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Effect of Boron on flower and fruit set and yield of ratoon Brinjal crop

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ABSTRACT

*This investigation was undertaken to study the effect of boron on flower and fruit setting and yield of ratoon crop of brinjal (*Solanum melongina L) in the Eastern Region of Sri Lanka. *The treatments were arranged in a Randomized Complete Design (RCBD) replicated three times. The treatments were defined as follows: T1-50 ppm, T2-100 ppm; T3-150 ppm and T4- Control along with recommended fertilizer. All other agronomic practices were in accordance with the Department of Agriculture. The results showed that foliar application of boron (H_3BO_3) at 150 ppm increased the number of flower buds/plant (70%), number of flowers/cluster (141%), number of flower clusters/plant (48%), total number of flowers/plant (122%), percentage of flower set (30%), percentage of fruit set (46%), number of fruits/plant (216%) and fresh weight of fruits/plant (88 %) than that of control. It was, therefore, concluded that foliar application of H_3BO_3 at150 ppm (at flowering stage) could increase the percentage of flowering, fruit set and fruit yield per plant of ratoon crop of brinjal.*

Key words: Brinjal, flower set, fruit set, ratoon, Boron

1. INTRODUCTION

Brinjal is known as eggplant or Aubergine (*Solanum melongina L)* belongs to the family solanaceae. It is one of the most popular and widely used low country vegetables in Sri Lanka and tropical countries as well. It is native to Sri Lanka and India. In Sri Lanka, total production of brinjal is 127,163 MT in an extent of 11760 ha in year 2012 (Ag stat, 2013). Brinjal is grown in an extent of about 169 ha in year 2012 (Ag stat, 2013) in Batticaloa District.

It is a hardy plant compared to other vegetables cultivated in Sri Lanka. It can, therefore, be grown in very dry areas under rain-fed conditions or with minimum irrigation facilities. Eggplant can be maintained for more than one year in production by pruning at the end of the harvesting season. Then the crop is fertilized and maintained as main crop and this is known as ‘‘ratoon crop.’’ Nonetheless, the yield of ratoon crop is far lower than the main crop, but in terms of cost of production it is cost effective.

Nutritionally, brinjal is low in energy (30 kcal/100g), protein (1.2%) and vitamin C (5 mg/100g), but is a very good source of dietary fiber, potassium, calcium, manganese, copper and vitamin also possess antioxidant ability (KAU-AgriInfotech portal, 2012). The yield potential and quality of fruits could be improved by maintaining proper fertilizer application. Nutrients play an important role in production of brinjal. It is clearly evident that chemical fertilizers ameliorate plant growth directly (Splittstoesser, 1990).

Micronutrients such as boron had great influence on plant growth and development. The essential physiological activities of boron linked to strength of cell wall and development, RNA metabolism, sugar transport, hormones development, respiration, cell division, Indole acetic acid (IAA) metabolism and as part of the cell membranes (Marchner, 1995). Boron deficiency causes delay in pollen germination and pollen tube development and ultimately it halts flowering and fruit setting (Halfacre, and Barden, 1979). Further, macronutrients are quickly absorbed and utilized by the

tissues of the plants by the catalyzing effect of micronutrients (Phillips (2004). Foliar spray of micronutrients is the common practice to overcome the deficiencies in order to improve the quality of fruit. Nutrients are generally quickly available to the plants by the foliar application than the soil application (Phillips *et al*., 2004 and Silberbush, 2002).

Boron also plays an important role in flowering and fruit formation Nonnecke (1989). Several studies have been conducted on effect of boron on flowering and fruit setting in tomato and potato which are belong to the same family Solanaceae. Nevertheless it is very rare to find studies on brinjal that also come under same family.

Most of the ratoon crops are raised as main crop. However, the yields are very low. Foliar application of boron may be able to improve flowering, fruit sett and yield of ratoon crop. To date no systematic study has been carried out to test the effect of foliar application of boron on flowering, fruit setting and yield of ratoon crop of brinjal and no evidence is available on the response of boron application in the sandy regosols. Hence, this investigation was undertaken to study the effect of boron on flowering, fruit setting and yield of ratoon crop brinjal (variety Thinnavelli purple) in the regosol in the Batticaloa District in Sri Lanka

2. MATERIAL AND METHODS

The study was carried out during the period Jan- March 2013 on a sandy soil at the Crop Farm of Eastern University of Sri Lanka, Chenkalady, Sri Lanka, with the variety of brinjal ''Thinnavelli purple'' (Latitude between 7^0 43' and 7^0 431/2' N and the Longitude between 81^0 42' and 81^0 43' E) which falls within dry zone of Sri Lanka and DL2 agro-ecological zone. The texture of the soil was sandy with structure less single grain.

