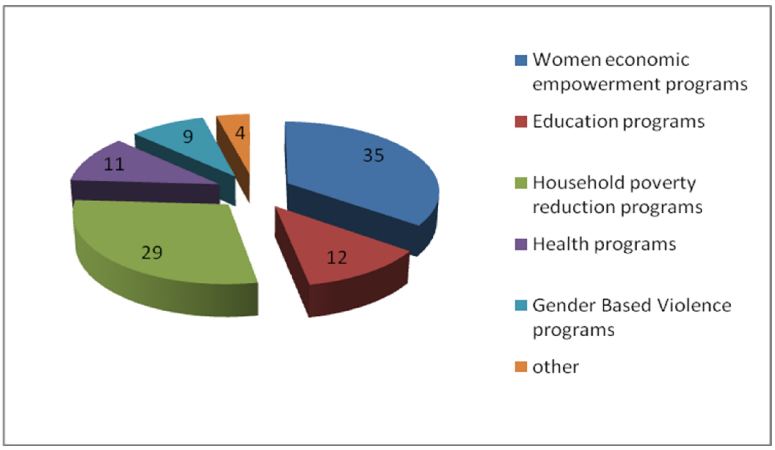

Figure 1: Nature of Development activities Undertaken by Women

Analysis in Figure 1 above shows that 35% of women groups in Nyamusi Division pursue women economic empowerment programs, 12% of the respondents said that women groups are undertaking education programs, 29% of women groups are engaging in household poverty reduction programs. Eleven percent of the respondents said that women groups are implementing health programs, 9% argued that women groups are undertaking Gender Based Violence (GBV) programs, whereas 4% of the respondents said that women groups in the Division are pursuing "other" projects in an effort to enhance rural development.

ECONOMIC EMPOWERMENT PROGRAMS

Analysis from the above data shows that women economic empowerment programs (35%) are the major initiatives by the women groups in Nyamusi Division. To overcome the economic challenges in the Division, women have formed groups to mobilize resources to foster rural development in the region. Some of the activities they engage in include Merry-go rounds, as an avenue for women to raise funds for their personal and group activities. In this case women contribute finance periodically and the amount is given to group members to initiate projects or activities to generate more income. A chairperson for a women group narrated that:

Ebieombe biakonyire abang'ina abange aiga Nyamusi. Etogosangereria chibesa twaa oyomo ogenda gokorera amaitachi aye. Meaning that women groups have assisted many women here in Nyamusi, we collect money and give one of our members to address her problems (Female, 39 years).

This implies that through women groups, members are able to access funds to address their challenges and those of their families. This has enabled many women to meet their familial needs and as a result improve their socio-economic wellbeing and their communities.

HOUSEHOLD POVERTY REDUCTION PROGRAMS

The study further found that household poverty reduction programs (29%) were other initiatives by women groups in the area of study. The women are committed to alleviate poverty among many households. The study established that some women have organized themselves into groups to contribute money and purchase utensils, cows, and furniture among themselves. Through these initiatives most women have met household needs. For instance, one member of a group during the study said that:

Our group has assisted members to acquire basic life needs. The women contribute little money to build modern houses and buy household commodities. Through this initiative living standards of women have been enhanced (Female, 34 years).

This implies that access to household essentials has enabled women in the area of study to reduce poverty rates through availability of food, household items and other basic facilities in their homes. The study also revealed that those women groups who engaged in education programs (12%), participated in various activities such as advocacy, awareness and fundraising through Merry Go Rounds to enable them educate their children at the same time informing the community the importance of educating their children. Due to high poverty rates, most women prefer joining groups to assist mobilize resources to support children through secondary and post secondary education.

CAPACITY BUILDING AND TRAINING

For women groups to achieve their objectives and goals, they need empowerment on various issues. Empowerment can be conceptualized as a process of enabling people to gain strength, confidence and vision to work for positive changes in their lives, individually and collectively, with others (Mulwa, 2010). People become empowered by their own efforts, not by what others do for them. The study found that some women groups in collaboration with other national or international organizations, organize expert trainings for their groups and community members on various issues such as business management, business plans, human rights and other aspects of human development, which are fundamental to not only women lives, but also to the whole community.

Women groups' leaders interviewed during the study argued that some women groups who are trained on various issues have taken a leading role in enlightening community members on the importance of equal education access for both boys and girls. They also train the community on the effects of some cultural practices such as Female Genital Mutilation (FGM) on the survival and development of a girl child. The study found that when women came together as a group it led to growth of awareness, capacity building, education and availability of information, which has led to confidence building among themselves. This has helped them to initiate various successful programmes that have addressed various social issues in their communities including early pregnancies, drug abuse and alcoholism and HIVAIDS. These findings are supported by Subbovao and Ronney (1983) who notes that education and training both formal and informal are among the most important determinants of women involvement in development.

HEALTH ACTIVITIES

The study revealed that women groups also engaged in health initiatives (11%) in Nyamusi Division. The most mentioned health initiatives were HIV/AIDS, nutrition, and hygiene. Women groups participated in raising awareness on the effects of HIV/AIDS to the households and the community as a whole, the importance of good nutrition to children and families and how to maintain proper hygiene and sanitation in their families and communities. Some of the key informants who were also leaders in the groups said that some of the groups have initiated projects such as construction of modern toilets in schools and their communities. They have also launched water borehole projects in most households in the Division to promote use of clean and safe water. A woman leader interviewed during the study said that:

Besides economic empowerment most women groups have taken the initiative to address health challenges of members through community mobilization, health and behaviour change trainings in their communities (Female, 47 years).

The study also established that women groups undertake Gender Based Violence (GBV) programs (9%) in the Division. These initiatives help to inform women about their rights and how to respond to human rights issues. They are therefore able to device necessary steps to be followed when responding to human rights violations.

LIVELIHOOD AND FOOD SECURITY

Data from focus group discussions in the study area revealed that rural women often manage complex households issue and pursue multiple livelihood strategies in their groups to enhance their survival and well being in their families. Women groups also participate in other initiatives aimed at improving their socio-economic welfare in the community. One of these initiatives is food security and livelihood activities. The study found that women groups form sub-groups which also address specific issues affecting their communities such as food insecurity and livelihoods. Their activities include producing agricultural crops, tending animals, processing and preparing food, working for wages in farms, collecting fuel and water and engaging in trade and marketing. The study also found that women groups encourage members to save money in the groups for future use.

From the foregoing discussions, increased women group participation and involvement in rural development activities helps to improve the quality of services. Members of the women groups are encouraged to develop a saving habit, which in turn, increases the self confidence level of the women. As such, women groups promote a sense of solidarity and cooperation among the group members impacts positively on education, health and other development programs as a result, rural development.

UNDERLYING CONSTRAINTS AMONG WOMEN GROUP

The study was also interested to understand the challenges that women groups in Nyamusi Division face in their attempt to foster rural development. Figure 2 below shows their responses.

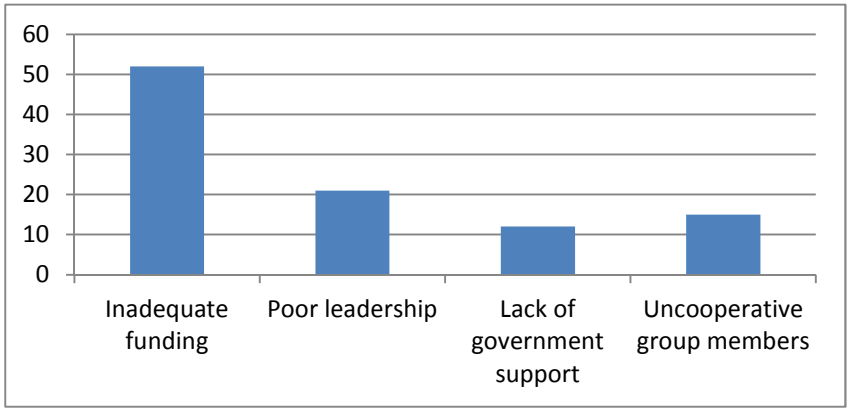

Figure 2: Challenges facing women groups in Nyamusi Division

As shown in figure 2 above, 52% of respondents argued that inadequate funding is the main challenge facing women groups in Nyamusi Division. For instance a key informant and a woman leader in a group argued that:

Poverty compels some women to leave the groups especially merry-go rounds. Therefore, this affects organization's productivity and attainment of poverty alleviation goal for the women groups (Female, 43 years).

This phenomenon is attributed to high poverty levels in the division which, hinder women groups from effectively supporting development initiatives in their regions. The analysis in figure 2 above indicates that poor and weak leadership is one of the challenges facing women groups in the Division as reported by 21% of the respondents. The study found that a few powerful community members can take advantage of the poor and weak leadership structures. Once a women group is formed, it is only a few members with vested interests who benefit most. This group takes advantage of the illiterate members (who are used as rubberstamp), collect funds from other members, take a big loan themselves and default. As one respondent said:

The study revealed that some women groups do not deliver as they promise as most of the Merry Go Round funds do not benefit all the members as some members become defaulters before all others benefit from the fund (Female, 38 years).

From the above evidence, it is clear that this is the reason why most women in the rural villages in the Division do not join women groups. This implies that despite the fact that these funds are owned by the group, defaulters create many problems. For instance, the groups are in most cases not in a position to effectively monitor how well the women groups' leadership deals with defaulters. This is because in most of the groups, many people are illiterate and even for literate people understanding the financial status of the group from the secretarial records is often difficult. The study found that in most informal women groups, mostly only one person is literate. For example, it is the secretary who is literate to handle secretarial assignments for the group.

The study further established that most leaders in the women groups have inadequate management skills since they have either primary or secondary education as their highest academic qualification with fewer opportunities in leadership and management trainings. This hinders women group coordination of activities, which in turn affect achievement of set group goals. Out of the twenty five key informants (women leaders) interviewed, twenty one had primary education while only three had secondary education and only one had post secondary education. A key informant narrated that:

Abarai abange mbachieti sukuru. Abande tibamanyeti korika.Chibesa echigosira ase engencho tibamanyeti waaka sabu (Female, 35 years).

Meaning that many leaders are not educated and don't know to write, the money gets lost because they don't know arithmetic.

The above evidence shows the extent to which women groups in the Division have leadership challenges. This implies that where leaders are not learned, groups' development and prosperity is affected negatively. For instance, loss of finances

affects the operation of such groups, which may lead to dissolution of some of these groups hence, deterring rural development. The study also revealed that in some women groups, members are uncooperative (14%).This challenge was attributed to the nature of leadership and education level of group members. It was evident that lack of management skills can drag a group into problems because leaders may be unable to influence their followers, make sound decisions pertaining group activities, and how to amicably resolve disputes in a group. Groups also delay in implementing their initiatives. This creates environment for criticisms from members resulting to disharmony in the group.

LACK OF GOVERNMENT SUPPORT

Thirteen percent of the respondents attributed lack of government support as one of the problems affecting women groups, the study found that, despite the government's effort on ensuring funds for women initiatives are available, through institutions like Women Enterprise Fund and Uwezo Fund to empower women economically throughout the country, the uptake is still low due to lack of information and awareness among women. This is partly due to low levels of sensitization and awareness among women groups. Besides, women groups lack recognition by the government particularly for those groups that are not formally registered by the relevant government bodies.

SOCIO-CULTURAL FACTORS

Most women in developing countries are economically disempowered and women in the study area are no different. In spite of their important contributions to rural development, women suffer from various constraints, which inhibit them from fully realizing their potentials for development. Cultural norms and practices have partly contributed to subordination and women's' low economic profile in society where men are perceived as the controllers of economic assets and decision makers. During focus group discussions with selected women group members, it was revealed that some socio-cultural values and norms hinder the participation of women in rural development in their communities. The study found that their reproductive role in the family and the community puts women in a disadvantaged position to engage in entrepreneurial activities. Additionally, women are not allowed by their men counterparts to own properties, thus, become a challenge when they want to have long-term investment for their livelihoods. Similar to the study's findings, from the literature review, Cohen (2006) opines that societal beliefs continue to hinder progress in women's empowerment in many parts of the developing world. Moreover, some legal provisions and legislative systems make it difficult for women to take initiatives for business development especially when collateral security is required to access finance for projects. The study also found that there is unequal access to productive resources and services, including finance and capacity building opportunities.

The authors perspectives from the above findings is that socio-cultural factors bring about gender imbalance in rural development given that women's status in development remain unrecognized, besides some legal provision become and impediment to women's development in the society. Therefore, there is need to sensitize the community on women's role in rural development and stream gender perspectives into development policies at all levels and in all sectors in order to strengthen women's participation in rural development.

LEVEL OF ACCESS TO INFORMATION

The study found that the level of women's access to information was low and therefore, women are not as empowered as their male counterparts or are totally disempowered. Even though women groups have devised interventional strategies in various ways to promote rural development, the greatest challenge is that they do not access current information to spearhead rural development. This is attributed to unreliable communication by the concerned stakeholders.

HOW CAN WOMEN GROUPS BECOME MORE EFFECTIVE?

PARTICIPATION AND INVOLVEMENT IN RURAL DEVELOPMENT

Observations made during the study shows that allowing all women in their groups to participate in their projects and supporting them educationally, financially and guidance in developing community owned programmes, it helps in promoting rural development. The study found that for most of the projects led by women groups and which significantly involved their women members right from the start of the project to the end, they ended up being the most successful in their interventions. The authors argue that development initiatives do best when a woman's role and needs are factored into programme design right from the beginning of the project to the end.

SUSTAINABILITY

From the findings of the study, it was evident that most of the women groups are short-lived thereby do not live long enough to make impact on the lives of members of the community. Therefore, lack of sustainability of women group initiatives hinder the scaling up of successful interventions to the rest of the community. In a nutshell, there is need to ensure that efforts to strengthen women's groups result in lasting and viable interventions that address community problems. Women groups empower its members to identify their needs, plan and implement their own projects, share the benefits of their collective efforts and evaluate their interventions. Women groups can establish various interventions that are aimed at improving their livelihoods and wellbeing in their communities. For instance, they can practice activities such as collective marketing, bulk purchasing, group lending and capacity building programmes.

FROM INFORMAL GROUPS TO FORMAL GROUPS

The study found that formal women groups had initiated various community interventions; this was attributed to the access of other finance opportunities other than group savings. This is because micro-finance institutions recognized registered women groups and were comfortable to lend them money which they could repay back in small installments unlike informal women groups which depended only on group contributions which was not enough to initiate many projects. This paper argues that for groups to be sustainable they need to move from informal groups to formal groups to give them an added advantage to access other finance opportunities from micro-finance institutions for their activities to spur sustainable development. As Manjunatha (2013) asserts, linked not only to banks but also to wider development programmes, women groups are seen to confer many social and economic benefits. Therefore, women groups enable women to grow their savings and to access the credit which banks are increasingly willing to lend.

CONCLUSION AND RECOMMENDATIONS

Despite broad recognition that women's improved capabilities and welfare through groups are strongly linked to rural development, women groups in the country and particularly in the study area are lagging behind in terms of rural development and do not receive the necessary support from the various relevant stakeholders in pursuing rural development related tasks. Their development efforts are hampered by gender inequalities, lack of participation and involvement negative socio-cultural values and norms and unequal access to finance opportunities for development. This paper concludes that empowering women groups in rural areas is critical in promoting sustainable rural development for the reason that rural interventions in communities have the advantage of positive effect on local living standards. If given opportunity, women have the potential to change their own socio-economic status as well as that of the communities in which they live in. The authors accentuate women groups as effective instruments and pathway to rural development. Once women groups have sufficient solidarity, experience and unity of purpose in their undertakings, rural development is achieved. This paper not only recommends policy frameworks that not only promote community-based approaches to rural development, but also encourages sustainability and equal participation and involvement of both genders as well as put in place monitoring frameworks to strengthen the activities of women groups.

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FLOODING AND TRAFFIC MANAGEMENT IN AKURE (NIGERIA) METROPOLITAN ENVIRONMENT

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ABSTRACT: In order to extend areas usable in cities, migrants to cities, often reshape the natural landscapes in various forms. In some cases, they reduce hills, reclaim beach regions, fill valleys and wetlands, and sometimes encroach on river valleys not minding the consequences on the environment. These cultural ways of increasing usable lands have some negative impact on the urban physical environment. The major negative impact is change in the micro-climate of urban environment which manifest in various forms including flooding. Based on the above impact, the paper identified the consequences of flooding in Akure and determines ways by which its menace on traffic congestion could be reduced. Structured questionnaire was administered to residents of Akure living within 200 meter radius to areas where flash flood had been witnessed. Result shows positive correlation between flash flood and traffic congestions in the city. Similarly, accident rates were found to increase during heavy downpour in many of the flood hot spots as many vehicles struggle for right of way. Flash flood on traffic corridor was noted to influence numbers of stranded vehicles in the pool of water. The paper recommends regular clearance of drainages at the on-set of rainy seasons especially in areas prone to flooding. Property developers should ensure that gutters are provided in newly developed areas of cities. The paper also advocated the creation of environmental awareness through both formal and Informal forms of education on how to dispose solid as the hallmark of managing traffic in flooded environment in the study area.

KEYWORDS: landscape, traffic corridor, flash flood, drainage system, urban managers.

1 INTRODUCTION

Natural disasters are unexpected sudden events which impacts with such severity that it is usually disastrous and uncontrollable whenever they occur. They could cause widespread destruction of properties, lives, displacement of people, animals and aquatic life wherever they occur. A natural disaster might be caused by one or more of the following: earthquake, flooding, tsunamis, land submergence, tornadoes, typhoons/hurricanes/willy-willies, smog and the likes. However, in order to be classified as a disaster, it must have profound environmental effect and human lost.

A flood is an overflow of an expanse of water that submerges lands. In a simple language, flood means a temporary covering by water of land not normally covered by water. Flood occurs when excess water fails to flow in any definite channel but spreads over land that is normally dry. Flooding may also result from the volume of water within a body of water, such as a river or lake which overflows or break levees, with the result that some of the water escapes its usual boundaries (Ayoade, 1983).

When rain falls, there are three (3) ways by which the water is disposed off. The first one is through percolation; the second is through surface runoff while the third one is through evaporation/evapo-transpiration. When the intensity of rainfall is very high, there is little or no time for the rainfall to percolate. Thus, the surface run-off water becomes greater than the water that percolates. It is this, in most cases that lead to flooding in some urban environment. If the duration of rainfall is elongated than usual, the flood becomes devastating and hazardous to people who live very close to river course or channels.

Some of the most notable flood disasters include:

- The Great Flood of 1931 in Huang-He, China claimed over 800,000 people.
- The 1998 Yangtze River Floods in China left 14 million people homeless.
- The 2000 Mozambique Flood covered much of the country for three weeks, resulting in thousands of death and leaving the country devastated for years afterwards.
- The 2010 Pakistan Floods, damaged crops and infrastructures and claimed many lives.

In Nigeria, there has been several reported cases of flood problems in cities such as Lagos, Port Harcourt, Uyo, Warri, Benin, Aba and so on but the chronological view of flood events in Nigeria include the following, Asa flood at Ilorin in 1976, Lisaluwa and Arogo flood in Ondo in 1988 and 1995. The serious and repeated flood disasters of Ogunpa River in Ibadan in 1978, 1980, 1981, 1985 , 1987 and 1988; Osun River flood in Oshogbo in 1992, 1996 and 2002. The Yobe River flood in 2000; River Ala flood in Akure in 1996, 2000, 2002 and 2004; Lagos flood in 1984, 1988 and 1995, Kano and Dekina floods in 1988, Lafia , Patigi, Kpada and Gbogbondogi floods in Kwara State in 1997, Indiegore flood of 1981 and 2012 in Aba as well as Jos, Gombe, Kaduna and Bauchi floods in 2013.