The experiment was carried out in a Randomized Complete Block Design (RCBD) replicated three times. There were twelve treatment combinations.

The ratoon brinjal crop (variety Thinnavelly purple) was allowed to grow as main crop with the addition of recommended fertilizer. All other agronomic practices were done as recommended by the Department of Agriculture. The treatments were comprised of 0, 50, 100 and 150 ppm of boron (H_3BO_3). Plants were sprayed 3 times at full bloom and other two were given at an interval of 10 days. Foliar sprays were applied using a hand sprayer.

Data were collected on number of flower buds, flowers/axil,number of flowers $plant^{-1}$, number of flower clusters/plant, flower setting percentage, number of pods and fruit set percentage. Total yield (g) was measured using digital balance. Data were reported as mean of six plants of each replicate of a treatment.The data were analyzed using SAS software and the mean comparison was done by using LSD at 5% level.

3. RESULTS AND DISCUSSION

Number of flower buds per plant

Number of flower buds is the prime factor which determines the ultimate yield of a plant. Foliar application of boron had an effect on number of flower buds per plant (Table 1). It was found that the application of 150 ppm of boron (H_3BO_3) produced ($p<0.02$) maximum number of flower buds (47), followed by foliar application of 50ppm (34) and control (28). This might be due to adequate amount of boron present to foliage which is used for development and growth of new cell in the plant meristem. It is also reported that boron maintains substantial amount of carbohydrate movement from senescing foliage region such as leaves and bark to flowering meristematic cells (Rashid *et al*., 2004).

Number of flowers /cluster

Number of flowers on an axil is an important parameter that determines yield of a plant. Highest number of flowers/axil was recorded ($p< 0.01$) in plants receiving 150 ppm of H_3BO_3 than other treatments tested (Table 1). The number of flowers/cluster was similar in the foliar application of H_3BO_3 at 50 and100 ppm and control. Therefore, higher the boron concentration was necessary to increase the number of flowers/cluster. There was no evidence to support this finding. Therefore, it

was concluded that foliar application of H_3BO_3 enhanced the number of flowers/cluster by 2.4 times compared to control treatment.

Total number of flower clusters/plant and total number of flowers/plant

Total number of flower clusters/plant and total number of flowers/plant are presented in Table 2. Maximum number of flower cluster per plant (16.33) was obtained ($p< 0.05$) in plants receiving 150ppm of H_3BO_3, followed by 100 ppm (13), and control (11) (Table 2). Therefore, foliar application of 150 ppm increased the number of flower cluster/plant by 48.45 % compared to that of control.

In total number of flowers, highest total number of flowers per plant was obtained ($p< 0.001$) with 150 ppm of boron while lowest number of flowers was obtained with control treatment. Therefore, application of boron increased the total number of flowers by 122% than control treatment tested. It may be attributed to the effect of boron in IAA metabolism which increases number of flowers and stimulates the phosphorus uptake by roots of plants that in turn promoted development of flower clusters (Day, 2000). This is in contrast to studies where total number of clusters/plant of tomato increased with increase in concentration of H_3BO_3 at 1250 ppm (Shnain, 2014).

Oyewole and Aduayi (1992) noted that application of B at 2 ppm to tomato plants increased the number of flowers. However, in this experiment, the concentration of boric acid used was 75 times greater than that used by Oyewole and Aduayi (1992). Naz *et al*. (2012) documented in the tomato that plants treated with boron yielded higher number of flower clusters than control treatments.

Percentage of flower set

Maximum percentage of flower set (93.03 %) was attained with the foliar application of 150 ppm of H_3BO_3, followed by 50 ppm (74.04 %), and control (71.31 %). It is clear that boron treated plants showed higher percentage of flower set than untreated plants (Fig.1). This is due to effect of boron that stimulate phosphorus uptake which promotes flowering directly. Boric acid spray had favorable effect on retention of flowers. These results are in agreement with those of (Smit and Combrink (2005) who reported that too low levels B in root zone may be the reason for significant (fraction) abscission in flowers and optimal level of B for the growth and performance of tomato appeared to be 0.16 mg L^{-1}(160 ppm).

Percentage of fruit set

The percentage of fruit set is represented by Fig. 2. Maximum percentage of fruit-set was attained with the foliar application of 150 ppm (91.4%), followed by 50 ppm (68.23 %), and control (62.77 %). It is evident from the result that boron treated plants showed higher percentage of fruit set than untreated control. This may be attributed to imperative role of B in maintaining of cell integrity, enhancing respiration rate, increasing uptake of certain nutrients and metabolic activities such as IAA which increases the fruit set (Shnain *et al*., 2014]. Huang *et al*. (2000) reported that boron deficiency cause abnormal development of reproductive organ. Fruit set may be limited by a suboptimal boron supply particularly if no other means for pollination are applied (Smit and Combrink 2005). Naz *et al*. (2012) reported that application of B increases the percentage of fruit set in tomato plant which is also come under family Solonaceae. Ali *et al*. (2013) reported that 60 % of fruit setting percentage with 5 x 10^6 ppm of boron in plant of Solanaceae family and Nonnecke (1989) also attained similar findings. However, in this study 41.6 % of fruit setting was obtained with 150 ppm than that of control. It may be due to genetic variability and micro and macro environmental conditions that persist during the flowering and fruiting season.

Number of fruits per plant

Significant difference was observed in the average number of fruits per plant of boron treated plots (Table 3). Highest number of fruits/plant was recorded at the foliar application of 150 ppm than the other treatments tested. Number of fruits/plant obtained at the foliar application of 100 ppm was

significantly greater than that of control. Application of B at 150 and 100 ppm increased number of fruits per plant by 216% and 94.7% respectively.
This attributed to the accessibility of boron by foliar feeding and the key role of boron on cell integrity, sugar transport, RNA metabolism and enhancing respiration rate, increasing uptake of certain nutrients and metabolic activities. Ali *et al*. (2013) documented that boron increases the number of fruits in tomato (30 fruits at 5x 10^6 ppm). Shnain *et al*. (2013) reported higher number of fruits/plant at 1250ppm of boron in tomato. However, in this finding higher number of fruits was recorded at the foliar application of 150 ppm which was 8.3 times lesser than the concentration used by Shnain *et al*. (2013).

Weight of fruits/plant
Weight of fruits/plant was significantly ($p< 0.001$) affected by the foliar application of H_3BO_3 (Table 3). Highest weight of fruits/ plant was recorded in the plants receiving 150 ppm of H_3BO_3, followed by plants receiving 100 ppm of H_3BO_3 and lowest weight was recorded in the treatments 50 ppm of H_3BO_3 and control. Foliar application H_3BO_3 at 150 and 100 ppm of H_3BO_3 increased weight of fruits by 88% and 49% respectively. This may be attributed to greater photosynthetic activity, resulting the increased production and accumulation of carbohydrates and favorable effect on vegetative growth and retention of flowers and fruits, which might have increased number and weight of fruits. The results of this finding is in agreement with studies done by Davis *et al*. (2003); Lalit Bhatt *et al*. (2004); Naga *et al*. (2013) and Basavarajeswari *et al*, (2008) in tomato.

4. CONCLUSION

It is clear from the results that foliar application of boron (H_3BO_3) at 150 ppm enhanced the number of flower buds/plant (70%), number of flowers/cluster (141%), number of flower clusters/plant (48%), total number of flowers/plant (122%), percentage of flower set (30%), percentage of fruit set (46%) number of fruits/plant (216%) and fresh weight of fruits/plant (88 %) of cv ‘‘Thinnavelli purple.’’ Application of 150 ppm showed a significant response in all the parameters tested than that of other levels tested. It was, therefore, concluded that 150 ppm of H_3BO_3 as foliar application could be used to increase the flowering, fruit set percentage and fruit yield per plant of ratoon crop of brinjal.

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Table 1: Effect of different concentration of B number of flower buds/plant and number of flower/axil

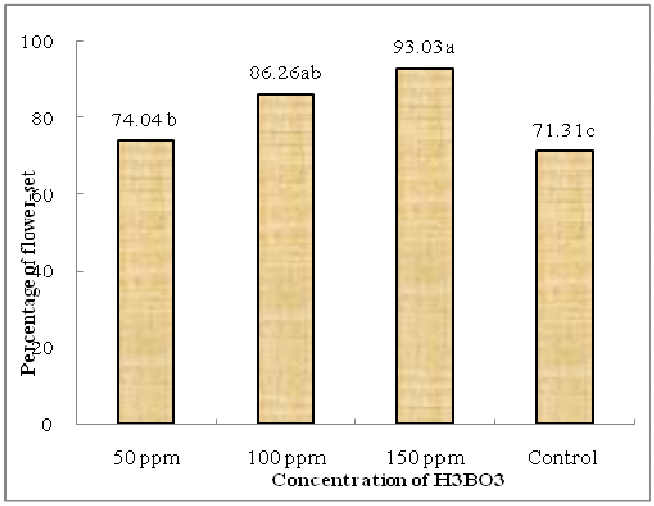
Treatment (Boron ppm)	Number of flower buds per plant	Number of flowers/cluster
50	34.33[b]	3.3[b]
100	38.67[ab]	3.3[b]
150	47.00[a]	5.3[a]
Control	27.67[b]	2.2[b]
F Test	0.0218	0.0152
LSD	11.059	1.66