Apart from Yobe's flood (2012) which was caused by breakdown of a dam, three other dam bursts have occurred in Nigeria, resulting in disastrous floods and these are;

(a) Ojirami Dam in Edo State (1981)
(b) Bagauda Lake Dam in Kano State (1988)
(c) Goronyo Dam in Sokoto State

The dam burst flooded the roads, settlements and farms, thus causing a lot of hardship to the immediate neigbours of such dam sites.

Traffic management is a technique designed and used to promote efficient vehicular and non-vehicular movement in any geographical space. Unfortunately, traffic management has been noted to constitute most daunting problems faced by highly urbanized cities of developed world, whereas some cities of developing world had to contend with urbanization problems in relation to traffic congestion (Ogunbodede and Aribigbola, 2003 and Ogunsanya, 1994). According to Ogunbodede and Aribigbola (2003), a number of factors have been responsible for the precarious traffic problems on roads. Such traffic problems range from inadequate transport facilities, gross inadequacies of public transport services, accidents, poor road infrastructure to environmental pollution and absence of integrated traffic management measures to combat congestion. Today, the rapid development of cities coupled with the fact that drainage facilities are not often developed almost immediately as new areas are developed has introduced another dimension into traffic problems in urban environment. Flash floods often take over the traffic corridors in the new areas of cities thereby unleashing hardship to motorists as well as dwellers in such environment.

In the analysis of vehicular concentrations on roads, Omiunu (1988) applied the index of percentage of vehicular concentration on some selected roads (25rods) in Benin –City (Nigeria) using the formula: IVC = TVM/TVY *100/1. Where IVC = Index of Vehicular concentration, TVM = Total Vehicle of Traffic per Month and TVY = Total Vehicle of Traffic per Year. Both TVM and TVY were based on peak hours from 7.30 – 8.0 a.m., 12.30 – 2.30 p.m., and 5.30 – 7.30 p.m. The formula according to Omiunu (1988) was adapted from Winifred Ashton's work on theory of traffic flow. This model has no serious application to travel demand modeling but was very relevant in determining vehicular concentration on roads of which floods played significant roles.

Dam failure can also lead to flooding especially in some agricultural regions or in regions that are very close to banks of river valley. This occurred in Nigeria when a dam was opened in Cameroun and the banks of River Benue were flooded up to Lokoja in year 2012. Vehicles going to Abuja from the southern part of the country had to be ferried on roads after about three days of inaccessibility through the major trunk connecting the southern part of the country to the northern part.

2 STATEMENT OF PROBLEMS

In contemporary time, flooding has become a common feature and part of life in Nigeria not only in the low-lying coastal areas but also in the wetland regions as well as the hinterland. The growing population and rapid urbanization processes, for example, has exerted pressure on available lands to the extent that a larger proportion of river basins have been encroached upon by people.

The poor drainage system and the attitude of people using such drainage as dump sites have led to blockage of drains. The consequences of this attitude are that the run-off water finds its ways on the major roads there by resulting in flooding.

These floods not only constitute an obstacle to free flow of traffic but many vehicles get stranded once such water enters into their engines.

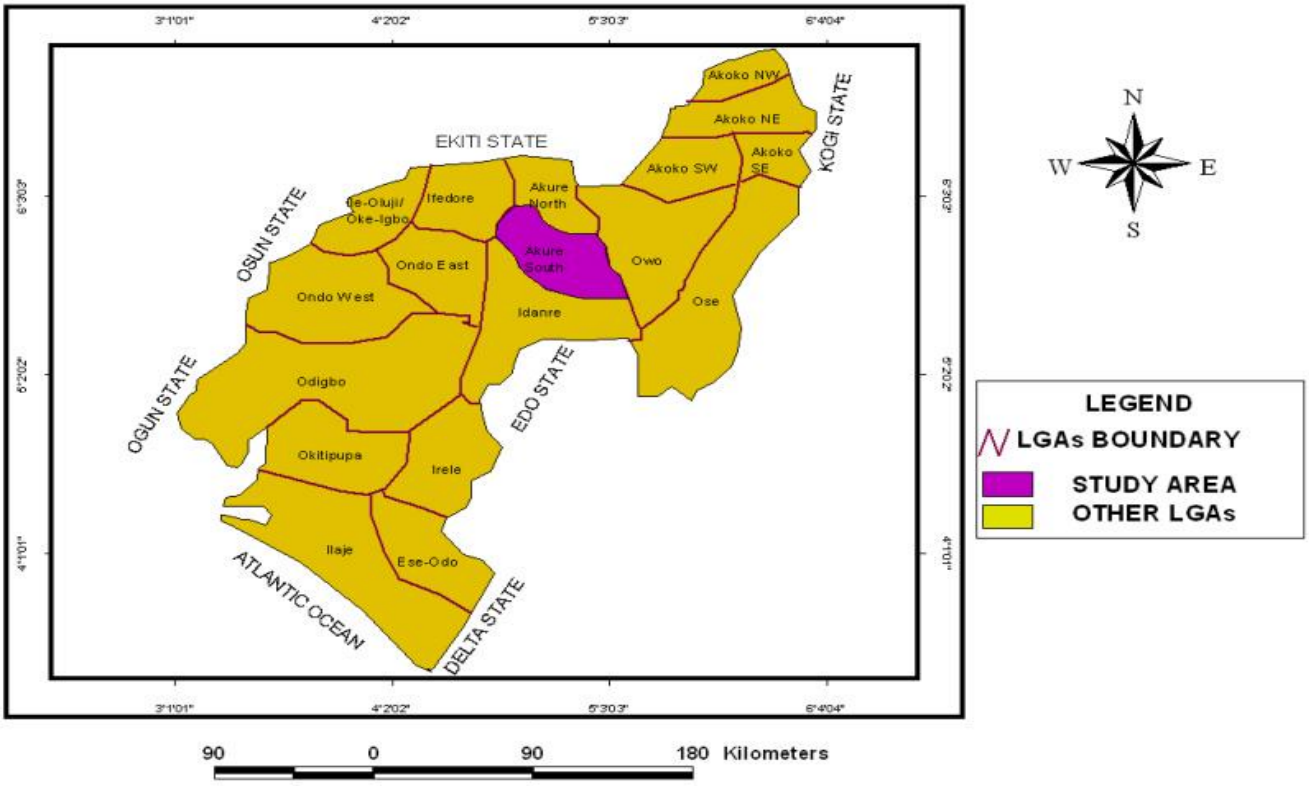
Flooded roads and broken down vehicles make journeys to be delayed. Commuters therefore get stranded and in most cases their journey time from home to place of work or other places in the urban environment are unnecessarily prolonged. Similarly, the aftermath of flooding is also felt in terms of loose soils and other debris that are deposited on the roads after flood. Apart from making affected roads to be dirty, they sometimes harbour sharp objects that may deflate tyres thereby causing untold hardship to motorists.

Most, if not all, environmental problems that we currently face can be directly or indirectly traced back to the legacy of lifestyles that we inherited and leading as human beings. Nowhere is this more correct than in the concentrations of human beings in urban environment. Cities and towns in most countries around the world have gained considerable attention due to the large number of migration to such cities and as a result, such high populations have always placed high pressure on their sites and their immediate hinterlands. In order to extend urban usable territories, urbanites often reshaped both natural and cultural landscapes involving the leveling of hilly areas, filling valleys, reclaiming beaches and putting wetlands into usable and profitable ventures, thus, creating huge areas of manmade land in urban areas. Structures of different magnitude occupy this new land irrespective of whether such lands have the capacity to sustain such structures or not. This is why Oriola (2000) and Sewel (1969) also confirmed that, though floods are purely environmental hazard of meteorological phenomena, very often they are induced by man's improper utilization of or abuse of the physical environment.

In view of the foregoing, this paper **aims** at identifying the consequences of flash floods on roads and traffic management in Akure Metropolis.

3 THE STUDY AREA (AKURE)

The study area is Akure, a rapidly developing metropolitan city. The city lies in the South-western part of Nigeria (Figure 1). Geographically, Akure lies approximately on 7^0 15^1 North of the Equator and Longitude 5^0 12^1 East of the Greenwich Meridian. Akure is currently the Capital city of Ondo State as well as Local Government Headquarter.



The city has had rapid population increase and space use over time because of its numerous roles in the sub-region. Such roles include being the central of economic activities, religion and cultures, commerce and industries, educational centres, Government seat, central of hospitality and headquarters of corporate organizations. With all these attributes, the city's morphology has changed over time to assume its present status with lots of transport problems.

River Ala and its tributaries are the major rivers that drain the city. The rivers have their annual floods which are very conspicuous in the wetland regions of the city. However, the flash flood which is a common phenomenon of the river has unleashed untold hardship on motorists and commuters during rainy seasons. In some cases, roads are made impassable while in other cases it elongates travelling hours.

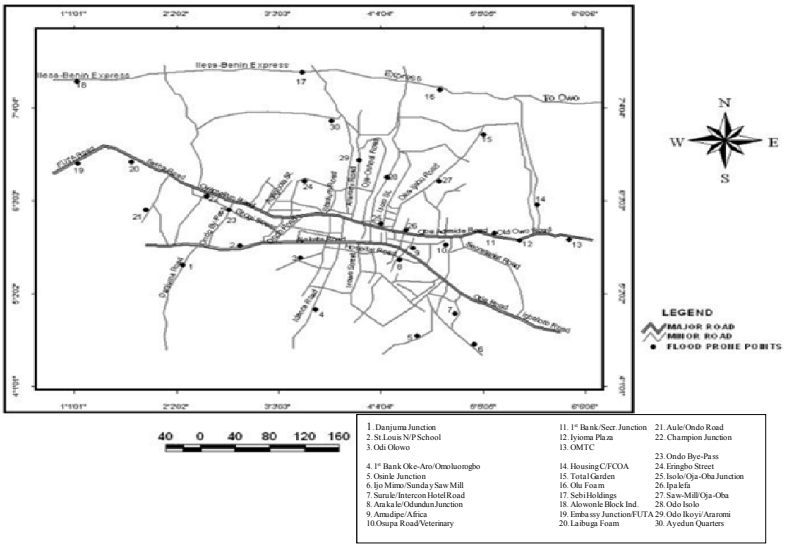
4 METHODOLOGY

The areas prone to flooding as well as wetland regions were identified through a reconnaissance survey in the city of Akure within a radius of about 10kms from the city centre. The streets were identified and mapped. About thirty (30) prominent flooded portions of these roads were identified and mapped (see Figure 2). Structured questionnaire to elicit information from respondents living within a 200metres radius to areas liable to flood were developed.

Data needed for the study and which were collected from the respondents include street names, nature of environment, nature of gutters, width of gutters, depth of gutters, nature of drainage during rainy seasons, waste disposal methods in the environment, causes of flood in the environment, consequences of flood in the environment with particular reference to road traffic and solutions to floods in the environment.

Data needed as specified above were collected using both primary and secondary methods of data collection. Purposive sampling method was used to sample ten hot spots where flash flood is said to be very prominent in Akure and these areas are Ipalefa, Odo Ijomu, Odo Isolo, Odo Ikoyi, Odo Araromi, Champion Junction, Oja Isikan, Ijala Kekere, Oja Adedeji and Ala close (figure 2). Fifteen copies of the designed questionnaire for this study were randomly administered in the ten (10) identified hot spots of the flooded zones in the environment. The target respondents are people living within 200metres radius within the vicinity of flood conflicts points. In all, a total of 150 copies of the questionnaire were administered in the study area.

Figure 2: Flood Prone Points along Major Roads in Akure



The second aspect of primary source was carried out by measuring areas occupied by flash floods as well as the depths and width of gutters in the flooded zone. Similarly, photographs of the affected areas were taken at different times and points. The topographical map of Akure was also used to identify the low and wetland areas.

Descriptive statistical method was used in summarizing responses on flooding and traffic congestion characteristics in Akure. Respondents perception on causes of flood, flood problems and surface run-off in the study area were identified.

Respondents were given options ranging from “Strongly Agree” ” (SA), “Agree” (A), “Disagree” (D) and “Strongly Disagree” (SD) from which to choose. The 4 point scale response was used to calculate the weight attached to SA, A, D and SD. The Mean Weight Value (MWV) were calculated from these order and compared with Group Arithmetic Mean (GAM) to determine acceptance or rejection of a problem items for taking decision (see Ogunbodede, 2009). Correlation analysis was then used to determine the relationship between width and depth of gutters and its implication on flood.

5 RESULTS AND DISCUSSIONS

DRAINAGE CHARACTERISTICS IN THE STUDY AREA

It was observed in the study area that about 36.57% of the built up areas have no gutters while the width of gutters between 31 and 90 cm carries a percentage of about 55.97% as shown in Table 1. A substantial part of the areas without gutters are found in the newly developed regions of the city. Thus, flash floods occur frequently in the city areas where there are no drainage system as well as areas with narrow gutter as soon as there is little downpour of rain in cities.

Table 1: Width of gutters in the study area

Width of gutters (cm)	Frequency	percentage
1 – 30	3	2.24
31 – 60	40	29.85
61 – 90	35	26.12
91 -120	01	0.75
121 – 150	06	4.48
No gutter	49	36.57
Total	134	100

Similarly the depth of the gutters in the study area shows that 36.57% of the areas had no gutter hence majority of the surface run-off has no channels to direct floods (see Figure 2). The implication is that all waters in the new areas are channeled on the traffic corridors thereby creating problems for road traffic management.

Table 2 : Depth of gutters in the study area

Depth of gutters (cm)	Frequency	Percentage
1 – 30	02	1.49
31 - 60	29	21.64
61 – 90	11	8.21
91 – 120	38	28.36
121 – 150	01	0.75
151 – 180	04	2.99
No gutters	49	36.57
Total	134	100

- **Causes of Flood in Akure**

Table 3 reveals that, the intensity of rainfall with a MWV of 3.769 ranked first among the cause of flood especially when it is high with little or no time for percolation, this is followed by dumping of refuse with a MWV of 3.291 into the gutters as perceived by respondents. However, the respondents did not accept anger of God with a MWV of 1.813, inadequate storm with a MWV of 2.694 and impervious urban surfaces with a MWV of 2.619 as important causes of flood in Akure. Although these factors were not significant as major factors causing floods but they have been very contributory as noted by respondents in the study area.

Blockage of drainage by sands is also noted to be one of the ways by which traffic corridor get flooded**.** The granitic rock which is the parent rock we have in this country is very loose and easily movable. With time, these loose soils accumulate in the drainage (gutters, culverts etc) and after sometimes too, start to block the drains. Blocked drainage system hampers smooth movement of water during rainy season. Since water must take its course, the surface run-off finds alternate routes thereby flooding the roads as well as houses (Odermerho, 1988).

Table 3 : Causes of flood as perceived by respondents

S/no	Statement items	Strongly agreed	agreed	disagreed	Strongly disagree	total	Mean Weight Value	Decision	Rank
1	Rainfall	456	42	02	05	505	3.769	accepted	1st
2	Anger of God	76	39	52	76	243	1.813	rejected	7th
3	Building along water flow path	144	153	20	37	354	2.642	rejected	4th
4	Impervious urban surfaces	116	177	24	34	351	2.619	rejected	5th
5	Inadequate storm drains	160	138	30	33	361	2.694	rejected	3rd
6	Dumping of refuse in drains and drainage paths	312	90	26	13	441	3.291	accepted	2nd
7	Concretization of urban surfaces (roads and buildings)	124	81	48	52	305	2.276	rejected	6th
	GMWV = 2.729								

Blockage of drainage by household wastes is one of the ways by which Nigerians have contributed to flood occurrence in our environment. Each time rain falls, you find children and adults emptying their household waste into the drainage. These wastes block the drainage and the surface run-off increases thereby flooding the roads and houses. It becomes difficult sometimes during this period to drive because sharp objects which sometimes accompany such wastes could deflate tyres. Houses that are constructed on low terrain are worst hit by flood because they easily get flooded. Table 3 reveals that dumping of refuse into gutters is an accepted cause of flood in the study area and ranked second as perceived by respondents with a MWV of 3.291.

Building close to river valley makes such structure highly susceptible to flooding. Thus**,** any street or buildings that are very close to river banks stand the risk of experiencing annual flood. This is because water must definitely take their normal course. In the same way a flooded valley allows water to encroach to its adjoining environment and any structure on its way becomes the first casualty. This factor ranked 4th among the causes of floods even though it was rejected by respondents as an important factor using GAMV.

PLATE 1: Flood has taken over this street and evidences of no vehicular movements are obvious

Another major factor influencing flood occurrence in cities is drainage failure. It is very common to find drainage system that are no longer functioning or had failed without attention being paid to it. In such circumstances, the flooded water makes use of the traffic corridor instead of the drainage and this affect free flow of traffic in urban environment as shown in Plate 2.

Another reason for flood occurrence is the absence of drainage system. As much as possible landlords must make provision for proper drainage system that will take care of not only the waste water in the house but also the surface run-off emanating from torrential rainfall.

PLATE 2: Pictures of Flooded road and traffic built-up

6 CONSEQUENCES OF FLOOD ON TRAFFIC MANAGEMENT

Table 4 shows the major consequences of flood in traffic management and the environment. Damage to landed property ranked 1st with MWV of 3.701 and this was followed by the following: clogging of drains (3.649), sediments build-up on the road (3.642), traffic congestion (3.612) and damage to household properties (3.604) which were all accepted with MWV greater than GMWV of 3.582. Others factors as far as this study is concerned fell below GMWV and so were rejected as not too important consequences of flood in the environment.

Table 4: Flood problems in various Land use zones in Akure as perceived by Respondents

S/no	Statement Items	Stongly agreed	Agreed	Disagree	Strongly disagree	Total	Mean Weight Value	Decision	Rank
1	Damage to landed property	404	84	06	02	496	3.701	accepted	1st
2	Damage to household property	344	132	06	01	483	3.604	accepted	5th
3	Business slow down	332	120	18	02	472	3.522	rejected	6th
4	Traffic congestion	364	102	18	0	484	3.612	accepted	4th
5	Clogging of drains	356	129	4	0	489	3.649	accepted	2nd
6	Accidents on the roads	296	117	28	07	448	3.343	rejected	7th
7	Sediments build up on the road	380	99	6	3	488	3.642	accepted	3rd
	GMWV = 3.582								

- **Surface water run-off and road traffic management**

It has been noted in another study that surface run-off on traffic corridor inhibits smooth traffic flow in cities (Ogunbodede, 2004 and Ogunsanya, 2002) and sometimes lead to road accident. Table 5 shows respondents' perception on the implications of surface run-off on traffic corridors. The most prominent of these factors was that, urban surface run-off in most streets was through open gutters and this accounted for a MWV of 3.276. Next to this, is that, road surfaces in the study area serve as disposal channel for floods in some streets with a MWV of 3.276. The implication of this is that such flash floods on traffic corridors impede smooth movement of vehicles on the road thereby leading to congestion. In some cases it may lead to accident especially when vehicles rush to escape flooded zones. Others factors in descending orders are as shown in table 5.

Table 5: Respondents' Perception of surface run-off in the study area (Akure)

S/no	Statement items	Strongly Agreed	agreed	disagree	Stongly disagree	total	Mean Weight value	decision	Rank
1	The road surface serves as a disposal channel for floods in my street.	300	63	76	0	439	3.276	accepted	2nd
2	Urban surface run-off disposal channel in my street is mainly open gutters	212	228	10	0	450	3.358	accepted	1st
3	Urban surface run-off disposal channel is barely open	192	213	24	3	432	224	accepted	3rd
4	Urban surface run-off disposal channel in my street is mainly through road surface	228	102	80	3	413	3.082	accepted	4th
5	Urban surface run-off disposal channel in my street is mainly covered gutters/drains	240	81	46	24	391	2.918	rejected	5th
6	Concretized surfaces increase surface run-off	112	102	28	58	300	2.239	rejected	6th
	Grand Mean weight value (GMWV) = 3.016								

Other factors which were not significant as important factor since they did not meet the cut-off point of the GMWV are items 6 and 7. This shows that urban surface run-off disposal channels are not covered in most areas covered by the study. The study also shows that respondents do not believe that concretized surface increase surface run-off. Even though this factor was rejected as important factor in flood formation, it was however noted to be a contributory factor.