Means followed by the same letter in each column are not significantly different to Least significant different at 5% level

Table 2: Effect of different concentration of B on total number of flowers/plant and number of flower cluster/plant

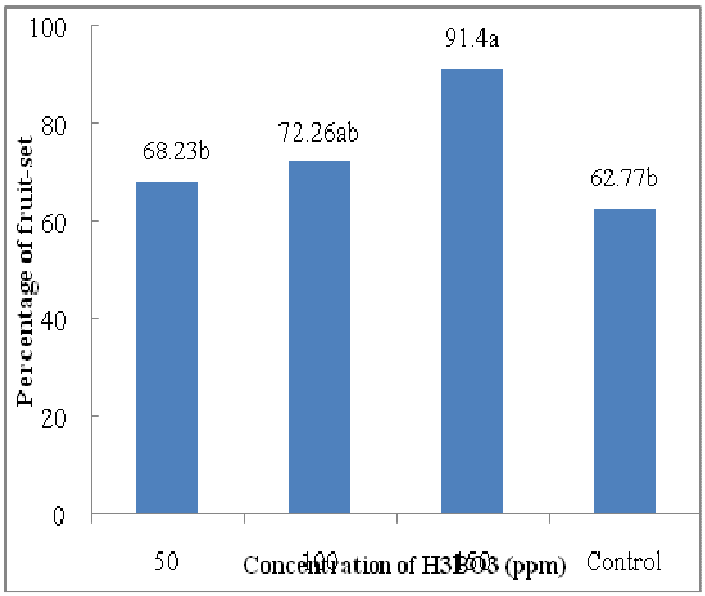
Treatments (Boron ppm)	Total number of flower clusters/plant	Total number of flowers/plant
50	11.67[b]	25.00[bc]
100	13.0[ab]	33.67[b]
150	16.33[a]	43.67[a]
Control	11.00[b]	19.67[c]
F Test	0.0437	0.0018
LSD	3.72	9.367

Means followed by the same letter in each column are not significantly different to Least significant different at 5% level



Means followed by the same letter in each column are not significantly different to Least significant different at 5% level

Figure 1: Effect of different concentration of B on percentage of flower-set of brinjal



Means followed by the same letter in each column are not significantly different to Least significant different at 5% level

Figure 2: Effect of different concentration of B on fruit set percentage of brinjal

Table 3: Effect of different concentration of B on number of fruits/plant and weight of fruits/plant

Treatment (Boron ppm)	Number of fruits/plant	Number of flowers/cluster
50	16.67^{bc}	552.50^{c}
100	24.67^{b}	815.28^{b}
150	40.10^{a}	1030.83^{a}
Control	12.67^{c}	548.33^{c}
F Test	0.0006	0.001
LSD	9.17	191.57

Means followed by the same letter in each column are not significantly different to Least significant different at 5% level

A Survey on Jamming in VANET

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Abstract

Vehicular Ad Hoc Networks (VANET) has attracted today's research efforts. Despite the attention that VANET research got, current solutions to achieve secure VANET still undergoing to protect the network from adversary and attacks. The need for a reliable VANET networks is strongly tied to the security and privacy features. This paper provides a detailed study on wireless networks and focuses on undergoing research solutions to secure VANET. In particular, this paper provides intensive information regarding jamming problems in wireless network and shows the seriousness of this type of attack. Moreover, a various types of security problems and challenges of VANET been analyzed and discussed; we also surveyed different set of solutions that research has proposed to help securing wireless networks.

Keywords

VANET, Jamming, Security,

1. Introduction

Traffic fatalities have been increasing all over the world. The National Highway Traffic Safety Administration (NHTSA) statistics shows that in 2012, there were over 30 thousand fatal crashes in which, passengers, drivers and even pedestrians were affected. The number is still increasing due to continually issuing driving licenses and more vehicles being purchased. In 1994, there was over 190 thousand vehicles registered and 175 thousand licensed drivers. These numbers jumped in 2012 to more than 265 thousand registered vehicles and 211 thousand licensed drivers [15]. These numbers have showed a direct relation with the number of fatalities. As a result, the need to have safer roads started to arise to reduce money and lives losses.