A correlation analysis was carried out between width of gutter and depth of gutter to determine their influence on flood formation in the study area. It was discovered that correlation (r) between width of gutter and depth of gutter is 0.679 (see Table 6). This is a positive correlation which was significant at 0.01 level. The coefficient of variation (r^2) is 0.46, thus

percentage of variation is 46%. This therefore shows that the depth of gutter in all the zones has 46% influnce on the width of the gutter in the smooth flow of surface run-off in the study area.

Table 6: summary of Pearson correlation between width of gutter and depth of gutter

	Width of gutter	depth of gutter	length of street
width of gutter pearson correlation	1	0.679**	0.263*
significant (2 - tailed)		0	0.015
N	85	85	85
Depth of gutter pearson correlation	0.679**	1	.334**
significant (2 - tailed)	0		0.002
N	85	85	85
Length of street pearson correlation	0.263*	0.334**	1
significant (2 - tailed)	0.015	0.002	
N	85	85	121

**Correlation is sig. at the 0.01 level (2-tailed)
*correlation is sig at the 0.05 level (2-tailed)

7 MEASURES TO REDUCE FLOOD MENACE ON TRAFFIC CORRIDOR IN URBAN ENVIRONMENT

One thing we should note is that absolute control of floods is impossible rather partial control in form of protection is achievable Two feasible measures for combating flood menace in man's environment according to Oriola, (2000) *is flood prevention/abatement and flood protection.* Flood abatements/preventions are efforts geared towards the management of the water shed or river catchments zones, river bank stabilization and adherence to land use practices.

- **Flood Prevention:** Flood protection is carried out to control flood and minimize the damage it causes by regulating its flow or diverting it away from where it could damage properties. This measure, according to Oriola (2000) includes construction of flood walls, dykes, dams and reservoirs, channel improvement and dredging.
- **Discourage dumping of refuse into gutters:** This study shows that a very high proportion of people living in the study area still dispose off their refuse into the gutters especially when it is raining. This method aggravates flooding that often leads to flooding of streets. This attitude should be changed and the people educated on how to properly dispose their wastes.
- ***Channelization****:* Channelization is one of the major ways by which flood could be controlled in the study area. The river valley as well as gutters channeling water should be properly monitored during rainy seasons to ensure that they are not blocked in any way. Free movement of water in these channels will reduce flood occurrence during the peak of rainy season
- ***Town planning laws*****:** Set-back laws must be enforced for all structures close to the banks of river valley in urban areas as much as possible. A set back to streams for any structure is about 20 meters in low-density residential areas and not less than 30 meters in high-density areas.
- ***Reduction in concretization of urban surface:*** Majority of houses in urban environment have concretized surfaces leaving no room for greening environment. This situation reduces rainfall percolation irrespective of whether the rain is heavy or not. These types of water are added to surface run-off and invariably add to water that result in flood. A reduction in concretized surface of urban environment will definitely reduce flood in cities as more of the surface run off will percolate to join underground water.

8 RECOMMENDATIONS

- **Environmental education:** There is the need to create awareness through both formal and Informal forms of education on how to dispose solid waste in order to reduce its blockage on river channels. Most people are ignorant of the consequences of their uncontrolled use and abuse of the environment. To this extent, we need holistic approach through environmental Education that will capture both the young and the old. Environmental awareness can be created through: drama, radio jingles & TV, community meetings, bill-boards, posters, as well as through other indigenous means to inform people on how to manage their waste.

- **Minimum depth and width of gutters:** property developers should ensure that gutters are provided in newly developed areas of cities simultaneously as the structures are developed. This will reduce the rate at which such areas get flooded and create problems for smooth traffic movement.
- **Reduction in pot holes:** Attention should be paid to road maintenance in cities. Pot holes should be constantly attended to in urban environment and maintenance culture should be made part of the urban policy by urban managers.

9 CONCLUSION

Flood is a disaster that has become one of the environmental problems in Nigeria. This is because man's activities on daily basis continuously encourage flooding. The menace of flooding on traffic congestion has increased the problems confronting commuters as well as motorists in cities. Many people are becoming skeptical about travelling to urban environment as well as working there because of traffic congestion which has become daily menace.

It is therefore important for man to understand the limit of his activities within his environment (environmental determinism) otherwise there will always be conflict. Man should therefore understand that forces of nature can only be held at bay for a short time whenever there are conflicts. The consequences could be very disastrous, if necessary measures are not put in place to address such conflicts. Thus, there is need for man to understand his limit in his interaction with the environment. Man therefore needs to harmonize his actions as much as possibl e with the environment so as to reduce flood and its effects on traffic flow in cities.

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Analysis of Voltage Stability using HOPF Bifurcation in Power System

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ABSTRACT: In this paper an attempt has been made for analysis of voltage stability using Hopf bifurcation in power system and a new formula for computing and loading of any power system is proposed with the help of using Bifurcation technique using VST Toolbox. Minimum Voltage of the feeders can also be maintained by allowing the feeders to take load growth up to a specific period of time. The critical values of total real power load (TPL) and total reactive power load (TQL) for constant power, constant current, constant impedance, composite as well as exponential load modeling is derived out for the substation voltage of power system. When any parameter changes, the stable Equilibrium points may lose its dynamic stability at the feasibility boundary, which is caused by one of three different local bifurcation the singularity induced bifurcation, saddle-node and Hopf bifurcation. After solving the Differential Algebraic Equation is calculated for different power condition using iterative process. Those results will help to find types of bifurcation, and after that to using MATLAB coding to analyzing HOPF bifurcation static and dynamic process with the help of two simple indices we detected oscillatory problems in power systems, based on the system state matrix as well as an augmented system matrix.

KEYWORDS: Voltage stability, Static voltage stability, Dynamic voltage stability, voltage collapse, VST Toolbox.

1 INTRODUCTION

Generation, Transmission and Distribution systems are the main components of an electric power system. Generating stations and distribution systems are connected through transmission lines. Normally, transmission line implies the bulk transfer of power by high-voltage links between main load centers. Electric power is generated in the range of 11 kV to 25 kV, which is increased by stepped up transformers to the main transmission voltage. The network formed by these very high voltage lines is sometimes called as the Super Grid. This grid, in turn, feeds a sub-transmission network operating at 132 kV or less. In our country, networks operate at 132 kV, 66 kV, 33 kV, 11 kV or 6.6 kV and supply the final consumer feeders at 400 volt three phase, giving 230 volt per phase. The distribution system objectives are distributing electric energy to various consumers, is measured in terms of voltage regulation, flexibility, security of supply efficiency and cost. But all this power distribution system some problems are introduced such as voltage collapse, blackout and voltage stability. Voltage stability analysis problems are removed from for analysis of voltage stability using Hopf bifurcation in power system and a new formula for computing and loading of any power system is proposed with the help of using Bifurcation technique using VST Toolbox.

2 VOLTAGE STABILITY

In the recent years, the analysis of voltage stability has assumed importance, mainly due to several documented incidents of voltage collapse in France, Japan, Belgium and Florida. Voltage stability is commonly analyzed by employing two techniques, namely time-domain (dynamic) simulation and steady-state analysis. Depending on the stability phenomenon or phenomena under investigation, one or both of these techniques may be applied. At any point of time, a power system operating condition should be stable, meeting various operational criteria, and it should also be secure in the event of any

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credible contingency. Present day power systems are being operated closer to their stability limits due to economic and environmental constraints. Maintaining a stable and secure operation of a power system is therefore a very important and challenging issue. Voltage instability has been given much attention by power system researchers and planners in recent years, and is being regarded as one of the major sources of power system insecurity. Voltage instability phenomena are the ones in which the receiving end voltage decreases well below its normal value and does not come back even after setting restoring mechanisms such as VAR compensators, or continues to oscillate for lack of damping against the disturbances. Voltage collapse is the process by which the voltage falls to a low, unacceptable value as a result of an avalanche of events accompanying voltage instability. Once associated with weak systems and long lines, voltage problems are now also a source of concern in highly developed networks as a result of heavier loading.

3 CLASSIFICATION OF VOLTAGE STABILITY

The time span of a disturbance in a power system, causing a potential voltage instability problem, can be classified into short-term and long-term. Automatic voltage regulators, excitation systems, turbine and governor dynamics fall in this short-term or 'transient' time scale, which is typically a few seconds. Induction motors, electronically operated loads and HVDC interconnections also fall in this category. If the system is stable, short-term disturbance dies out and the system enters a slow long-term dynamics.

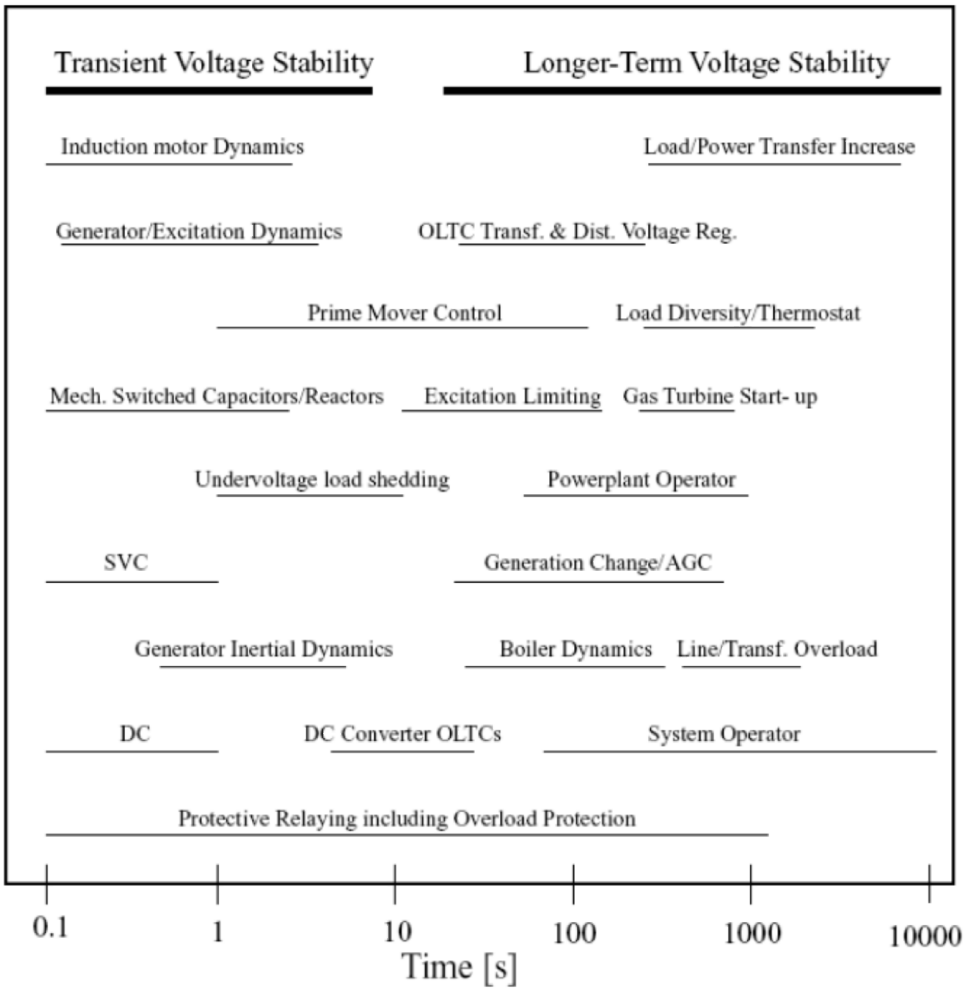

Figure 1 Classification of Voltage Stability

4 VOLTAGE STABILITY ANALYSIS

Midterm stability programs that can simulate the system up to a few minutes can be utilized for this purpose provided that they can model the load characteristics accurately and also include the dynamics of OLTC and over excitation limiters. Load representation should include not only static loads which are voltage dependent but also dynamic loads such as

induction motors and thermostatic loads. All the reactive compensation devices : switched shunt reactors, capacitors, SVC (with limiting action) need to be represented adequately .In addition, special protection schemes such as under voltage load shedding, OLTC blocking, reactor tripping and generator runback should be modeled. Voltage stability is commonly analyzed by employing two techniques, namely time-domain (dynamic) simulation and steady-state analysis. Depending on the stability phenomenon or phenomena under investigation, one or both of these techniques may be applied. For example, if steady-state analysis reveals that voltages at the buses at or near induction motor loads drop by more than 10% of their pre-disturbance value, time-domain (dynamic) analysis should be undertaken to assess the potential for motor stalling (steady-state analysis will not directly yield this information). This may involve extending the model to incorporate aggregate induction motor models at lower voltage buses as necessary. The two most common methods employed within the electric utility industry for analyzing power system stability are static and dynamic analysis.

5 STATIC ANALYSIS

Static analysis (also referred to as load-flow or steady-state analysis) reveals equilibrium points of a system under study. The power flow equations employed in static analysis assume constant system frequency; in other words, generation output equals load demand plus losses. Voltage stability studies are frequently undertaken through the use of static analysis. A common use of this is the development of P-V curves.The graph is obtained in power-flow simulation by monitoring a voltage at a bus of interest and varying the power in small increments until power-flow divergence is encountered. Each equilibrium point shown represents a steady-state operating condition. In other words, each point may be considered as representing a system that has been in a stable operating point for over ½ hour. This means that the generation real-power dispatch and all voltage support equipment have been established such that the system meets the NERC/WECC reliability criteria for each operating point on the graph up to and including the operating limit point indicated on the graph. Beyond the operating limit, further increase in power may result in a breach of one or more of the WECC reliability criteria. A series of curves can be produced, each one as shown in Figure 2, with each curve depicting one or more transmission outage.

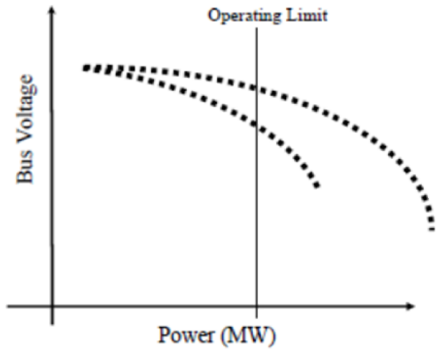

Figure 2 Curve depicting Transmission Outrage

6 DYNAMIC ANALYSIS

Dynamic analysis is commonly employed in the study of power system stability to reveal system trajectory after a disturbance. In contrast to static analysis in which equilibrium points of a P-V curve are not time-dependent, dynamic analysis method reveals the transient and/or the longer-term stability of a power system under study. The graph below adopted from the "Undervoltage Load Shedding Guidelines" document published by WECC in 1999 provides an example of dynamic analysis undertaken to study voltage stability. Voltage Stability Index the formulation of a voltage stability load index at a load bus using voltage equations. The technique uses measurements of voltage phasor and no-load voltage at the bus to calculate the voltage stability L-index. The complete mathematical derivation of the L index is presented in the Appendix. The index gives the distance of the bus to the voltage stability limit. The voltage stability L-index is given by the equation: voltage phasor at the load bus for a given topology of the system. Since the no-load voltage is dependent upon the system topology and operating point, it varies as the system topology or operating point changes. In practice it is difficult to obtain no-load voltage at a bus. The proposed Multilayer Perception (MLP) approach capable of estimating the L-index without directly obtaining the no-load voltage overcomes this limitation of and facilitates on-line determination and use of L-index.The electric power grid is rapidly growing and demanding new technologies for efficient and rapid control in order to ensure reliable and secure power networks carries out a study of the impact of Plug-in Electric Vehicles (PEVs) parking lots (Smart

Parks) on the stability of a power system. In particular, the study shows voltage characteristics following changes in power demand of PEVs. When PEVs discharge into the power network, system voltage support is enhanced, while charging action is accompanied by voltage drop in the load area. The method for estimation of voltage stability L-index developed in this study is applied for monitoring voltage stability in a power system with Smart Parks include.

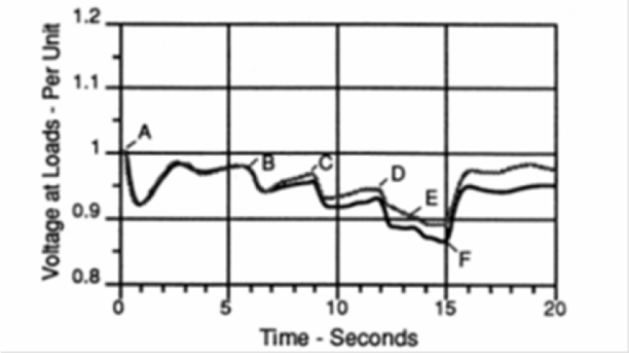

Figure 3 Impact of Increasing Load and LTC Operation

7 BIFURCATION ANALYSIS

In any system with the change in parameters there is some change in the dynamic behavior. Most of the time, these changes are only quantitative in nature. But there may also be situations, where a small change in parameters may result qualitative change in steady state behavior of a dynamic system. Such events are called Bifurcations. The number of attractors in a non – linear dynamic system can change when the system parameter is changed. This change is called Bifurcation. It is accomplished by a change of stability of an attractor. In a bifurcation point, at least one Eigen value of the Jacobian matrix gets a zero real part. It is defined as the sudden change in the behavior of the system as a parameter passes through a critical value called a bifurcation point.

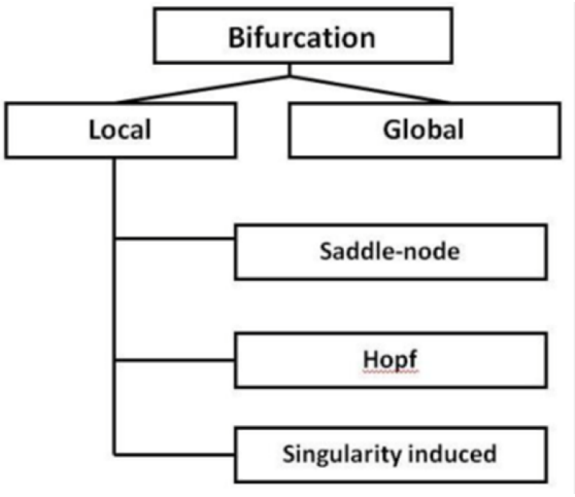

Figure 4 Bifurcation Process

Global Bifurcation- Global bifurcation often occurs when larger invariant sets of the system collide with each other or with equilibrium of the system. They cannot be detected purely by a stability analysis of the equilibrium.

Local Bifurcation- Local bifurcation can be analyzed entirely throughout changes in the local stability property of equilibrium, periodic orbits or other invariant sets as parameters cross through critical thresholds.

Then further Local Bifurcation in divided into three different types –

a) **Saddle-Node Bifurcation -** A saddle-node bifurcation is a local bifurcation in which two fixed point (or equilibrium) of a dynamical system collide and annihilate each other.
b) **HOPF Bifurcation -** A Hopf bifurcation is a local bifurcation in which a fixed point of a dynamic system loses stability as a pair of the complex conjugate Eigen values of the linearization around the fixed point cross the imaginary axis of the plane.
c) **Singularity Induced Bifurcation -** It is a generic property of this encounter that one Eigen value of the linear stability mapping associated with the equilibrium will pass form one half of the complex plane to the other without passing through the imaginary axis. This is known as singularity induced bifurcation. While this property is generic it is shown how more than one Eigen value can diverge in an analogues manner, with applications in electrical power systems.

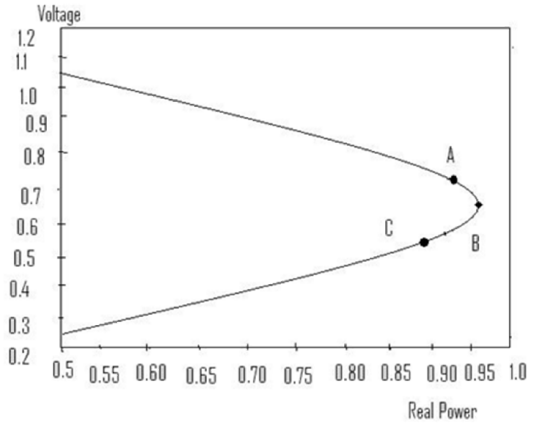

Figure 5 Bifurcation graph: (A) Hopf bifurcation, (B) Saddle node bifurcation, (C) Singularity induced bifurcation

8 HOPF BIFURCATION ANALYSIS

A Hopf-bifurcation is a local bifurcation in which a fixed point of a dynamic system loses stability as a pair of the complex conjugate Eigen values of the linearization around the fixed point cross the imaginary axis of the complex plane. To develop Jacobian matrix J we use the following equation which is provided by the company. the necessary condition for HB is the existence of purely imaginary Eigen values. In this presents the application of the bifurcation analysis to study the behavior of active distribution systems and detects the critical points for unbalanced distribution systems. Some voltage collapse problems are not directly associated to bifurcations, but are generated by voltage control devices such as under-load tap changers or AVRs . Some early work on the Hopf bifurcation related instability of power systems was done . A fundamental platform for solving practical stability related problems in large constrained nonlinear systems such as power systems was developed in. In our work, we study power system stability related to Hopf bifurcations of the oscillatory modes involved in real power- angle dynamics. In the past, significant efforts have been made in analyzing the oscillatory instabilities. the coherent oscillations between weakly connected and geographically scattered clusters in a large power system. Oscillations are related to local instabilities of operating points of the system through a study of feasibility boundaries and sustained coherent inter-cluster oscillations are explained as Hopf bifurcations which occur at certain operating conditions.

If the Hopf bifurcation is supercritical, locally there exist stable limit cycles around the equilibrium. As illustrated on the branching diagram , an exchange of stability takes place between the periodic branch and the stationary branch . The amplitude of these periodic solutions, denoted by [x], grows continuously as the parameter value gets away from the bifurcation point . Thus, a soft loss of stability (soft generation of limit cycles) takes place through supercritical Hopf bifurcation. If the Hopf bifurcation is subcritical, unstable limit cycles encircle the equilibrium, however we can observe stable periodic solutions after the periodic branch turns back and gains stability globally at a turning point, a saddle-node bifurcation of periodic orbits, Thus, a hard loss of stability (hard generation of limit cycles) can be experienced due to a subcritical Hopf bifurcation. In order to study these phenomena in relation with inter cluster oscillations, we start our analysis with small examples of power system models and continue with systems involving power flow distribution (weakly connected) and coherency based clusters.

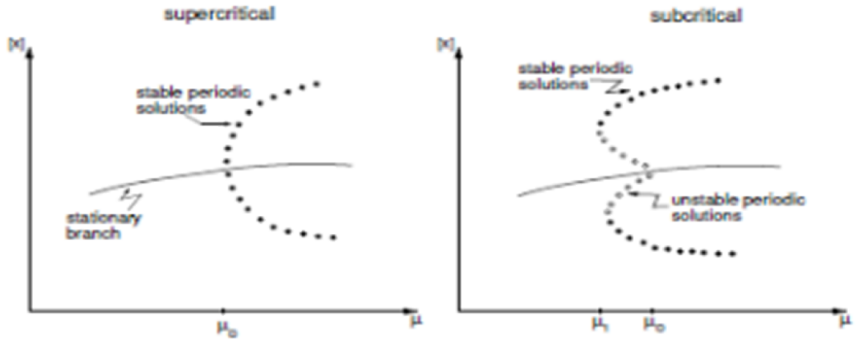

Figure 6 Generic Branching Diagrams for Supercritical and Subcritical Hopf Bifurcations

9 VOLTAGE STABILITY TOOLBOX

The methods of bifurcation theory can be effectively used to analyze various types of stability problems in power systems, such as voltage stability and collapse and oscillatory phenomena. This paper describes a new Matlab-based voltage stability toolbox (VST) that uses visualization capabilities of Matlab and integrates the symbolic and numeric computations to investigate voltage stability and bifurcation issues in power systems.VST is an open source simulation tool and is freely available at http://power.ece.drexel.edu, the website of the Center for Electric Power Engineering (CEPE) of Drexel University, Philadelphia, VST was first designed to have a computational tool that supports the ongoing research on the voltage stability analysis at CEPE. Table I gives a comparison of the currently available Matlab-based tools for power system analysis and VST. The features illustrated in the table are: load flow (LF), voltage stability analysis (VSA), small-signal stability analysis (SSA),

Table 1: Margin specifications

Tool	LF	VSA	SSA	TD	EMT	GUI
VST	√	√	√	√		√
PST	√		√	√		
MatEMTP				√	√	√
PAT	√		√	√		
EST	√		√	√		
SPS	√		√	√	√	√
MatPower	√					

SOFTWARE CONFIGURATION

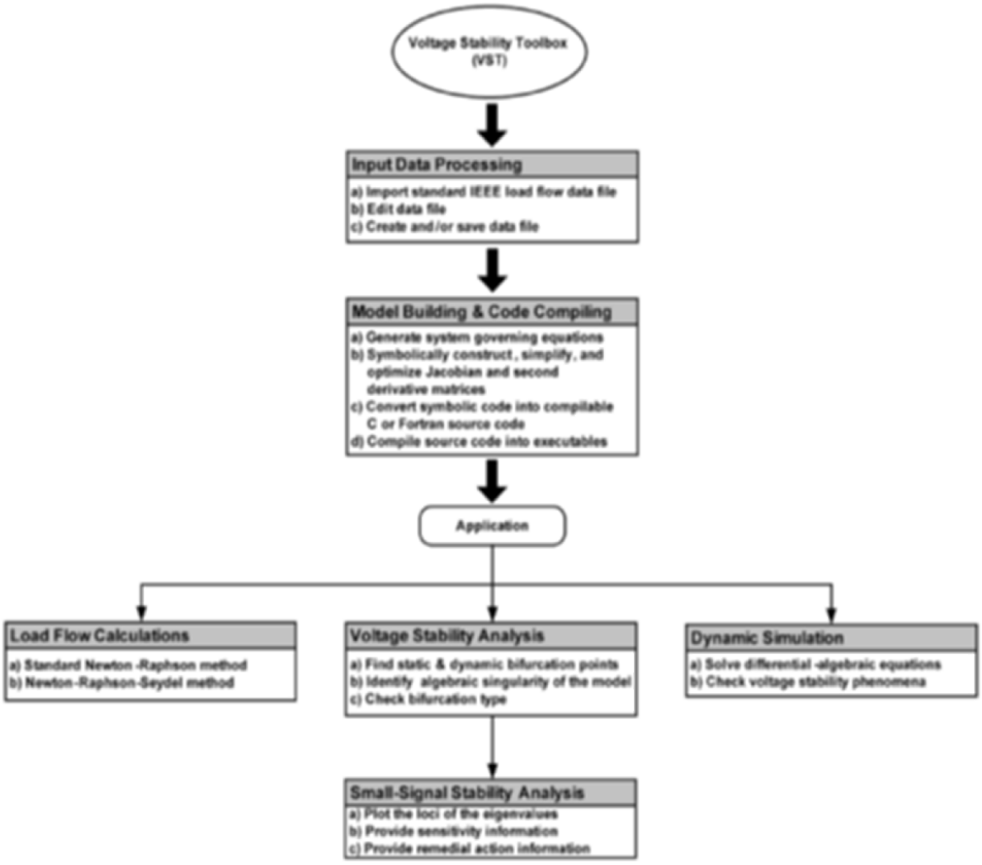

Figure 7 Steps in Software Configuration

The main features and application modules of VST can be summarized as follows –

- Use of Matlab's visualization capability to create graphical user interface and visualize output data.
- Use of stand-alone MEX-files to generate classical power system model equations.
- Use of symbolic toolbox to generate Jacobean and second order derivative matrices.
- Load flow calculations: standard NR and convergent Newton–Rap son–Seydel (NRS) methods.
- Voltage stability analysis: identification of local static and dynamic bifurcation points, such as SN, Hopf, and SI bifurcations.
- Small-signal stability analysis.
- Dynamic (time-domain) simulations.

Power System Stability and Control, a graduate course, mainly focuses on bifurcations and voltage stability, small-signal stability, transient stability, and control of active and reactive power. For this course, the bifurcation analysis and TD simulation applications of VST are used for class demonstration to illustrate to students the concept of multiple equilibria, loss of equilibria, small-signal stability features of the equilibrium, and local bifurcations. The PV curves for a load increase pattern as illustrated in combines the above concepts into a single graph, helping students easily graph the idea. During the class, students are asked to choose a load increase scenario for the IEEE 118-bus system to observe the change of equilibrium and stability with respect to the load increase to determine local bifurcations. They are also asked to run the TD simulation around stable and unstable operating points along the PV curve to investigate the dynamic response of the system. The graduate students are given several assignments for which the capabilities of VST could be used. The typical assignments are as follows –

- Find a load/generation increase pattern so that the entire lower voltage part of the PV curve is unstable (i.e., only the SN bifurcation is observed).
- Using the right and left eigenvectors information at the SN bifurcation point, determine the buses that are most sensitive to loading and find remedial action information useful for corrective control.
- Analyze the participation factors to determine which components (state variables) are most involved in the various system modes (Eigen values).
- Initialize TD simulations around the Hopf bifurcation point and determine the frequency of the oscillations.

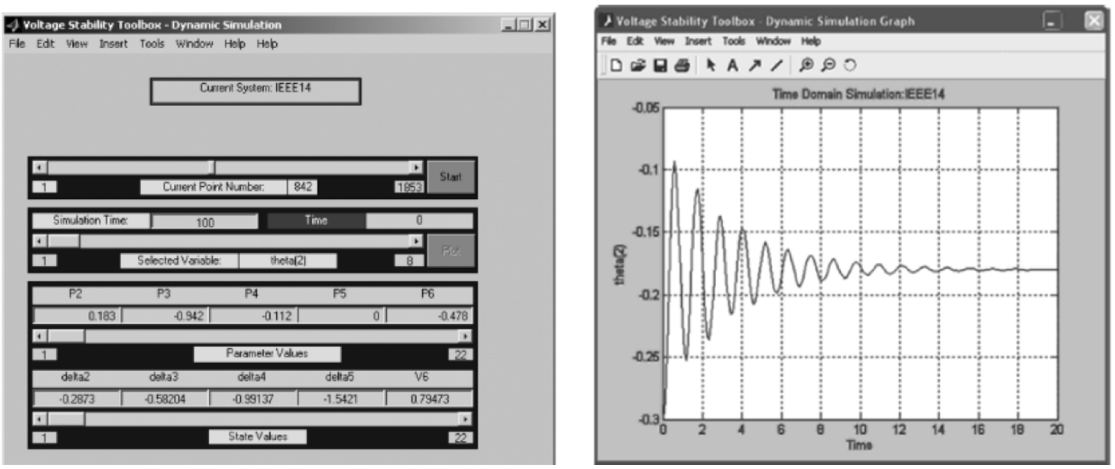

Figure 8 (a) GUI for dynamic simulations, (b) Simulation result for generator 2.

Voltage profile of IEEE 14-bus system: (a) Voltage magnitude and (b) phase angle.

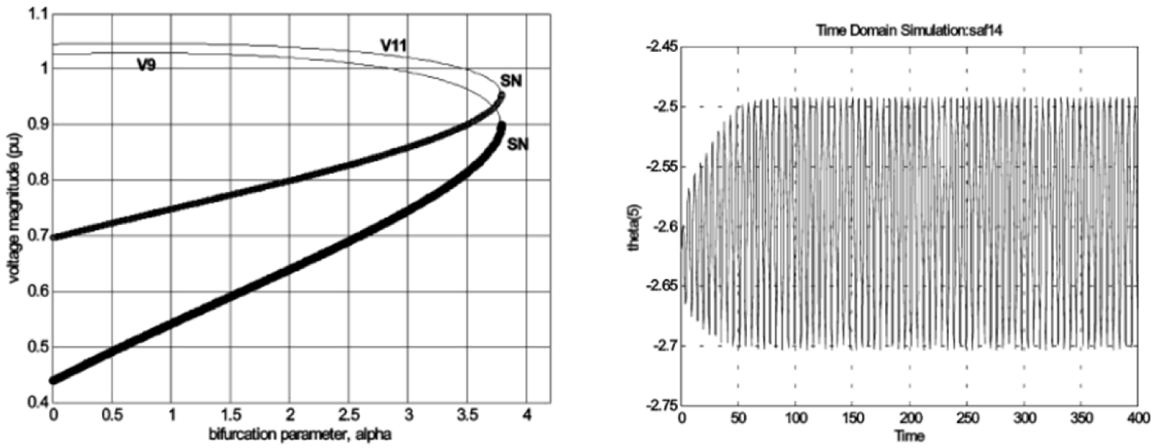

Figure 9 Results (a) PV curves whose lower part is unstable. (b) Hopf bifurcation.

10 CONCLUSION AND FUTURE WORK

For control of static voltage stability, the shunt capacitor and tap-changer were used. From the simulation result, it was shown that the control of the shunt capacitor and the tap-changer can increase the stability margin for static voltage stability and the increase of the stability margin improves the overall voltage profile of the power system, preventing a severe voltage decline. It is shown that the static voltage stability criterion developed in this paper is a useful tool in preventing a severe voltage drop. A voltage stability simulation tool in Matlab is presented in this paper. The developed VST is the outcome of the ongoing research conducted at Drexel University on bifurcation theory and its implementation into voltage stability analysis.

VST integrates numeric and symbolic computations with powerful graphical interfaces for load flow, small-signal and transient stability, and bifurcation analysis. Simulation results show that it is a powerful and promising tool for voltage stability studies, and very helpful to understand voltage stability phenomena. Based on its modular programming structure, other element models, such as nonlinear dynamic load models and more sophisticated generator models, can be easily included in the toolbox, which will definitely improve its usage. Future work will concentrate on such issues.

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The management of industrial waste by recycling in Tunisia

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ABSTRACT: Waste management is the "generation, prevention, characterization, monitoring, treatment, handling, reuse and residual disposition of solid wastes. Waste management in Tunisia is currently one of the priorities of environmental protection and is one of the main pillars of sustainable development. Thus, Tunisia has opted for a comprehensive and progressive policy of environmental protection in order to cope with the current state of the object affected by the strong economic growth and the environment rapid urban expansion in recent years. The area of waste management has received attention currently given the quantity produced changes in the multiplicity of forms and aspects of pollution caused by waste, and limited resources used in the field of solid waste management. During this, our research has been devoted to the study of the phenomenon of industrial waste management by recycling in Tunisia. We used a model based on a time series analysis for a period of 12 years (2000-2011) model. We used the software STATA12 to empirical validation. In addition, we estimated the ability to manage industrial waste recycling based on variables related to the business of recycling industrial waste, variables related to the intervention of Tunisia policy in the management of industrial waste recycling and macroeconomic indicators.

KEYWORDS: Waste, waste management, pollution, recycling, time series.

1 INTRODUCTION

The main objectives of waste management strategies are addressed to health, environmental and economic concerns associated with the improper disposal of waste.

These issues are a constant concern for nations, municipalities, corporations and individuals worldwide, and the international community at large.

Therefore, most countries have sought systems and models for use in waste management. These systems will be used by organizations main mission; is the management of waste from economic activities [1].

Systems of waste management defined by each country will be considered as aids to decision tools for planning, monitoring and optimization of expected following waste management results [2].

Most of these systems have been used in developed countries and low intensity in developing countries [3].

In this respect, economic growth can play an important role in waste management. However, a developed country can guarantee the existence of an effective system of waste management from different economic activities.

With the advent of the industrial revolution, waste management has become a crucial issue. This was due to the increase in population and mass migration of populations to the industrial cities and towns in rural areas during the 18th century.

There was a significant increase in industrial and domestic waste posing a threat to human health and the environment. The living conditions of rural areas in England during this time forcing companies to offer solutions and make changes. Understanding of good hygiene is important to maintain a desired lifestyle [4].

Waste has played a significant role in history. Bubonic plague, cholera and typhoid fever, to name a few, are diseases that affect the populations of Europe and influenced monarchies. They were perpetuated by dirt which housed rats and contaminated water supplies.

Note as well that there was a close correlation between economic growth and environmental degradation: as communities grow environmental declines. This trend is clearly demonstrated on graphs of human population, economic growth and environmental indicators.

In economic and environmental fields, the term decoupling is increasingly used in the context of economic production and environmental quality. When used in this way, it refers to the ability of an economy to grow without incurring a corresponding increase in pressure on the environment.

We will proceed in this article to study the management of waste recycling in the case of Tunisia. The area of waste management has received attention currently given the quantity produced changes in the multiplicity of forms and aspects of pollution caused by waste, and limited resources used in the field of solid waste management. And, under the terms of the Basic Act on common, the sector has been a significant change reflected in the early 1990s by the implementation of the National Waste Management Programmer. This development was followed by a framework law on waste management in 1996, and finally the creation of the National Agency for Waste Management in 2005.

To do so, we present a literature review in the second section. In the third section, we will focus on waste management in Tunisia. The fourth section is devoted to the presentation of the research methodology. In the fifth section, we present and analyze the different empirical results. Finally, the last section is devoted to conclusion.

2 LITERATURE REVIEW

The development of industrial production has led to an increase in the amount of waste of all kinds, which thus appears as a sequel to economic growth.

The accumulation of waste is also related to shortening the life of the property [5].

Recycling appears to be an attractive solution to the problem of waste from industrial companies since values what was considered fallen and useless [6].

Indeed, the problems of scarcity and that of waste far from being solved by substituting materials or by extending product life are instead often aggravated.

Thus, the recycling policy appears to be the most beneficial solution among other policies including resource conservation, materials substitution and extending product life.

2.1 MATERIALS SUBSTITUTION

Material substitution is to replace a potentially hazardous material with one that appears less problematic to the environment; this is particularly the case with the so-called synthetic products: rubber and synthetic fibers and plastics [7].

The possibilities of substitution between materials can fight against the shortage of resources and can solve the problem of resource supply.

This action seems reasonable that may sometimes be desirable, however, it will be problematic to the environment if it leads to the depletion of a scarce resource or increased extraction of other materials that are not biodegradable and en-harmful to our planet.

Indeed, it is undeniable that the emergence of substitutes is brought against the possibility of resource depletion means, but the outcome is quite complicated by the fact that substitution of materials has several limitations [8].

It is noted that for such a discussion on the substitution of materials must take into consideration the following limits:

- The problem of time required for adequate substitutes must be developed and deployed ie substitution may sometimes be a delay over time, which can cause disruption to the economy. Thus, many substitutes for some they are available at reasonable prices and can take several decades [9].

- The substitution of metals requires a large amount of energy and therefore high costs of energy.
- Several substitutes such as synthetic products are not biodegradable unlike those they replace and therefore can be enormously harmful to the environment.
- Substitutions metals can cause more negative effects on the environment than those they replace, e.g. aluminum smelter may cause more pollution than their counterpart's tinplate.
- Replacements can be obtained from a scarce resource as well. It is not obvious that if a resource becomes scarce, its substitute is available. It is thus possible for a plurality of raw materials substituent's there between become scarce almost simultaneously.

In conclusion we can say that the material substitution is technically feasible. However, the problems posed by the scarcity of some resources and the problem of excessive energy consumption and pollution impacts persist and may even worsen the adoption of this approach to materials substitution.

2.2 THE EXTENSION OF PRODUCT LIFE

Extending the life of the assets as a means to prevent waste favors and fight against the depletion of resources.

Indeed, with increased product durability, it throws less as the need to replace old products decrease (lower replacement rate) which reduces the amount of waste produced. In addition, it avoids the waste of natural resources used to develop the products.

This extension of the life of a product can be done thanks to the repair, or to re-use or re-use of the products.

It should be noted that the extension of the life of a well, which implies a change in the behavior of consumers and producers, could slow economic activity.