Integrating cars with computers was the first step toward reducing fatalities. Equipping vehicles with computers to monitor and control car's components helps drivers to identify problems in their cars, e.g., engine failures and improve safety by providing an early warning of cars malfunction. Computers in cars first appeared by Chevrolet in 1975. Soon after that, many cars' manufacturers started adopting the technology and integrating new systems to vehicles. Doing so, allowed many systems to be standardized such as Electronic Control Unit (ECU). ECU consists of different modules that control different electrical systems or subsystems in motor vehicles: engine control module (ECM), Transmission Control Module (TCM), Brake Control Module (BCM), is systems referred at as car's computer [6] [14].

While deploying ECU in cars increases the quality and safety of driving, it only helps drivers to identify car's internal malfunction. That's because ECU can only provide information regarding different cars parts. ECU cannot report external hazards that are important to take into counts; road hazards, weather changes, and accidents on roads are only some examples of external factors that affect drivers' safety.

The new era targets making cars more intelligent to enhance drivers' safety by protecting drivers against internal and external hazards. This can be achieved by equipping cars with early warning capabilities against any type of hazards that drivers may encounter. Implementing intelligent transportation system (ITS) was the first step to achieve this goal. ITS, which is a national program, intended to use modern computers and communications to make driving safer, smarter, faster and more convenient. To achieve these goals, ITS provides automatic toll collection, traveler information system, intelligent commercial vehicles and intelligent traffic control systems [2]. The main goal of ITS program is to equip every car with communication capabilities, so that cars can communicate with each other's, i.e. vehicle-to-vehicle (V2V), and with different communication centers spread down the roads – called Road Side Units (RSU)– the latter communication is called vehicle-to-infrastructure (V2I). The combination of V2V and V2I communications forms VANET (Vehicular Ad-Hoc Network).

VANET promises a safer environment for everyone who shares the road, by alerting pedestrians, vehicles and motorcyclists to avoid fatality. The alerts are generated by collecting data from nodes in VANET and provide warning messages to nodes that are in affected areas or routing toward it. Additionally VANET increases comfort by allowing automatic toll collection, traffic congestion detection, emergency dispatch services, and electronic inspection of moving trucks through data transmissions with roadside inspection facilities [11]. VANET proved how useful these warning messages to avoid crashes, safe lives and enhance driving experiences.

The Research and Innovative Technology Administration (RITA) has acknowledged the need to utilize technology for safety purposes. Hence it allocated 75 MHz in the 5.9 GHz frequency band licensed for Dedicated Short-Range Communication (DSRC) [1]. The U.S. Department of Transportation commitment to DSRC highlights two critical points: (1) safety is the highest priority and is the central focus for the connected vehicle technologies. (2) The analysis illustrates that DSRC is the only available technology in the near-term that offers the latency, accuracy, and reliability needed for active safety [2]. Thus many organizations and manufacturers started advocating VANET by investing on perfecting it.

In spite of the ongoing research efforts from, academic and industry, many security issues remain to be resolved. Since VANET is expected to provide safety for drivers, it is essential to secure it against abuse, and ensure the Quality of Service (QoS) in the presence of security breaches. However, security and QoS are two requirements that are related but in conflict. When security increases QoS drops and vice versa. Hence, VANET needs to strike a balance between the two goals (security and QoS) to make it real.

Despite the different types of attacks that may be carried out, we can categorize their importance in terms of: Authentication, Availability and non-repudiation, which are the security requirements that have been validated [7]. Although, authentication and non-repudiation are important, availability is the foundation for all different type of networks and has to be assured. One of easy-to-launch yet, hard-to-cope threats is jamming attack.

Jamming attacks can affect VANET availability, because a jammer can block warning messages e.g. accident warning, road hazard, emergency vehicle etc. The consequences of not receiving these messages can result in failing to slow down, rerouting or stopping the vehicle, which can jeopardize drivers' and passengers' safety. It is difficult to detect jamming reliably and the impact can be devastating. Hence, Jamming is an open problem. This paper surveys the security issues that VANET may encounter in particular Jamming attack. At the same time, it surveys current and different solutions for jamming attack in other type of networks and show the specialty of coping jammers in VANET. The paper is organized as follow, section 2 provides background information. Security challenges and goals will be discussed in section 3. Section 4 will survey available solutions for jamming problem. Future work and improvements will be discussed in section 5. Finally a conclusion will be given in section 6.

2. Background

In this section we provide background on VANET and discuss the importance and need of VANET. The reality of VANET will be discussed as well and real examples will be given to prove that VANET is becoming a reality.

2.1 VANET Infrastructure & Standards.

VANET, a type of ad hoc networks, is a self-organized and infrastructure-less network. In this type of networks, mobile devices are connected together wirelessly [10]. Each mobile device (called a node) acts as both data terminal and router. Nodes in the network use the wireless medium to communicate with neighboring ones within range. These nodes can

be vehicles or roadside units (RSUs) in VANET.

The discovery of VANET appeared after the wireless data networks proliferation due to the recent adoption of the various 802.11. Wireless LANs are widely deployed and the cost for wireless equipment is dropping. 802.11 adapters or access points (AP) can be purchased for next to nothing. As a result of the high acceptance of the 802.11 standards, academic and commercial sectors focused on finding other applicable wireless technologies. Hence, Mobile ad-hoc network (MANET) is one area that has received considerable attention which led to VANET development. MANET and VANET are very similar at the network level yet the details differ. They key difference is that nodes in MANET move randomly while in VANET, vehicles tend to move in an organized fashion. The advantage of using ad hoc networks is to allow the deployment in areas where it is impossible to install the needed infrastructure. It would be unrealistic and costly to install 802.11 access points to cover all the roads in The United States for instance. Another advantage of ad hoc networks is how easily and quickly they can be deployed without administration involvement.

The Federal Communications Commission (FCC) acknowledged the importance of VANET. Hence, it allocated 75 megahertz of spectrum in the range 5.850 to 5.925 GHz to be used for V2V and V2I communications. The 5.9 GHz spectrum was named Dedicated Short Range Communication (DSRC) and its goal is to enable technologies that support safety applications and communication between vehicle-based devices and infrastructure to reduce collisions [24]. DSRC consists of seven 10MHz channels in which, six channels are used for services and one channel for control [12]. The control channel is used to, for example, broadcast safety messages to alert drivers of potentially hazardous road conditions. Also, the control channel is used to announce the services that are available. If a vehicle finds a service of interest on the control channel, it then switches to one of the service channels to use the service. The ultimate target for all channels is to enable drivers to receive information about their surrounding environment. Besides safety related messages, service channels can announce places of interest (e.g. restaurants in the area or gas stations) in the driver's locations to enhance comfort [13].

2.2 VANET becoming reality

The discovery of VANET has drawn much interest all over the world. In Japan, many ITS projects have been established in 2000 to bring VANET to reality. A standard for V2I communication was published in 2001 and denoted as DSRC (which was adopted by FCC in 2004) [22]. Based on the success of the DSRC system and on infrared-based V2I communications, various ITS projects are currently joining forces to enhance V2I and V2V communication under Japan's national ITS safety 2010 initiative [18].

In Europe, six companies and three universities have joined efforts to develop FleetNet project (2000-2003) [20]. The main objective of FleetNet was to develop and demonstrate a platform for inter-vehicle communication (IVC). The key design requirements for FleetNet are the capability to distribute relevant data (e.g. road and weather conditions) where needed, and to satisfy drivers' and passengers' needs for location-dependent information and services [17].

In addition, Network on Wheels (NoW) [16] is a German research project carried out by major car manufacturers, suppliers, research institutes and universities. The project NoW is the successor of the previous pioneering research project FleetNet which ended in 2003 [20]. NoW is supported by the German government aiming to develop a vehicular communication system for V2V and V2I based on ad hoc principles and wireless LAN technology. The project started on 2004 to enhance road safety and develop infotainment applications [21].

Many governments and institutes started adopting and researching VANET using these

projects as a foundation to build on the top of. The goal of these projects is to create or modify network algorithms to be used in a vehicular environment securely. Nowadays, VANET is no longer a project in labs or academic research. Car manufacturers (e.g. BMW, Opel, Honda, Renault, Volvo etc.) have signed Memorandum of Understanding on Deployment (MoU) in 2012 to expand the deployment of VANET applications [19]. Many real-life experiments and demos are currently implemented and deployed using different VANET systems in vehicles. Automatic toll collection, traveler information system, and intelligent traffic control systems are already deployed and used on a daily basis in different parts of the world. Many security projects have been started academically; however, efforts in making security projects in the real world are yet to be established.

Since VANET is becoming a reality, the security of the network is an important key to insure the feasibility and reliability of services. Hence, VANET security is an important aspect to be assured when using the network. Security projects in the real world are needed to evaluate the risk of adversaries. The next section will discuss the security issues that VANET lack as well as the current progress and effort to resolve them.