For example, major tire producers who are facing a looming crisis as they have improved the life of their products to their competitors difficulty [10].

Indeed, today's modern goods are manufactured to a shorter life and this is because the producers are interested to increase sales and maximize profits by increasing the rate of replacement goods among consumers.

2.3 RECYCLING

The fact that recycling is currently experiencing an unprecedented development, we must not forget that this activity still exists. Any time, for fear of missing or for reasons of economy, the man recovered and reused materials and products that may be.

The developments of recycling activities are part of an awareness of the damage caused by economic growth.

Thus, it is through the use of waste from industrial recycling companies trying to address the problems of waste and resource scarcity [11].

Indeed, given the environmental problem the solution is simply to recycle old materials for reuse after treatment as first or secondary materials. It is possible to get even by recycling equal or exceed the original quality natural materials. Moreover, this method allows us to save resources in natural materials as in the case of the manufacture of glass or aluminum from used materials and avoids landfill or incineration which is modes waste management promoting pollution of soil and air.

Recycling is the processing for reuse of natural products or goods that have been the subject of even several previous uses and are reintegrated into the production circuit.

It therefore requires prior salvage and waste processing [12].

Recycling can be done at different levels depending on whether recycling of a final product that has already been the subject of consumption (out-put) what Pearce calls "old waste" or as that it comes to recycling of a product used in intermediate stages of production (input), so-called "new waste".

Recycling "waste again" usually leads to the production of another input (case of waste iron and steel steelworks which are directly reused in the production process.

Recycling "waste old" can lead to the production of an input (in the case of scrap cars crushed recycled steel production) or an output (if the old paper from which the product recycled paper).

In all cases, recycling can both solve the problem of waste accumulation and substitute resources already used for virgin resources that can sometimes be non-renewable.

Operations environment friendly recycling can help conserve resources and protect our planet. However, if they are not carried out properly, recycling operations can generate them even pollution is sometimes resented the pollution from processing virgin materials.

It should be noted as well that many obstacles may hinder the development of recycling and it is therefore necessary to optimize this technique to make it even better.

3 WASTE MANAGEMENT IN TUNISIA

3.1 THE MANAGEMENT OF HOUSEHOLD AND SIMILAR WASTE

According to the results assigned by the 2007 estimates by the NAWM (National Agency of Waste Management), the amount of household and similar waste produced annually is estimated at 2.2 million tones and about 53,000 tones of packaging. These results are derived according to studies on this subject. In fact, household waste is characterized by a high level of organic material (68%) and a high humidity of between 65% and 70%.

Thus, according to the information published by the NAWM, the various components of municipal solid waste are presented in the figure 1.

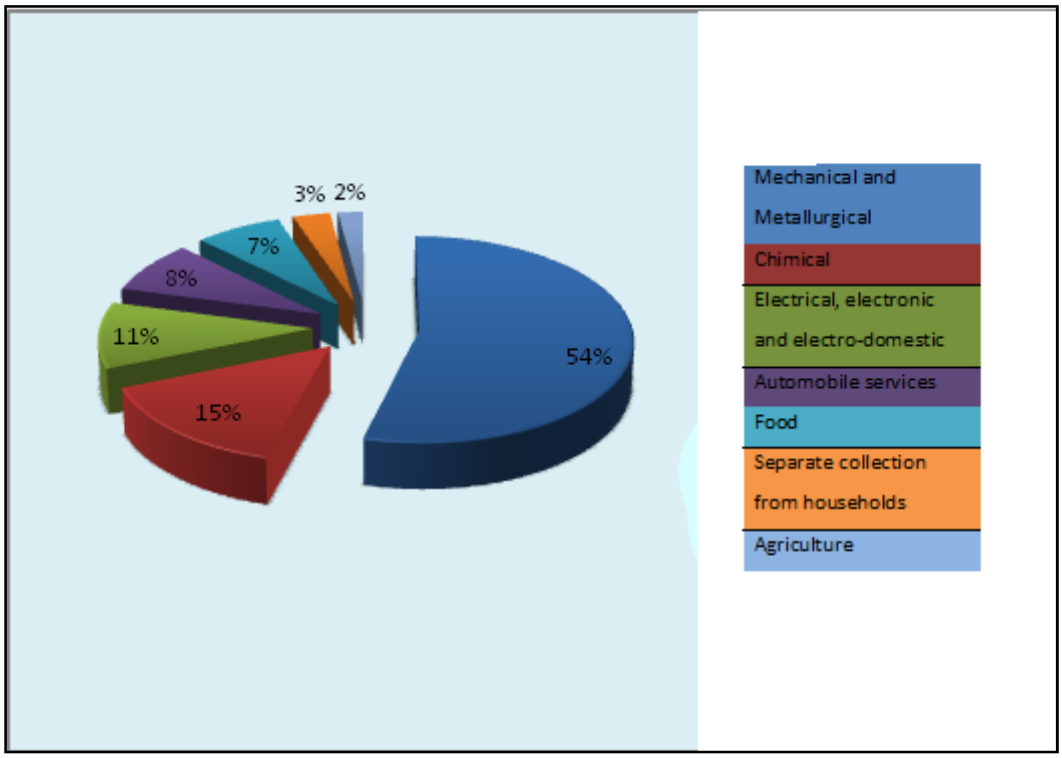

Fig. 1. Components of household and similar waste

In the context of environmental programs in the fight against pollution caused by waste, with the support of the clean development mechanism of the World Bank, and in the Fund Carbon introduced by the Kyoto Protocol, Tunisia has made the signing of two contracts for the sale of 50% of greenhouse gas emissions from the landfill Jebel Chakir and controlled landfills governorate of Bizerte, Nabeul, Sousse, Monastir, Kairouan, Sfax, Gabes, Medenine and the island of Djerba.

However, the amount of gas is 3 million tonnes and the transaction is expected to generate about 21 million dinars to be used for the extension of the landfill Jebel Chakir, the financial program closure and rehabilitation of landfills anarchic and network installation for the extraction and flaring of gas in landfills.

Progress in this program is characterized by the three projects and one project:

- The project of collecting and processing biogas at the controlled Jebel Chakir discharge and continuation of operation and maintenance of collection system and flare operations since November 2008.
- The project of collecting and processing biogas at controlled Bizerte, Gabes and Djerba landfills and continuation of logging operations and maintenance collection system and flare, since August 2010.
- The project of collecting and processing biogas at Sfax and Medenine controlled landfills and continuation of logging operations and maintenance of the collection system and flare, since June 2011.
- In preparation of tender dossiers relating to the projects collection and processing biogas at Sousse controlled landfills; Monastir Nabeul.

As the program of closure and rehabilitation of landfills anarchic Tunisia made:

- The closure and rehabilitation of 9 large uncontrolled discharge: "The Cement" in Bizerte, "El-Kantara" in Djerba, "Ghar Ettfal" in Nabeul, "Beni Wael" Hammamet "Ezzouhour" Sousse "Rmila" to Hammam Sousse, "Gazzeh" Monastir "Dissa" Gabes and "Thyna" in Sfax.
- The closure and rehabilitation of small and medium anarchic landfills (approximately 140), improving the current state of municipal landfills and participation in the removal of blackheads in cities.

3.2 The Management Of Industrial And Special Waste

Specific industrial waste is assessed in Tunisia of an annual quantity of 150,000 tons per year. Thus, waste treatment are also assessed an annual quantity of 16000 tones. Indeed, the components of industrial and hazardous waste are shown in the figure 2.

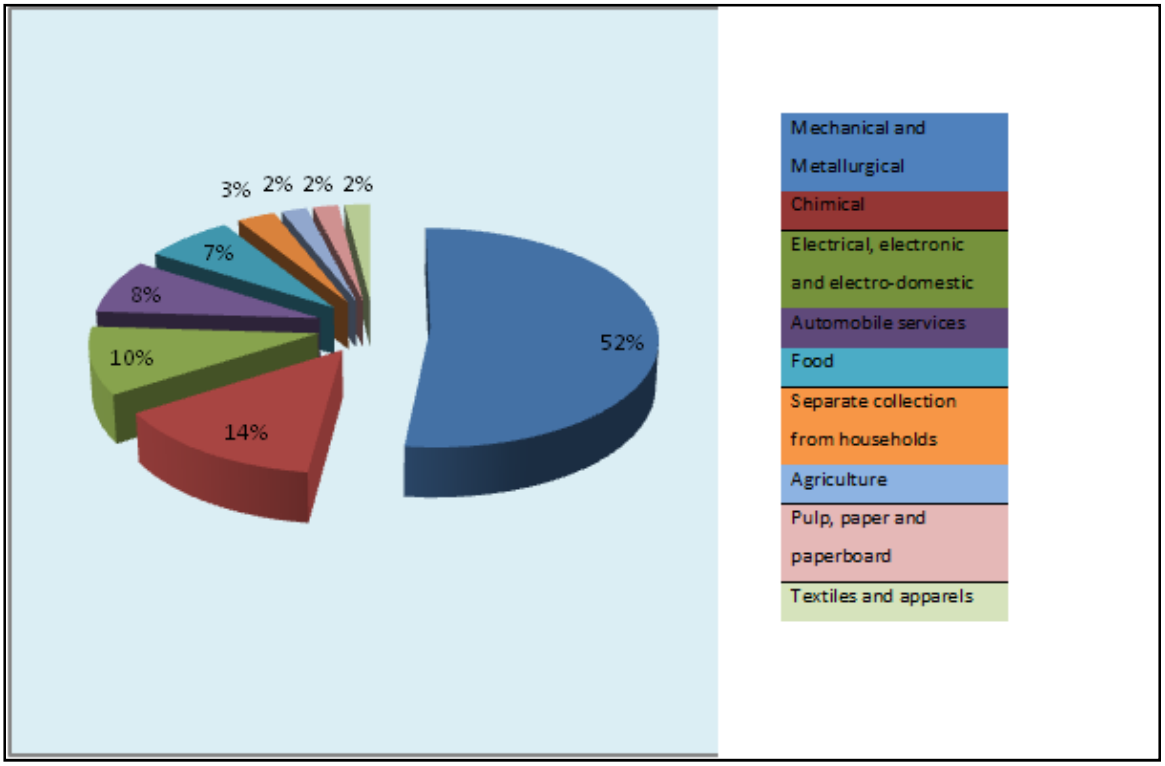

Fig. 2. Components of industrial and special waste

Tunisia has adopted national strategies for the management of industrial and hazardous waste. These following its strategies:

- Establishment of the list of hazardous waste according to their specifications and origins.
- Storage and transportation of hazardous waste according to their characteristics and hazards.
- Creating a central hazardous waste treatment for the whole Tunisian territory.
- Establishment of three regional transfers.

- Export of some hazardous waste abroad with reference to international agreements since their treatment in Tunisia does not present profitability.
- These strategies are performed by a program of management of industrial and hazardous waste:
- Realization du the center of treatment of industrial and special waste "Jradou" Zaghouan a cost approximately $ 32 million dinars. The processing center of industrial and special waste Jradou was inaugurated on 5 June 2009.
- Programming implementation of three facilities Reception, Storage and Transfer (IRST) in the North (Bizerte), Centre (Sfax) and South (Gabes), a total cost of about 22 million dinars. These facilities allowed in 2011 to treat 60% of industrial and special waste by 2011.

3.3 The Management Of Recyclable And Recoverable Waste

The management of recyclable and recoverable waste is done by setting up channels. In addition each of them has a specific mission.

3.3.1 Chain Management Of Plastic Waste "Ecolef"

- Total number of points created is 300.
- Total points operated by NAWM are 65 with two of them seasonal.
- Number of items privatized in collaboration with the municipalities concerned is 17.
- Number of points created and is operated by private 228 with:
- 114 operated by tertiary education.
- 9 operated by people with specific needs.
- 18 created in priority delegations employment.
- Number of businesses created as part of the mechanism is 41.
- Number of units under agreement with the agency recycling is 109, with:
- 70 operated by tertiary education.
- 39 operated by people with specific needs.
- Total number of small businesses (collection, transport and recycling of plastic waste) created by graduates of tertiary education is 231.
- Amounts collected from the start of the die 2001est 85000 tones.
- Create between 15,000 and 18,000 jobs.

3.3.2 Die Collection Of Used Batteries And Accumulators "Ecobatteries" And "Ecopiles"

According to reports from the NAWM, the application of the mandatory deposit resumption of accumulators used in vehicles, transport and various industrial purposes started on 1 August 2009.

While for used batteries, collection operations continue in schools and large spaces in accordance with signed agreements in place.

3.3.3 Die Collection And Recycling Of Used Cooking Oil "Ecozit" And "Ecofiltre"

For this sector, 35 small businesses have received the specifications for the collection of waste and four companies have been approved for establishing primary processing units such waste by filtration.

3.3.4 Chain Management Of Waste Electrical And Electronic Equipment "Weee"

This sector is responsible for the management of waste electrical and electronic equipment.

4 METHODOLOGY

4.1 DATA AND SAMPLE

Tunisia is a country which contains approximately 10.2 million people with an area of 165,000 km2. Thus, Tunisia also contains 24 governorates and 264 municipalities. Well done, communal population represents 65% of the total population (35% rural).

In last year's, several studies have been conducted on the waste generated. Thus, data on annual quantities of waste are as follows:

- Household waste 2.2 million tones / year (0.8 kg / person / day).
- Specific industrial waste: 150,000 tons / year.
- HCW: 16000 tons / year.
- Packaging waste: 55,000 tons / year (1.4 million units / year).

In this research, we will try to empirically validate the industrial waste management in Tunisia recycling. Thus, programs to protect the environment in Tunisia were established in the early 2000s. These programs are designed for waste management for whatever their type. Moreover, we employ a study period of 12 years (2000-2011).

We will try in this work to study the phenomenon of industrial waste management in Tunisia during the study period while using variables related to the intervention policy of the government, variables related to recycling activities in Tunisia and economic indicators.

Thus, the data sources, which we will use, are:

- The National Statistics Institute of Tunisia (NSIT).
- The Ministry of Environment and Sustainable Development.
- The National Agency for Waste Management (NAWM).
- International Centre for Environnemental Technologies in Tunisia.
- The World Bank.

4.2 THE MODEL

To study the phenomenon of management by recycling industrial waste in Tunisia, we will first of all, present in Table 1 the main factors that can influence the recycling process.

Table 1. The main determinants of recycling [13]

Determinants of recycling	Significant impact	Insignificant impact
Demographic		
Sex	[14], [15]	[16], [17]
Age	[18], [19]	[20], [21]
Education	[22]	[23], [5]
Household size	[12]	[10], [14]
Location	[22], [23]	[17], [18]
Ethnicity		[10]
Residential status	[13]	
State of the environment	[14]	
Economic		
Household income	[18], [19]	[20], [23]
The coefficient Engel	[18], [19]	
GDP	[9]	
Taking individual preferences and awareness		
The level of environmental awareness	[10]	
Compliance with laws and regulations		[1], [6]
Environmental values and beliefs	[4]	
The habit of recycling	[3]	
Amenities and recycling conditions	[18]	
Access to recycling program	[19]	
The affiliation of the environment	[8], [13]	
Environmental concerns	[5], [8]	
The economic benefits	[6]	

To examine the factors that influence the amount of waste treated and exploitation rates of recycling facilities, we will use a model that is presented as follows [13].

$$\mathbf{CAP}_i = \alpha_0 + \alpha_1 DIG_i + \alpha_2 TRDI_i + \alpha_3 DVMM_i + \alpha_4 DVCH_i + \alpha_5 DVEEEM_i + \alpha_6 DVAA_i + \alpha_7 DVCSM_i + \alpha_8 DVSA_i + \alpha_9 DVAAI_i + \alpha_{10} PIB_i + \alpha_{11} CIPIB_i + \varepsilon_i$$

With:

α_0 **:**A constant.

α_j **:**The coefficients of different variables with j = 1, ..., 11.

ε_i **:**The error term (i = 1, ..., 12).

- **<u>The dependent variable:</u>**

- CAP_i **:** The government's ability to recycle industrial waste during the year i (tones / year).

- **<u>Independent variables:</u>**

➢ **Indicators relating to the recycling activity in Tunisia:**

- DIG_i **:** Industrial waste generated in Tunisia during the year i (tones / year).

- $TRDI_i$ **:** The rate of recycling of industrial waste for the year i (%).

- **Indicators related to the intervention policy of the government:**

- $DVMM_i$ **:** a dummy variable for the recycling of mechanical and metallurgical waste, whether 1 and 0 if not.
- $DVCH_i$ **:** a dummy variable for the recycling of chemical waste, 1 if yes and 0 if not.
- $DVEEEM_i$ **:** a dummy variable for the recycling of electrical, electronic and electrical appliances waste 1 if yes and 0 if not.
- $DVAA_i$ **:** a dummy variable for the recycling of agro-food waste, whether 1 and 0 if not.
- $DVCSM_i$ **:** a dummy variable for the recycling of waste separate collection from households, 1 if yes and 0 if not.
- $DVSA_i$ **:** a dummy variable for the recycling of waste automotive services, whether 1 and 0 if not.
- $DVAAI_i$ **:** a dummy variable for the recycling of waste from other industrial activities, whether 1 and 0 if not.

- **Economic indicators:**

- PIB_i **:** The rate of GDP growth in the year i (%).
- $CIPIB_i$ **:** The contribution of industry to GDP in year i (%).

Indeed, we will use the software to perform STATA12 estimation of the model used and the presentation of the different results that will be interpreted in the following section.

5 EMPIRICAL RESULTS

5.1 DESCRIPTIVE STATISTICS

Throughout this section we will try to analyze and interpret the different results obtained from the estimates made on the variable cap. Thus, we will use the STATA 12 software to perform the various estimates and to obtain different results that will be important in our research.

Therefore, we will specify the type of the model used for estimation is a regression on time series or time series. The choice of this type of regression is justified by the presence of only one dimension in the data used; this is the time dimension (a period of 12 years). This study focuses on the management of industrial waste in Tunisia during the period 2000 to 2011.

The Table 2 summarizes the descriptive statistics for each variable used in the estimation of the model used.

The CAP variable, which expresses the ability of Tunisia for the recycling of industrial waste throughout the study period, can reach a maximum value of 14,000 tons / year, as its minimum value is 2000 tons / year. The level of risk of the variable CAP which is measured by the standard deviation of 3892,378. Other statistics on other variables were presented in the table 2.

Table 2. Descriptive statistics

Variables	Comments	Mean	max	min	Sd	Skewness	Kurtosis
CAP	12	7083.333	14000	2000	3892.378	0.249231	1.738972
DIG	12	132916.7	150000	100000	19477.06	-0.7509479	2.101687
TRDI	12	0.5333333	0672	0.4	0.0976276	0.0186706	1.681058
DVMM	12	0.3333333	1	0	0.492366	0.7071068	1.5
DVCH	12	0.3333333	1	0	0.492366	0.7071068	1.5
DVEEEM	12	0.3333333	1	0	0.492366	0.7071068	1.5
DVAA	12	0.4166667	1	0	0.5149287	0.3380617	1.114286
DVCSM	12	0.4166667	1	0	0.5149287	0.3380617	1.114286
DVSA	12	0.5833333	1	0	0.5149287	-0.3380617	1.114286
DVAAI	12	0.5833333	1	0	0.5149287	-0.3380617	1.114286
GDP	12	2.912658	5.333685	-3.144916	2.370479	-1.413724	4.561963
CIPIB	12	30.33873	33.83842	28.43901	1.465741	0.9335821	3.810863

We can also mention the importance of the contribution of industrial activities in the GDP is measured by the variable CIPIB. This variable has a maximum level of 33.83% and a minimum level of 28.44%. So, industrial activities play a dominant role in the economic cycle in Tunisia which reflects the existence of significant amounts of industrial waste role.