3. VANET requirements and Security challenges

So far, VANET security has not gotten enough attention even though it is very crucial. The criticality lays on the contents of VANET's packets which contains significant life information. So it is important to assure reliable delivery of packets in the network without alteration. To do so, security challenges need to be addressed and considered when designing VANET architecture [7].

VANET must satisfy the security requirements before deployment. In this section, we present the security requirements that must be considered. Some attack scenarios will be given to prove the potential fatality when attacks are launched by adversaries.

3.1 Availability: Availability requires all services that the network offers to be available when needed by legitimate users. One harmful attack is DoS.

3.2 Confidentiality: Confidentiality offers protection for nodes against unauthorized ones to avoid messages delay attack. A famous attack that targets confidentiality is Eavesdropping.

3.3 Authentication and Identification: This requirement ensures that users and messages in the network are legitimate. Impersonation and Sybil attacks are very well known to target and harm this requirement.

After reviewing the security requirements that VANET should satisfy when deployed, we conclude that security is very important in VANET. Moreover, securing all communication and assuring attack-free environment is not an easy job due to the high mobility and the topology of the network. Hence, Research is still on going to secure more areas of VANET communications.

4. Jamming problem.

Jamming attack deliberately transmits of radio signals to disrupt communications by decreasing the signal-to-noise ratio. The term jamming is used to distinguish it from unintentional jamming which called interference. Our focus is to study Jamming attacks that launched to disrupt communications intentionally. To do so, we need to understand the different jamming strategies of jammers.

Jamming attack can be classified into four different classes based on its behavior; Constant, Deceptive, Random and Reactive jamming. 1) Constant jamming transmits random generated data on the channel without checking the state of the channel (Idle or not). 2) The Deceptive jammer injects a stream of random data constantly without keeping gap

between successive packets transmission. 3) Random jamming fluctuates between jamming and sleeping mode to conserve energy. 4) Reactive jamming jams only when it senses activity on the channel otherwise it stays idle [43]. While all jamming attacks can harm the network performance equally, the main difference is the detection difficulty.

4.1 VANET

Jamming is a serious threat to VANET security. Jammers constantly send repeated signals (in affected area) to interfere with the communication between nodes in the network. The victim feels that the state of the channel is still busy. Therefore, it cannot send or receive packets in the jammed area.

When jamming is enabled, the sender may successfully send packets; the receiver cannot receive all the packets sent by the sender. Hence, its packet delivery ratio (PDR) is low. These packets can be carrying important information (life threatening) such as, road conditions, weather, accidents, etc. and failure to receive or disseminate these packets can lead to fatalities.

Challenges: Due to the high mobility of VANET and the rapid change of its topology, defending VANET against jammers has been a hard problem. That because jammers don't have to comply with any protocols and their mobility is not limited. A jammer can be standing on feet or driving randomly down the roads. Moreover, adversaries have full control of when to start jamming and when to go into a sleep mode to hide its existence. All these reasons have made jamming problem a challenge to solve and detect.

Related Work

- **Denial of Service (DOS) Attack and Its Possible Solutions in VANET** [41]: Authors explained the need to obtain network availability all the time in order to assure security. Then they described different possible attacks in VANET including DOS attack. The DoS attack was then introduced and its severity was presented. Authors categorized DOS attacks into three categories: 1) Basic Level (overwhelm node resources). 2) Extended level (jamming the channel). And 3) Distributed Denial of Services (DDOS). A proposed solution was given based on relying on utilizing the On-Board-Unit (OBU) that each vehicle is equipped with. OBU is supposed to make a decision as to prevent a DOS attacks using one of the proposed techniques (switching channels, technology or use frequency hopping) to avoid DOS attack [41].
- **Detection of radio interference in VANET** [42]: Authors proposed a new model of detection based on the correlation coefficient (CC). CC is a statistic measure of relation between two random variables and its value between (-1 and1). A node calculates and compares two values: the error probability (EP) and the correlation coefficient (CC). If the CC is greater than the EP then the network is considered jammed. The relation between EP and CC was measured using NS-2 to evaluate the model and SUMO was used to generate the vehicular mobility patterns.
- **A New Anti-Jamming Strategy for VANET** [44]: Authors have studied the security issues that VANET can encounter. In particular they focused on jamming-style DoS attacks. The paper measured the effeteness of defense mechanism against jamming and proposed a new direction to utilize RSU to make VANET defense more feasible. Authors defined a scheme called (Hideaway strategy) which uses the PSR (packet send ratio) to determine if a network is jammed and consequently all nodes should go into silent mode. The paper didn't discuss detection and presumed it is out of the paper scope.
- **Security Challenges, Issues and Their Solutions for VANET** [7]: R. Raw et al studied the security requirements and

challenges to implement the security measure in VANET. Different attacks and their solution were discussed. Upon studying the security requirements, authors concluded that confidentiality is not required in VANET. The conclusion was based on the assumption that packets on VANET do not contain any confidential data. The paper provided a tabular to measure different attacks, technology, security requirements, and solutions used for defense.