The contribution of various industrial activities in GDP is presented in the figure below:

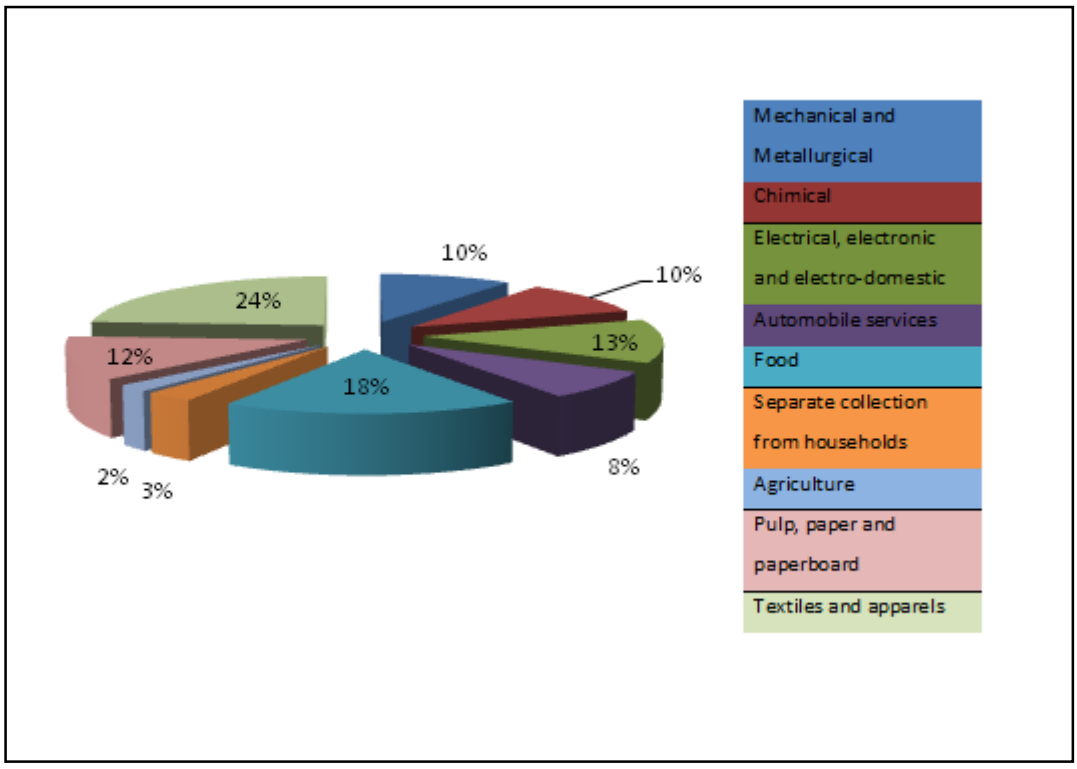

Fig. 3. The Share of industry in GDP (year 2011)

In further analysis of the results, we conducted a test of correlation between the variables used. The table below summarizes the results. In addition, the results show that the majority of Pearson correlation coefficients do not exceed the tolerance limit (0.7) except for a few variables, which does not cause problems when estimating the model used to measure the ability to Tunisia for recycling industrial waste (CAP).

Table 3. Correlation matrix

	CAP	DIG	TRDI	DVMM	DVCH	DVEEEM	DVAA	DVCSM	DVSA	DVAAI	GDP	CIPIB
CAP	1.0000											
DIG	0.0412 (0.0058) *	1.0000										
TRDI	0.0658 (0.0000) *	0.3665 (0.0036) *	1.0000									
DVMM	0.0574 (0.0043) *	0.6478 (0.0227) **	0.5767 (0.0030) *	1.0000								
DVCH	0.0574 (0.0043) *	0.6478 (0.0227) **	0.5767 (0.0030) *	0.0700 (0.0000) *	1.0000							
DVEEEM	0.0574 (0.0043) *	0.6478 (0.0227) **	0.5767 (0.0030) *	0.0700 (0.0000) *	0.0700 (0.0000) *	1.0000						
DVAA	0.0565 (0.0004) *	0.6383 (0.0255) **	0.5632 (0.0003) *	0.6367 (0.0007) *	0.6367 (0.0007) *	0.8367 (0.0007) *	1.0000					
DVCSM	0.4565 (0.0004) *	0.6383 (0.0255) **	0.5632 (0.0003) *	0.6367 (0.0007) *	0.6367 (0.0007) *	0.5367 (0.0007) *	0.0230 (0.0000) *	1.0000				
DVSA	0.4489 (0.0005) *	0.6760 (0.0158) **	0.5511 (0.0004) *	0.5976 (0.0402) **	0.5976 (0.0402) **	0.5976 (0.0402) **	0.4143 (0.0091) *	0.5143 (0.0091) *	1.0000			
DVAAI	0.4489 (0.0005) *	0.6760 (0.0158) **	0.5511 (0.0004) *	0.5976 (0.0402) **	0.5976 (0.0402) **	0.5976 (0.0402) **	0.5143 (0.0091) *	0.4143 (0.0091) *	0.0230 (0.0000) *	1.0000		
GDP	-0.2277 (0.4767)	-0.1668 (0.6043)	-0.1636 (0.6115)	-0.5719 (0.0520) ***	-0.5719 (0.0520) ***	-0.5719 (0.0520) ***	-0.3666 (0.2412)	-0.3666 (0.2412)	-0.2538 (0.4260)	-0.2538 (0.4260)	1.0000	
CIPIB	0.6413 (0.0246)	0.2703 (0.3954)	0.6670 (0.0178) **	0.6554 (0.0207) **	0.6554 (0.0207) **	0.6554 (0.0207) **	0.7519 (0.0048) *	0.7519 (0.0048) **	0.5422 (0.0686) ***	0.5422 (0.0686) ***	-0.2570 (0.4200)	1.0000
Significant at a threshold value (*) 1%; (**) And 5% (***) 10%												

5.2 INTERPRETATION OF THE RESULTS OF THE ESTIMATION

The estimation results of the variable **CAP** are presented in Table 6. This tables include two estimations with the number of explanatory variables related to the management of industrial waste recycling in Tunisia.

For the variable **CAP** we based our study on explanatory variables that are grouped by categories, namely category on the activity of industrial waste recycling in Tunisia, a category on the intervention policy adopted by Tunisia for recycling industrial waste and a class on macro-economic indicators.

First, we perform unit root tests to test the stationary of the variables selected. The results for these tests are presented in the table 4.

Table 4. The test of the unit root

		Augmented Dickey-Fuller test			Philipps-Perron test		
Variables	**Obs**	**t- statistical[a]**	**t-critical[b]**	**p-value[c]**	**t- statistical[d]**	**t-critical[e]**	**p-value[f]**
CAP	12	3343	3240	**0.0664**	3294	2630	**0.0317**
DIG	12	3527	3240	**0.0147**	2891	2630	**0.0363**
TRDI	12	3612	3240	**0.0745**	3310	2630	**0.0247**
DVMM	12	3892	2630	**0.0727**	2756	2630	**0.0807**
DVCH	12	-0592	2630	0.8727	-0556	2630	0.8807
DVEEM	12	-0592	2630	0.8727	-0556	2630	0.8807
DVAA	12	2739	2630	**0.0365**	2700	2630	**0.0467**
DVCSM	12	-0739	2630	0.8365	-0700	2630	0.8467
DVSA	12	3108	2630	**0.0119**	3061	2630	**0.0302**
DVAAI	12	1108	2630	0.7119	1061	2630	0.7302
GDP	12	2958	2630	**0.0684**	2872	2630	**0.0969**
CIPIB	12	2717	2630	**0.0225**	2731	2630	**0.0154**

[a]This is the calculated t-Student test for unit root by ADF value method.
[b]This is the critical value of Student's t-test for the unit root by the ADF method.
[c]This is compared to the threshold value of 10% p-value.
[d]This is the calculated t-Student test for unit root by Philipps-Perron method value.
[e]This is the critical value of Student's t-test for the unit root in the Philipps-Perron method.
[f] This is compared to the threshold value of 10% p-value.

The table above is devoted to test the stationary of the variables used in the model to estimate. We used the test Increased Duckey-Fuller test and Philipps-Perron. Thus, we noticed that only four variables that present the p-value greater than 10% for both tests Augmented-Duckey-Fuller and Philipps-Perron. These four variables are DVCH, DVEEM, DVCSM and DVAAI. In addition, these variables are by nature Dummy variables. In this case, we have excluded from the model to estimate. Thus, the non-stationary of these variables can be a problem in the estimated model. For other variables, the values of p-values for them are less than 10% and the t-Student calculated values are lower than the t-Student critical threshold of 10%. In this case, the presence reject H0 unit roots and thereafter all these variables are stationary.

We also used the technique Breuch-Pagan- for testing of heterosciedasticity. This test allows us to check if the variance of the variables is constant or not. According to the results table below, we conclude that the variance is constant since the probability of chi2 is greater than 10%, therefore we accept the hypothesis H0 the variance is constant.

We process technology Ramsey for testing omission of relevant explanatory variables. This test allowed us to check if there are omitted variable or not. Since the omission of a variable allows you to be a problem in the estimated model. According to the results table below, we can conclude that there is no omitted variable Fischer since the probability of greater than 10%, therefore we accept the hypothesis H0 there is no omitted variable in the estimated model.

Table 5. The test of Breuch Pagan-test and Ramsey

Of hétérosciedasticité Test (Test Breuch-Pagan)			
chi2 (1)	0.19	prob> chi2	0.6607
Test omission of explanatory variables (Test Ramsey)			
F (3, 1)	2.89	Prob> F	0.4023

After performing various tests mentioned above, we perform the estimation of the model used. The results of estimation are shown in the table 6.

Table 6. Estimation of the variable CAP

Dependent variable: CAP		
	Estimation 1	**Estimation 2**
Period of study	**2000-2011**	**2000-2011**
Explanatory variables	**Coefficients (T-Student)**	**Coefficients (T-Student)**
DIG	- .005644 (-1.16)	- .0022296 (-1.05)
TRDI	39875.18 (4.51) *	38608.86 (2.28) **
DVMM		-1018.372 (-0.37)
DVAA		795.6958 (1.34)
DVSA		208.8219 (1.10)
GDP	-129.1342 (-1.79) ***	-179.5199 (-1.82) ***
CIPIB	-101.7592 (-3.25) *	-104.4706 (-2.18) ***
CONS	-9969.876 (-0.86)	-9633.213 (-0.47)
Number of obs	12	12
Probability of Fisher	Prob> F = 0.0002	Prob> F = 0.0235
The value of Fisher	F (4, 7) = 26.63	F (7, 4) = 9.40
R	0.9383	0.9427
R^2adjusted	0.9031	0.8424
✓ The values in parentheses are t-Student vales.		
✓ Significant at a threshold value (*) 1%; (**) 5% and (***) 10%.		

The test of significance of the model is based on the probability of Fisher. We noticed that all probability values Fisher are less than 5% in the estimates of the variable CAP; Prob> F = 0.0002 for the first estimate and Prob> F = 0.0235 for the second estimate. So we can deny that the estimated (CAP) model is globally significant.

Thus, we found that the coefficient of determination R2 is equal to 0.9383 in the first estimate and 0.9427 in the second estimate, so the model used is characterized by a good linear fit.

In the first estimate, we estimated the dependent variable **CAP** based on variables related to the activity of industrial waste recycling in Tunisia and macro-economic indicators.

Based on the results of the first estimate, we noticed that there are three significant variables.

We noticed that the variable **TRDI** which represents the rate of recycling of industrial waste in Tunisia has a significant and positive impact on the dependent variable CAP which measures the ability of Tunisia to recycle and manage industrial waste. This impact is significant at the 1% level and a value of t-Student equal to (4.51).

The ratio of growth of GDP has a significant and negative impact on the CAP variable to a threshold of 10% and a value of t-Student (-1.79). This is explained by the fact that GDP growth is justified by the increased industrial activity and subsequently the existence of huge amounts of industrial waste. And since the ability to Tunisia for recycling this type of waste is limited. So, GDP will negatively affect the ability of recycling industrial waste.

The third significant variable is the variable **CIPIB.** This variable measures the contribution of industrial activities in the GDP. We noticed that this variable has a significant and negative impact on the dependent variable CAP to a threshold of 1%

and a value of t-Student (-3.25). In addition, over the contribution of industrial activities in GDP is increasing the capacity of Tunisia to recycle industrial waste decreases.

In this case, Tunisia is required to implement policy intervention to increase its capacity to recycle industrial waste. This was the objective of the second estimate in which we incorporated variables related to intervention policy adopted by Tunisia to improve its capacity to recycle industrial waste.

In the second estimate, we noticed that there are three variables that have a significant impact on the variable **CAP** and other variables have an insignificant impact on the dependent variable but CAP.

We noticed that the variable **TRDI** which represents the rate of recycling of industrial waste in Tunisia has a significant and positive impact on the dependent variable CAP which measures the ability of Tunisia to recycle and manage industrial waste. This impact is significant at the 5% level and a value of t-Student of (2.28).

The growth rate GDP has a significant and negative impact on the CAP variable to a threshold of 10% and a value of t-Student (-1.82). This is explained by the fact that GDP growth is justified by the increased industrial activity and subsequently the existence of huge amounts of industrial waste. And since the ability to Tunisia for recycling this type of waste is limited. So, GDP will negatively affect the ability of recycling industrial waste.

The third significant variable is the variable **CIPIB.** This variable measures the contribution of industrial activities in the GDP. We noticed that this variable has a significant and negative impact on the dependent variable CAP to a threshold of 10% and a value of t-Student (-2.18). In addition, over the contribution of industrial activities in GDP is increasing the capacity of Tunisia to recycle industrial waste decreases.

On variables related to the intervention policy applied by Tunisia to improve its capacity to recycle agro-food waste (**DVAA**) and waste automotive services (DVSA), we noticed that they have a positive impact on the ability of management and recycling industrial waste. This positive effect is justified by the creation of specialized companies in the management and recycling of this type of waste. These programs have been created in 2005.

While, the third variable which measures the political strategy adopted by Tunisia for the management of mechanical and metallurgical waste (DVMM) has a negative impact on the dependent variable CAP.

Indeed, we can conclude that the management of industrial waste recycling in Tunisia is based primarily on the adopted policy interventions such as the creation of specialized companies in the recycling of industrial waste.

6 CONCLUSION

Waste management has attracted the attention of existing authorities in Tunisia and it is one important objective to ensure the protection of the environment and one of the main axes of sustainable development.

Thus, Tunisia has adopted several policy guidelines in strategies of socio-economic development in order to meet the challenges of environmental protection that we refer to the report of the National Agency for Waste Management of Tunisia in 2012.

In this sense, we have developed this research to study the management of industrial waste recycling in Tunisia. In fact, this chapter was devoted to an empirical study on the management of industrial waste recycling in Tunisia.

In addition, the third chapter was devoted to the study of the phenomenon of industrial waste management by recycling in Tunisia. It is divided into two sections. In the first section, we presented the strategies adopted by Tunisia for the management of waste from various activities. In the second section, we analyzed empirically management of industrial waste recycling in Tunisia.

We used a regression model of time series estimated by the STATA 12 software. We estimated a model that expresses the capacity of Tunisia for the management of industrial waste through recycling. We used as predictors of variables related to the activity of recycling industrial waste, variables related to the intervention of Tunisia policy in the management of industrial waste through recycling and macro-indicators.

According to the results, we conclude that the macro-economic indicators have a negative impact on the dependent variable. The variables related to the intervention of Tunisia policy in industrial waste management through recycling have a positive impact and a negative impact depending on the nature of the waste. And finally, the variable relative to the activity of recycling industrial waste TRDI has a positive impact and DIG variable has a negative impact.

Furthermore, the proper management of industrial waste recycling is based on the nature of the intervention of Tunisia for recycling industrial waste policies.

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Study of Existing Fuzzy Goal Programming Method: New Idea

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ABSTRACT: Fuzzy goal programming (FGP) is, the most widely used method for solving multi-objective real-world decision making problems. In this paper, we focus on fuzzy goal programming (FGP) formulation for solving fuzzy multi objective fractional goal programming problems, which will easily help the decision makers to set the correct policy corresponding to their goals. Furthermore, the proposed concept of membership goals gives desirable and more realistic solution than the existing FGP methods in the sense that the goals are achieved according to the real case needs. Finally, for illustration, one example is used to demonstrate the correctness and usefulness of the proposed analysis of FGP method.

KEYWORDS: Multi objective decision making; Fuzzy sets; Goal programming; Fuzzy goal programming; Fuzzy fractional programming Fuzzy fractional programming.

1 INTRODUCTION

Goal programming (GP) has been one of the most commonly used methods. In 1955, the concept of goal programming (GP) was first introduced by Charnes et al. [1]. GP has been studied to solve conflicting multi linear or fractional objectives of real-world decision making problems [2-9]. However, decision maker (DM) is always faced with the problem of assigning the definite aspiration levels to the goals. To overcome such a problem, the fuzzy set theory (FST) initially introduced by Zadeh [10] has been used to decision-making problems with imprecise data. Bellman and Zadeh [11] state that a fuzzy decision is defined as the fuzzy set of alternatives resulting from the intersection of the goals or objectives and constraints. The concept of fuzzy programming was first introduced by Tanaka et al. [12] in the framework of fuzzy decision of Bellman and Zadeh. Afterwards, fuzzy approach to linear programming (LP) with several objectives was studied by Zimmermann [13].

Similarly, the application of fuzzy set theory was used to overcome the computationally burdensome of most of the methods for solving multi objective fractional programming (MOLFP) problems [14, 15]. In 1980, Narasimhan [16] was first studied the use of fuzzy set theory in GP. Thereafter, there are several methods [17, 18,19, 20] to solve multi objective linear or fractional programming problems involving uncertainty. Many real-world problems [21-28] are solved by fuzzy multi objective linear or fractional goal programming technique.

In 1997, Mohammed [29] presented a new fuzzy goal programming method which is used to achieve highest degree of each of the membership goals by minimizing their deviation variables. Thereafter, in order to reflect the relative importance of the goals several pioneer researchers projected some new FGP methods and work in the field of fuzzy multi objective linear or fractional goal programming with consideration of both the under- and over deviation variables and also only under deviation variables to the membership goals . However, there may be a situation exists in FGP problems where some of the fuzzy goals may meet the behavior of the problem and some are not. In such situations, the estimation of the relative weights attached to the fuzzy goals plays an important role in multi objective decision-making process.

Still now, fuzzy goal programming (FGP) has been widely used method for solving multi objective decision making problems [30 - 34].

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The main purpose of this paper is to analysis the concept of membership goals of some well-known existing FGP methods [22, 28] when weights are taken as less than unity. Also it has been note that the FGP models in most of the existing FGP methods incorporate each goal's weight into the objective function which is to be minimized where highest degree of each of the membership goals has been achieved by minimizing their under deviation variables or by maximizing the min operator for the corresponding goals. Some of these FGP problems may produce undesirable solutions when the construction of membership goals is changed. To overcome this, new FGP concept has been proposed, where membership goals are constructed in exact way to force λ or μ belongs to [0,1] when weights are taken as less than unity .

For illustration, one example adopted from [19] is used to demonstrate the usefulness of the proposed analysis. The obtained results are discussed and compared with the results of the existing methods.

This paper is organized as follows: following the introduction, in Section 2, formulation of multi objective linear programming problem and multi objective fractional programming problem is discussed in brief. In Section 3, fuzzy goal programming formulation has been described. In Section 4, studies of the existing methods are explained and construction of membership goals has been proposed for solving FGP problems. In Section 5 numerical example is solved by the existing methods and proposed FGP methods for comparison. In Section 6, results of the fuzzy fractional goal programming problem using the proposed FGP methods and existing FGP methods are discussed. Section 7 details the advantages of the proposed FGP methods. Section 8 deals with the concluding remarks.

2 PROBLEM FORMULATION

The general format of the multi objective linear programming problem (MOLPP) can be written as:

Optimize $Z_k(x) = c_k x,\ k = 1, 2, \ldots, K$

Where $x \in X = \{ x \in R^n / Ax \begin{pmatrix} \geq \\ = \\ \leq \end{pmatrix} b,\ x \geq 0,\ b^T \in R^m \}$, (1)

Where $c_k^T, \in R^n$.

If the numerator and denominator in the objective function as well as the constraints are linear, then it is called a linear fractional programming problem (LFPP).

The general format of the multi objective fractional programming problem (MOFPP) can be written as:

Optimize $Z_k(x) = \frac{c_k x + \alpha_k}{d_k x + \beta_k}$, $k = 1, 2, \ldots, K$

Where $x \in X = \{ x \in R^n / Ax \begin{pmatrix} \geq \\ = \\ \leq \end{pmatrix} b,\ x \geq 0,\ b^T \in R^m \}$, (2)

Where $c_k^T, d_k^T \in R^n$; α_k , β_k are constants and $d_k x + \beta_k > 0$.

3 FUZZY GOAL PROGRAMMING FORMULATION

3.1 CONSTRUCTION OF FUZZY GOALS

In multi objective fractional programming, if an imprecise aspiration level is introduced to each of the objectives then these fuzzy objectives are termed as fuzzy goals. Let g_k be the aspiration level assigned to the kth objective $Z_k(x)$. Then the fuzzy goals are

i) $Z_k(x) \gtrsim g_k$ [For maximizing $Z_k(x)$] and

ii) $Z_k(x) \lesssim g_k$ [For minimizing $Z_k(x)$].

Where $' \gtrsim '$ and $' \lesssim '$ represents the fuzzified version of '$\geq$' and '$\leq$'. These are to be understood as 'essentially greater than' and 'essentially less than' in the sense of Zimmermann [13].

3.2 CONSTRUCTION OF FUZZY MULTI OBJECTIVE GOAL PROGRAMMING

Hence, the fuzzy multi objective goal programming can be formulated as follows:

Find *x,*

$$\text{So as to satisfy } Z_k(x) \gtrsim g_k, \quad k = 1,2,\ldots,k_1,$$
$$Z_k(x) \lesssim g_{k,} \quad k = k_1+1,\ldots, K,$$

subject to $Ax \begin{pmatrix} \geq \\ = \\ \leq \end{pmatrix} b,$

$$x \geq 0. \tag{3}$$

3.3 CONSTRUCTION OF MEMBERSHIP FUNCTIONS

Now the membership function μ_k for the *k*th fuzzy goal $Z_k(x) \gtrsim g_k$ can be expressed as follows:

$$\mu_k(Z_k(x)) = \begin{cases} 1 & if\ Z_k(x) \geq g_k \\ \frac{Z_k(x) - l_k}{g_k - l_k} & if\ l_k \leq Z_k(x) \leq g_k \\ 0 & if\ Z_k(x) \leq l_k \end{cases} \tag{4}$$

Where l_k is the lower tolerance limit for the *k*th fuzzy goal and ($g_k - l_k$) is the tolerance (p_k) which is subjectively chosen. Again the membership function μ_k for the *k*th fuzzy goal $Z_k(x) \lesssim g_k$ can be expressed as follows:

$$\mu_k(Z_k(x)) = \begin{cases} 1 & if\ Z_k(x) \leq g_k \\ \frac{u_k - Z_k(x)}{u_k - g_k} & if\ g_k \leq Z_k(x) \leq u_k \\ 0 & if\ Z_k(x) \geq u_k \end{cases} \tag{5}$$

Where u_k is the upper tolerance limit for the *k*th fuzzy goal and ($u_k - g_k$) is the tolerance which is subjectively chosen [13].

3.3.1 CONSTRUCTION OF EXISTING MEMBERSHIP GOALS

In fuzzy programming approaches, the highest possible value of membership function is 1. Thus, according to the idea of Mohamed [29], the linear membership functions in Eq. (4) and Eq. (5) can be expressed as the following functions (i.e. the achievement of the highest membership value):

$$\frac{Z_k(x) - l_k}{g_k - l_k} + d_k^- - d_k^+ = 1 \quad \text{for } \gtrsim \text{ type fuzzy goals} \tag{6}$$

$$\frac{u_k - Z_k(x)}{u_k - g_k} + d_k^- - d_k^+ = 1 \quad \text{for } \lesssim \text{ type fuzzy goals} \tag{7}$$

Where *x,* d_k^- , d_k^+ (≥ 0); $d_k^- \times d_k^+ = 0$ and d_k^- and d_k^+ represent the under deviation and over deviation variable from the aspired levels; *k* = 1,2,...,*K*.

The FGP methods where membership goals are based on Eq. (6) and Eq. (7), do not give completely correct solution always. So the introduction of both deviation variables to the membership goals is unnecessary. Thus, the membership goals have been constructed by introducing only under deviation variables to the membership function.

The existing membership goals with the aspired level 1 based on the Eq. (6) and Eq. (7) could be written as:

(i) $\mu_k(Z_k(x)) + d_k^- \geq 1$[28] (8)

(ii) $\mu_k(Z_k(x)) + d_k^- = 1$[22] (9)

(iii) $\lambda + d_k^- = 1$[22] (10)

Where $d_k^- \geq 0$, *k* = 1,2,..,*K*. $\mu_k(Z_k(x))$ represents the membership function for the objective linear or fractional $Z_k(x)$ of '≥' type or '≤' type.

3.3.2 THE EXISTING FUZZY GOAL PROGRAMMING (FGP) METHOD

Method 1 Find $x \in X$

So as to Minimize $\Sigma\, w_k\, d_k^-$

and satisfy $\frac{Z_k(x)-l_k}{g_k-l_k} + d_k^-(\geq \text{or} =)1 \;\; for\; Z_k(x) \gtrsim g_k$

$\frac{u_k-Z_k(x)}{u_k-g_k} + d_k^-(\geq \text{or} =)1 \;\; for\; Z_k(x) \lesssim g_k$

Subject to $Ax \begin{pmatrix} \geq \\ = \\ \leq \end{pmatrix} b$

Where $x \geq 0$, $d_k^- \geq 0$; $Z_k(x) = \frac{c_k x+\alpha_k}{d_k x+\beta_k}$; $k = 1,2,\ldots..,K$; $w_k < 1$, [28,22]. (11)

Method 2 Find $x \in X$

So as to Minimize d^-

Subject to $w_k \lambda \leq \frac{Z_k(x)-l_k}{g_k-l_k}, for\; Z_k(x) \gtrsim g_k$

$w_k \lambda \leq \frac{u_k-Z_k(x)}{u_k-g_k}, for\; Z_k(x) \lesssim g_k$

$\lambda + d^- = 1$

$Ax \begin{pmatrix} \geq \\ = \\ \leq \end{pmatrix} b$

Where $x \geq 0$; $d^- \geq 0$; $Z_k(x) = \frac{c_k x+\alpha_k}{d_k x+\beta_k}$; $k = 1,2,\ldots..,K$; $\lambda \in [0,1]$, $w_k < 1$, [22]. (12)

4 STUDY OF THE EXISTING FGP METHODS

In this section, some of the existing methods for solving FGP problems are analysed.

In this paper a new FGP method will be focused to resolve the fuzzy fractional goal programming problem efficiently with different importance levels.

We know that λ, $\mu_k(Z_k(x)) \in [0,1]$ and $\lambda = \min \mu_k(Z_k(x))$. So the goal constraint in the existing FGP method 1 can be written as $\mu_k(Z_k(x)) + d_k^- (\geq \text{or} = \text{or} \leq) 1$ and in FGP method 2, $\lambda + d^- (\geq \text{or} = \text{or} \leq) 1$.

Therefore in this paper, four new FGP methods have been proposed.

4.1 CONSTRUCTION OF PROPOSED FUZZY GOAL PROGRAMMING (FGP) METHOD

Method 3 Find $x \in X$

So as to Minimize $\Sigma\, w_k\, d_k^-$

and satisfy $\mu_k(Z_k(x)) + d_k^- \leq 1$

Subject to $Ax \begin{pmatrix} \geq \\ = \\ \leq \end{pmatrix} b$

Where $x \geq 0$, $d_k^- \geq 0$; $Z_k(x) = \frac{c_k x+\alpha_k}{d_k x+\beta_k}$; $k = 1,2,\ldots..,K$; $w_k < 1$, $w_k = 1/g_k$. (13)

Method 4 Find $x \in X$

So as to Minimize w d^-

Subject to $\lambda \leq \mu_k(Z_k(x))$

$\lambda + d^- \ (\leq \text{or} \geq) \ 1$

$Ax \begin{pmatrix} \geq \\ = \\ \leq \end{pmatrix} b$

Where $x \geq 0$; $d^- \geq 0$; $Z_k(x) = \frac{c_k x + \alpha_k}{d_k x + \beta_k}$; k = 1,2,.....,K; $\lambda \in [0,1]$, $w_k < 1$, $w_k = 1/g_k$. (14)

Method 5 Find $x \in X$

So as to Minimize $\sum w_k \mu_k(Z_k(x))$

Subject to $\lambda \leq \mu_k(Z_k(x))$

$\mu_k(Z_k(x)) \leq 1$

$\lambda >= 0$

$Ax \begin{pmatrix} \geq \\ = \\ \leq \end{pmatrix} b$

Where $x \geq 0$; $Z_k(x) = \frac{c_k x + \alpha_k}{d_k x + \beta_k}$; k = 1,2,.....,K; $\lambda, \mu_k(Z_k(x)) \in [0,1]$, $w_k < 1$, $w_k = 1/g_k$. (15)

Method 6 Find $x \in X$

So as to Maximize λ

Subject to $w_k \lambda \leq \mu_k(Z_k(x))$

$\lambda \geq 0$

$\lambda \leq 1$

$Ax \begin{pmatrix} \geq \\ = \\ \leq \end{pmatrix} b$

Where $x \geq 0$; $Z_k(x) = \frac{c_k x + \alpha_k}{d_k x + \beta_k}$; k = 1,2,.....,K; $\lambda, \mu_k(Z_k(x)) \in [0,1]$, $w_k < 1$, $w_k = 1/g_k$. (16)

5 ILLUSTRATIVE EXAMPLE

The computational superiority and effectiveness of the FGP methods are illustrated through one example by varying different weights (less than unity).

One example adopted from [19] has been solved and the obtained results are compared with the solution of existing methods and proposed methods.

Example

The fractional programming problem is represented as:

Maximize $Z_1(x) = \frac{x_1 - 4}{-x_2 + 3}$

Maximize $Z_2(x) = \frac{-x_1 + 4}{x_2 + 1}$

$-x_1 + 3x_2 \leq 0$

$x_1 \leq 6$

$x_1, x_2 \geq 0$

Now we attach some tolerances $p_1 = 3$, $p_2 = 6$ to aspiration levels ($g_1 = 2$, $g_2 = 4$) (p_k are subjectively chosen constants).

Now following the proposed fuzzy goal programming method based on the Eq. (15), the FGP model of fuzzy fractional goal programming problem (FFGPP) can be written as:

$$\text{Minimize } w_1 \mu_1 + w_2 \mu_2$$

$$\text{Subject to } \lambda \leq \frac{\frac{x_1-4}{-x_2+3}+1}{3}$$

$$\lambda \leq \frac{\frac{-x_1+4}{x_2+1}+2}{6}$$

$$\mu_1 \leq 1$$

$$\mu_2 \leq 1$$

$$\lambda \geq 0$$

$$-x_1 + 3x_2 \leq 0$$

$$x_1 \leq 6$$

$$x_1, x_2 \geq 0 \qquad (17)$$

Where $w_k > 0$, $w_k < 1$; $w_k = 1/g_k$; $\lambda, \mu_k \in [0,1]$; $k = 1,2$.

Now, for comparison, the fuzzy fractional goal programming problem has been solved by existing methods based on the Eq. (11), Eq. (12) and proposed methods based on the Eq. (13), Eq. (14), Eq. (15), and Eq. (16). The comparison results are shown in the Table 1 and Table 2.

Table 1 Solution by existing FGP methods and Comparison

FGP method based on	w_1, w_2	Solution
Eq. (11) with $\mu_k + d_k^- = 1$	$\frac{1}{3}, \frac{1}{6}$	$Z_1(x) = 2, Z_2(x) = -.66, d^-_1 = d^-_2 = .77$
,,	< 1	$Z_1(x) = 2, Z_2(x) = -.66, d^-_1 = d^-_2 = .77$
Eq. (11) with $\mu_k + d_k^- \geq 1$	< 1	$Z_1(x) = 2, Z_2(x) = -.66, d^-_1 = 0, d^-_2 = .77$
Eq. (12) with $\lambda + d^- = 1$	$\frac{1}{3}, \frac{1}{6}$	$Z_1(x) = 1, Z_2(x) = -1, \lambda = 1, d^- = 0$
,,	.9, .1	$Z_1(x) = 1.5, Z_2(x) = -3/2, \lambda = 1, d^- = 0$
,,	.7, .5	$Z_1(x) = 2, Z_2(x) = -.66, \lambda = .44, d^- = .55$

Table 2 Solution by proposed method and Comparison

FGP method based on	Weights w_1, w_2	Solution
Eq. (13) with $\mu + d_k^- \leq 1$	$\frac{1}{3}, \frac{1}{6}$	$Z_1(x) = .66, Z_2(x) = -2, d^-_1 = d^-_2 = 0$
,,	$\frac{1}{2}, \frac{1}{4}$	$Z_1(x) = .66, Z_2(x) = -2, d^-_1 = d^-_2 = 0$
Eq. (14) with $\lambda + d^- \geq 1$	$\frac{1}{3}, \frac{1}{6}$	$Z_1(x) = 1, Z_2(x) = -1, \lambda = 1, d^- = 0$
,,	$\frac{1}{2}, \frac{1}{4}$	$Z_1(x) = 2, Z_2(x) = -.66, \lambda = .88, d^- = .11$
Eq. (14) with $\lambda + d^- \leq 1$	$\frac{1}{3}, \frac{1}{6}$	$Z_1(x) = .66, Z_2(x) = -2, \lambda = 0, d^- = 0$
,,	$\frac{1}{2}, \frac{1}{4}$	$Z_1(x) = .66, Z_2(x) = -2, \lambda = 0, d^- = 0$
Eq. (15)	$\frac{1}{3}, \frac{1}{6}$	$Z_1(x) = .66, Z_2(x) = -2, \lambda = 0, \mu_1 = .55, \mu_2 = 0$
,,	$\frac{1}{2}, \frac{1}{4}$	$Z_1(x) = .66, Z_2(x) = -2, \lambda = 0, \mu_1 = .55, \mu_2 = 0$
Eq. (16)	$\frac{1}{3}, \frac{1}{6}$	$Z_1(x) = 1, Z_2(x) = -1, \lambda = 1$
,,	$\frac{1}{2}, \frac{1}{4}$	$Z_1(x) = 2, Z_2(x) = -.66, \lambda = 1$

6 RESULTS AND DISCUSSION

In this paper, a numerical example has been solved by the existing FGP methods and proposed FGP methods. According to the comparison results based on the Table 1 and 2, it is to be noted that the objective values are sufficiently close to the aspiration level only when

i) The fuzzy fractional goal programming problem has been solved by FGP method based on the Eq. (11) with $\mu_k + d_k^- = 1$, $w_k < 1$; Eq.(12) with $\lambda + d^- = 1$, $w_1 = .7$, $w_2 = .5$; Eq. (14) with $\lambda + d^- \geq 1$, $w_k = 1/ g_k$ and Eq. (16) with $w_k = 1/ g_k$.

So, the membership goals in existing FGP methods based on the Eq. (11), Eq. (12) should be written as

$\mu_k + d_k^- \geq 1$, $\mu_k + d_k^- = 1$, $\lambda + d_k^- = 1$ and the membership goals in proposed FGP method based on the Eq. (14) should be written as $\lambda + d_k^- \geq 1$ with $w_k = 1/ g_k$.

7 ADVANTAGES OF THE MEMBERSHIP GOALS

The main advantages of the proposed FGP method over existing FGP methods are as follows:

(i) The restriction that $\lambda \in [0, 1]$ is always satisfied even though the weights are varied (less than unity).

(ii) The FGP methods, can effectively handle the vagueness and imprecision in the statement of the objectives and ensure that the more importance of a fuzzy goal, the higher achievement degree it can obtain.

(iii) The FGP methods detailed in this paper over the existing method [19] could be directly applied to solve the fuzzy fractional goal programming problem (FFGPP) and easily solved without any computational difficulties in the solution process even though the number of goals would be increased.

(iv) Based on the example, the objective values are sufficiently close to the aspiration level when the weights in proposed FGP method can be taken as reciprocal of aspiration level.

8 CONCLUSION

In most of the existing FGP methods, the FGP models incorporate each goal's weight into the objective function, to achieve highest degree of each of the membership goals to the extent possible by minimizing their under deviation variables or by maximizing the min operators for corresponding goals. But they do not produce desirable and realistic solution for fuzzy fractional programming problems always when the weights are changed. In this paper, it has been shown that the proposed FGP methods easily find the unique optimal solution for the fuzzy fractional programming problems without any computational difficulties when the weights are less than unity. The solutions are more suitable and realistic in the sense that the goals are achieved nearing perfection. It is hoped that the proposed methods can contribute to future study in the field of real-world multi objective decision making problems.

In this paper, the software LINGO (version 11) has been used to solve the problems.

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Patterns and Dynamics of Psychoactive Substance Use among Street Children in Eldoret Municipality, Kenya

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ABSTRACT: The use of psychoactive substances among street children for survival has been a prevalent problem in most urban centres in Kenya. Eldoret Municipality is one of the regions that has been affected by generally high numbers of street children who in particular capitalize on the use of psychoactive substances to survive on the streets. This paper is an outcome of a study that was conducted in Eldoret Municipality and partly examined the patterns and dynamics of psychoactive substance use among street children in the Municipality. The focus on the Municipality was based on the fact that it is a politically hot spot town and has an ever growing number of street children. This is largely attributed to factors such as poverty, HIV/AIDS, tribal clashes and/or wars, emergence and expansion of low income estates (slums). The research on which this paper draws adopted an ethnographic design commonly used in studies dealing with network analysis or organizational structures. Data was collected by means of semi-structured interviews and focus group discussions with street children and service providers. The study found that glue sniffing and use of other substances like, bhang (Marijuana), alcohol (local brew), smoking and chewing tobacco were most used by the street children and hence, thwarting efforts of rehabilitation and reintegration of street children with their families and/or caregivers. From the findings of the study, there has been little achievement in rehabilitation and reintegration of street children with their families particularly those addicted to various psychoactive substance abuse. This paper concludes that the principal barrier to prevention of psychoactive substance use has been the failure by the government and street children agencies to implement an all-inclusive and sustainable strategy for street children's rehabilitation and reintegration. The authors recommend that the government, health service providers and street children agencies should adopt a holistic health and rehabilitation approach for street children population. This shall lead to eventual removal of street children from the streets not only in Eldoret Municipality, but also in all urban centres in the country.

KEYWORDS: Psychoactive Substance, Patterns, Dynamics, Drug Abuse, Eldoret Municipality, Kenya.

1 INTRODUCTION

Street children constitute a marginalized population in most urban centres of the world. Estimates indicate that there are million of street children in most urban centres throughout the world [1]. These urban centres have been the theatres and the battlegrounds for the children from poor resource settings [2]. Their peer interactions, social networks, living arrangements and survival strategies are much the same all over the world. They have invariably been exploited and marginalized. Various studies have estimated the number of street children in different countries in the world. For instance,

in Ethiopia, Non Governmental Organisations estimated that there are nearly 600,000 street children and 100,000 of these in Addis Ababa [3]. Around 1,000,000 children are believed to be on the streets of Egypt [4]. The Indian Embassy has estimated that there are 314,700 street children in metros such as Bombay, Calcutta, Madras, Kanpur, Bangalore and Hyderabad and around 100,000 in Delhi alone [5]. There are about 10,000-12,000 street children in South Africa [6]. In Bangladesh, around 380,000 were on the street in 2004 (50.8% in the age-group of 11 to 19 years) with 55% of these children residing in Dhaka [7]. In Kenya, there are 250,000-300,000 children living and working on the streets with more than 60,000 of them in Nairobi [4]. In Eldoret town during post-election violence of 2007/2008, the number of street children was between 2500-4000 [8]. However, during this study these numbers had reduced magnificently to 1,500-2,000. This is as a result of various intervention programmes for street children initiated after the post-election violence by various agencies dealing with vulnerable children.

These studies have further indicated that children find their way to the streets because of poverty, overcrowding, abuse, neglect, family disintegration and HIV/AIDS. Over and above, poverty and financial needs have often been major reasons for being on the streets [9]. In Africa, street children reflect the patterns of urbanization and advent of capital economy in the early twentieth century [10], [11]. This has resulted to increased economic problems, political changes, civil unrest, natural disasters, increasing family separations and conflicts. In Kenya, the influx of street children in urban centres has been attributed to the disintegration of the family institution. According to the United Nations Universal Declaration of Human Rights (1948, Article 16.3), the family is the natural and fundamental group unit of society and is entitled to protection by society and State. This means that the family institution has a powerful impact on the lives and identities of individuals. However, the decline of family influence and control over its members, breakdown of the extended family, stresses on the nuclear family, the failing of intimate love, the changing roles of women and sexual permissiveness have drastically changed family structure and its primal roles [12]. This implies that the diminished role of the family system is caused by the failure of the kinship system to provide support for family members in distress. Therefore, when the children do not have someone to take care of them (or assume parental responsibilities), the streets become one of the alternative sources of their livelihood and survival.

As a marginalized group on the streets, street children fall into patterns of drug use in order to cope with their adverse circumstances and survive on the streets [13]. A Drug as defined by the International Convention of 1961 for Narcotic Drugs, and of 1971 for psychotropic substances include all substances and chemicals that should not be used for any purpose other than for medical and scientific research. If used for other purposes otherwise, they are called illicit drugs [14]. As a result, Drug abuse is a maladaptive pattern of substance use leading to clinically significant, impairment or distress [15]. In Nigeria, For instance, the prevalence of psychoactive substance use among street children stands at 45% [16]. In Egypt, 66% of the street children consume various substances or drugs on habitual basis and the consumption is mostly viewed as a common activity among themselves [17]. In Bangladesh, drug and substance use follows a rather predictable developmental progression, beginning with experimentation and recreational use of alcohol and cigarettes. Subsequently, the individual may then progress to the use of marijuana and other illicit substances like opiates [2]. In Brazil, drug-related violence is a particularly serious national challenge that has a negative impact on communities. Street children play an important part in this illicit market, acting as couriers for drug traffickers, and are frequently killed because they know too much, steal too much or are caught in the crossfire between gangs and dealers [18]. In Ukraine, children working and/or living on the streets were found to be disproportionately vulnerable to HIV due to several behavioral factors such as including injecting drugs [19].

Sociological and Anthropological accounts indicate that psychoactive substance use did not start with street children, but human beings have been using psychoactive substances for many millennia and used as food by some human groups or as a coping strategy to some life situations [20]. Psychoactive substance use among street children is a powerful activator of pleasure of centers of the brain thereby potentiating continuing drug-taking behavior. The use of psychoactive substances among street children has been through methods such as ingestion, sniffing, smoking or injection [15]. Various factors such as biological make-up, family background, school environment or neighbourhood and the events at the developmental stage of these children combine to influence psychoactive substance use. Drug use, however, is also about seeking enjoyment, reinforcing solidarity and creating a sense of belonging and status within the group. Moreover, it is a collective protest against stigmatization as street children, and thus a claim to power over their own bodies. Street children take psychoactive substances to experience the effects that come with their mind-active properties [21]. The authors of this paper argue that some drugs are used by street children in the studied area to influence perception, mood, cognitive processes, and emotions which in turn enables them to comfortably fit into the street culture and life.

From a sociological point of view, street children use psychoactive substances specifically as a social activity, socialization and social interaction. Others use psychoactive substances as a way of relieving anger and stress. Group membership among street children plays a central role in the use of psychoactive substances. As reference [22] contends, drugs and alcohol are

compensatory devices for the children since they help relieve hunger pangs, boredom and feelings of being ashamed, and because they help the children to fill a void in their lives, enabling them (at least temporarily) to forget their daily concerns and also facilitate sleep. Reference [23] argued that given that their lifestyle cannot afford the exclusive focusing of their energies on drug procurement and consumption, 'hard' drug use is not as prevalent among children living and working in the street populations as commonly believed. Although, the long-term effects of children living and working in the street's substance use may not be clear, there is evidence that sniffing glue places them at high risk of injury in pedestrian traffic accidents [24]. Reference [25] opined that familial stress and connectedness can actually modulate psychoactive substance use.

Despite various interventions to increase knowledge on problems related to psychoactive substance use among street children, very little has been achieved due to knowledge gaps on patterns and dynamics of psychoactive substance use. This has led to lack of appropriate strategies and preparedness in addressing the problem. Various studies conducted on the existence and extent of psychoactive substance use in Kenya, there is a dearth of literature on the patterns and dynamics of psychoactive substance use among street children. Therefore, this study was conducted to fill this knowledge gap. This is in concurrence with [2] who confirmed that the very individuals (street children) who should benefit the most from drug abuse treatment and prevention efforts are the least studied, the least understood and the most elusive to clinicians, researchers and others concerned with understanding and improving their health-the street children. It is against this background that this paper examined the patterns and dynamics of psychoactive substance use among street children and how it impacts on rehabilitation programmes for street children in Kenya.

2 RESEARCH METHODOLOGY

This paper is an output of a study that was conducted in Eldoret Municipality in the year 2012. Eldoret Municipality is the fastest growing commercial hub of Western Kenya. It's well interlinked with roads, railway and air transport network. It has an expansive agricultural production that offers opportunities for a number of economic activities. Eldoret town is the headquarter of Uasin Gishu County in the North Rift Region of Rift Valley province. The County share common borders with Trans Nzoia County to the North, Elgeyo-Marakwet County to the East, Baringo County to the South East, Kericho County to the South, Nandi County to the South West and Kakamega County to the North West the County has a total area of 3,327.8km^2 (Uasin Gishu County Information Office, 2011). Street children in Eldoret town were first reported in 1989, with numbers increasing significantly in 1991/1992 and 2007/2008 in the wake of post-election violence due to internal displacement that resulted in large numbers of families migrating into impoverished urban slums in Eldoret Municipality [10].

The focus on Eldoret Municipality was based on the fact that it is a politically hot spot town and has an ever growing number of street children. This is largely due to factors such as poverty, HIV/AIDS, tribal clashes/wars, emergence and expansion of low income estates (slums). The town also acts as a strategic meeting point for children from different parts of the country. Thus, Eldoret Municipality was an ideal context to answer the research questions raised in the study. The research on which this paper draws adopted an ethnographic design commonly used in studies dealing with network analysis or organizational structures. Data was collected by means of semi-structured interviews and focus group discussions with street children and service providers. This paper is based on the findings of objective three of the study which partly examined street children's survival mechanisms on the streets. The paper significantly revolves around the patterns and dynamics of psychoactive substance use among street children in the study area. This is vital in understanding how it influences their survival on the streets.

3 FINDINGS AND DISCUSSIONS

3.1 INITIATION OF STREET CHILDREN INTO STREET LIFE

The study found that initiation gives a street child entry into the streets and entry into a new sub-culture within the streets through basic socialization. Once they start living on the streets, base members spend their time together in sleeping places, carrying out different routine activities including the consumption of various substances such as glue and alcohol. Pressures for conformity among street children are emphasized and express the shared principles of solidarity, unity, bonding and protect the collective interest of the street children. The set norms, rules, regulations and values also determine the social relationships and identity within the members and as a result, become imperative for their own survival. However, the study found that the rules and regulations are not adhered to or put into practice by some street children. This was very common in bases that are heavy drug users who are always in conflict with the set norms and regulations.

3.2 PATTERNS OF PSYCHOACTIVE SUBSTANCE USE AMONG STREET CHILDREN ON THE STREETS

In human history, almost in all cultures people have used some kinds of substances and the use of substances has continued over generations [26]. However, today, use of these substances has increased and has led to an increase in the consequences. The study found that the uptake of psychoactive substances among street children is associated with many health and risk factors. These health risk factors included behavioral such as belligerence, theft, begging, fighting, telling lies, being sexually abused to get the psychoactive substances to consume. Health physical factors included chest ailments, skin diseases, nutritional diseases, and various forms of substance which induced violence based on how they obtain the psychoactive substances for consumption. A significant number of street children psychoactive substances were highly vulnerable to health risks given that that they had neither regular source of health care nor access to counseling therapy.

The study established that push factors such as poverty, psychological difficulties, illnesses and lack of educational and recreational opportunities led children into the streets. These factors had a positive correlation with the way they operated on the streets. The study found that these factors including peer influence, street life situations and accessibility of drugs and substances acted as significant motivators to psychoactive substance use among street children. Street children assume that psychoactive substance use may provide excitement, or help in imagining a better future and offer relief from physical, psychological and emotional pain. The study observed that glue sniffing was one of the most abused substances among the respondents. This greatly affected the health of street children as it has severe risk of brain damage, and respiratory infections. This finding is consistent with [26], [10], and [11] who found out that the street children who are heavy users of psychoactive substances severely affect their health. They are easily recognized by their ragged clothing, soiled faces, scaly skins, looking drowsy with glazed eyes, and the effects of brain damage are observable among long-time users. During the study, one of the key informants from a Non-Governmental Organization narrated that:

On their arrival on the streets, street children start sniffing glue and most of them get fantasy, lose appetite, and become weak and drowsy. When street children come to our centre they tell us that they were introduced to glue sniffing by other street children. They embarked on scavenging, begging, pick pocketing, prostitution and doing menial jobs…to finance their addiction. The children tell us that when the glue is inhaled, and one becomes addicted to it, it boosts one's confidence, reduces one's social concern, and stops hunger pains, helping them to forget problems and giving them courage to face dangers. Heavy users of drugs develop a don't care attitude (NGO worker, Male, 31: June 2012).

During interviews, a street girl narrated that:

When you are living on the streets, there are some things that you cannot do when you are sober. For example, eating from the dustbin, pick pocketing, begging and sleeping in the cold. Therefore, you need to sniff glue so that you can have the courage and confidence to eat from the dustbin and do all these on the streets (Street girl, 17 years).

From the above evidence, it implies that sniffing glue and using other psychoactive substances gives you courage and confidence of pursuing various activities while on the streets. And psychoactive substance use has been developed as a culture among street children and many children may use it as a way of belonging to a group or social bonding.

3.2.1 INITIATION TO DRUGS AND SUBSTANCES USE

The study revealed that over 50% of street children have experience in psychoactive substance use. For all psychoactive substance users, experimental use was the rule. The study found that some street children use only a particular psychoactive substance and others uses more than one psychoactive substance. Most of the new street children who try a given illicit drug do not use it regularly. However, they will start use it regularly when they are useda or addicted to the substances. Findings from the study showed that the earliest age of psychoactive substance use among street children in Eldoret Municipality is 5 years. However, usage of psychoactive substances arose sharply from children aged 12 years and had stayed more than three years on the streets. It was evident that the more street children stayed on the streets and approached teenagehood they graduated to using more hard drugs such as cocaine. This is consistent to what [28] found that as vulnerable young people approach their teenagehood there is a likelihood to involve themselves in illicit drug use such as heroin, cocaine among others.

The study found that glue was the most used psychoactive substance by street children. Majority of the street children in the study identified themselves with one or more forms of psychoactive substances. Findings of the study revealed that glue sniffing, locally brewed alcohol, miraa and marijuana were the most common psychoactive substances used by street children in Eldoret Municipality. Glue sniffers were found to frequently use other substances in addition to glue. A large proportion of the current glue sniffers used alcohol (54%). Other substances used by the current glue sniffers were marijuana (16%), alcohol miraa (8%), heroin/cocaine (6%), injectables (2%) and other groups of street children (14%) used glue only. The

study found that most street children are addicted to glue sniffing due to their persistent use. Some street children lamented that they sometime substitute it with food. This is also confirmed by other studies that glue is a popular intoxicant among street children throughout the developing world because it is very cheap, diminishes pain, reduces fear, increases bravado, and suppresses hunger [29].

Besides, the study found that living alone on the streets was associated with the use of psychoactive substances due to the freedom to experiment and unrestrained exposure to drug and substances. This is also confirmed by literature that street childrens' psychoactive substance use is one of the ways to overcome boredom and a survival strategy to harsh living conditions on the streets. Drug use is an attempt to escape from everyday strains and negative feelings experienced by street children. The study revealed that street children repeatedly suffer from depression, shame, helpless, unwanted, low self-esteem and loneliness. In turn they indulge in drug use provides temporary relieve from these negative emotions and thoughts and helps not to think about future. Findings from key informants revealed that planning of drug abuse and prevention services for street children were planned, however, this was hampered by lack of coordinated efforts and the absence of reliable information for designing appropriate interventions.

The study sought to understand the categories of children who used psychoactive substances. The study found that majority (54%) of street children who were orphaned or came from problematic families engage in psychoactive substance use. Seventeen percent (17%) of the respondents from this category had experience of using psychoactive substance before they came to the streets. They started using psychoactive substance for the reason that their parents or guardians use it. However 46% of the respondents learned the use of psychoactive substance while they were on the streets. This is similar to [31] study, which showed that adolescents are more likely to start smoking if their parents' smoke. This is due to lack of moral guidance while growing up. This is also in concurrence with other studies which have shown that more often than not, most children from dysfunctional families engage in psychoactive substance use [30].

3.2.2 PEER INFLUENCE

Drug possession was also very common to most street children. Drugs abused included glue, bhang (Marijuana), chang'aa and busaa. During Focus Group Discussion with the children, one participant posited that:

I mostly sniff glue because it helps me not to feel shy, pain, hungry and feel cold at night because I sleep on the corridors or Verandah (Male street boy, Age, 14).

The study found that peer influence was the main reason for sniffing glue with more than 75% of the current glue sniffers. Other reasons included coping with cold environment (47%); forgetting family problems (28%); out of curiosity (25%); sniffing is an alternative to food (16%); and out of frustration (19%). Majority of the street children were sniffing glue in groups as this gave an opportunity for those children who did not afford to buy theirs to share what their colleagues had. The study found that there were very minimal cases of Injecting Drug Users (IDUs). The few cases of Injecting Drug Users were more prevalent among teenagers who had stayed on the streets for a longer period (*over three years)*. Findings of the study on health status of the respondents showed that glue sniffers were less likely to seek medical care when they had a health problem. Thirty five percent (35%) of glue sniffers opted for self medication compared to (4%) of non-glue sniffers who complained of negative reception by medical professionals in the hospitals they visited. This also gives a reason why there was low utilization of the public health facilities among street children in Eldoret Municipality.

3.3 DYNAMICS OF SUBSTANCE USE AND DRUG ABUSE

The study found that street children were fond of using psychoactive substances that were readily available and affordable. The study revealed that how drugs are distributed, how drugs get from one base A to Base B was through the networks street children and their leaders have created on the streets. Some street children who didn't have money to buy psychoactive substances, they could exchange with other materials such as clothes, food and even sex for drugs and the consumption of these substances is eminently social activity, relational and active and acted as a medium of social interaction. This implies that street children care for each other and they practice generalised reciprocity for them to survive on the streets. The study observes that psychoactive substance abuse operate as the medium of exchange in interpersonal relations and interceding relationships between street children and their leaders to confirm social allegiances.

From the foregoing discussion, this study observes that individuals sometimes choose to use substances in order to enhance the perceived rewards of other experiences. When used for this basis, the substance begins to fulfill multiple functions for the user such as serving to enhance sex, improve social situations and advance the user's sense of self-worth. As the substance user becomes increasingly dependent upon the psychoactive substances to fulfill unmet needs and

compensate for deficits in coping skills, their capacity to handle life problems diminishes. The study found out that despite the negative health effects of drugs, street children are persistent users notwithstanding, adverse consequences. Addiction involves continuing to use even though one knows it is causing problems. Street children revealed that the effects of psychoactive substance use resulted to feelings of well being, and relaxation.

3.3.1 HEALTH RELATED BEHAVIORS AMONG STREET CHILDREN

Street children are faced by numerous health related problems due to the kind of environment they are exposed to. These include sleeping outside in the cold, high sexual activities, and unhygienic food and water. Consequently, they are prone to health complications. The researcher was interested in understanding the kind of health risk behaviors children engage in while on the streets. The researcher found that street children indulge in risk health related behaviors that end up affecting their health. Analysis of the findings indicated that glue (50%) was used by majority of the respondents, followed by eating dirty food (21%), smoking cigarettes and bhang (13%), taking alcoholic drinks (9%) and prostitution (6%) respectively. From the focus group discussions with respondents, it was found out that street children are at risk to sexually transmitted infections (STIs) such as HIV/AIDs, gonorrhea, and syphilis. These infections can be attributable to ignorance, multiple sexual partners, lack of information, low rates of condom use and psychoactive substance abuse. The repeated use of drugs and substance use resulted to intoxication, which affected children's alertness, perceptions, decision making, judgment, emotions and their moral behaviour. The combined effects of psychoactive substance use made them even more dangerous. Psychoactive substances have many effects that are the result of improper use and direct exposure or use. Glue sniffing was the most common and abused because it is relatively cheap, easily available and mostly shared amongst street children.

4 EMERGING ISSUES

Article 33 of the Convention on the Rights of the Child states that:

States Parties shall take all appropriate measures, including legislative, administrative, social and educational measures, to protect children from the illicit use of narcotic drugs and psychotropic substances as defined in the relevant international treaties, and to prevent the use of children in the illicit production and trafficking of such substances.

On the contrary, findings from the study shows that most developing countries including Kenya do not have proper frameworks to monitor the use and trafficking of illicit drugs and substances, hence the drugs are easily accessed and used by street children. For instance, in Kenya, psychoactive substances such as glue have not been classified as a dangerous substance to street children.

Literature review from previous studies and the findings of this study indicate that children of drug or substance dependent parents or caregivers are at particular risk for later drug use. Therefore, there is need to protect children from such environments to protect them from entry into psychoactive substance use. The opportunity to attend school is an important protective factor for children who are able to attend school as well as educating them on the side effects of psychoactive substance abuse. The quality of school experience has an impact on their health and on their likelihood of engaging in risky behavior such as drugs and substance use. This paper observed that most street children and youths who are not in formal education system will eventually engage in psychoactive substance abuse. Therefore, they can be reached by street educators and other service providers for guidance and protection. In addition, the authors argue that protective factors help set a healthy channel and provide a safeguard against risk factors. There is need for well established rehabilitation and reintegration programmes so that the street children can benefit from the protective effects of healthy family, social, school and community environments.

5 CONCLUSION AND RECOMMENDATIONS

From the foregoing discussion, it is evident that psychoactive substance use among street children is a major challenge for street children in Eldoret Municipality. From the findings of the study, there has been little achievement in rehabilitation and reintegration of street children with their families particularly those addicted to various psychoactive substance use. Developing and implementing a plan to prevent harm from psychoactive substance use among street children, is an intricate undertaking that requires multi-stakeholder and coordinated efforts over a long period of time. Therefore, the role of the street children agencies and other service providers in preventing psychoactive substance use should be participatory and also involve street children and not merely that of responding to services planned and designed by peripheral agencies or individuals. The authors observed that the principal barricade to prevention of psychoactive substance use has been the failure by the government and street children agencies to implement an all-inclusive and sustainable strategy for street

children rehabilitation. Based on the finding of the study, this paper recommends that health service providers and Non Governmental Organizations should develop holistic health programmes that would address street children's' health issues not only in Eldoret Municipality, but also throughout the country and most importantly get children off the streets.

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