- **Jamming Attack: Behavioral Modelling and Analysis** [43]: the paper studied jamming attack intensively. It classified jamming attack into active and reactive jamming. Authors evaluated the impact of different type of jammers using NS2 simulation. The data was analyzed to show that reactive jamming is more difficult to detect than other attacks because of the intelligent behavior. The paper contribution suggested to use the behavioral modeling and analysis tools to understand jamming attacks behaviors to develop an efficient defense strategy.
- **A Secure Routing Protocol for Vehicular Ad Hoc Network to Provide ITS Services** [45]: the paper proposed a new hybrid routing protocol to secure VANET. The protocol is called Position Based Secure Routing Protocol (PBSRP) which is a hybrid of MFR (Most Forward within Radius) and B-MFR (Border node based) routing protocols. The proposed PBSRP consists of 3 phases. 1) Initialization, 2) Optimal node selection, and 3) Secure data delivery phase. Authors also integrated a security module by using RSU to RSU key agreement protocol to provide data confidentiality and defend against active and passive attacks. The proposed scheme shows better performance than MFR and B-MFR routing protocols in terms of PDR and end-to-end delay. Authors suggested that the scheme will help many real time applications and it makes the system robust.
- **Mitigating the effect of jamming signals in wireless ad hoc and sensor networks** [46]: authors proposed to use MPT (multi-packet transmission) and MPR (multi-packet reception) to mitigate the effect of DoS jamming signal. The paper main contribution was that MPR and MPT can be used to significantly to mitigate: 1)The probability of success reduction to jamming signals. 2)The effect of jamming signals on throughput reduction. 3)The maximum throughput at all jamming signals rate. Authors only showed theoretical work and claimed that the hardware and software to apply the proposed scheme can be implemented with moderate complexity due to the electronics advancement.
- **VANET Routing on CITY Roads Using Real-Time Vehicular Traffic Information** [9]: in this paper authors proposed a new routing protocol called RBVT (road-based using vehicular traffic) to use for better routing vehicles in VANET. The protocol is supposed to outperform existing routing protocols in city-based VANET. The proposed RBVT uses real-time vehicle traffic information to create road-based paths. The paper proposed 2 sub protocols called RBVT-R and RBVT-P to work as reactive or proactive protocols. The RBVT assumes that each vehicle is equipped with GPS, digital maps and navigation system. In RBVT-R the protocol goes through 2 phases, route discovery and route reply while RBVT-P algorithm has 4 phases, discover the topology, and disseminate it, computing route, and route maintenance. The proposed protocol performs 40% better than AODV and 30% increase compared with GSR in terms of average delivery ratio and average delay. The paper uses the flooding technique between nodes which can cause network overhead. Moreover, the paper didn't consider any security issues that VANET can face.

- **'NoW – Network on Wheels': Project Objectives, Technology and Achievements** [21]: The paper gives detailed information on a project called Network on Wheels which is a German research project. The project came as a collaborative work between major car manufacturers, suppliers, research institutes and universities. NoW has developed a system which unifies safety and infotainment. The main contribution of the project is to develop a CAR-2-X communication where X can be another car or infrastructure. The goal of the project is to provide (*i*) safety, (*ii*) networking, (*iii*) radio, and (*iv*) security and privacy. The paper provides technical contributions (architecture designs, protocol development, summarize system development, integration effort, and outline the sustainability of the project results). For detailed information regarding Now please refer to [21].
- **A Comparative Study of Various Routing Protocols in VANET** [4]: Authors discussed the advantages, disadvantages and applications of different routing protocols for VANET. The paper classified routing protocol into 1) Topology Based. 2) Position Based. 3) Cluster Based. 4) Broadcast and 5) Geo Cast routing protocols. Authors provided a comparison table at the end of the paper to show the differences between routing protocols. The following table was taken from the paper for illustration purposes.

Table shows Comparison of Various Protocols [4]

Protocol	Proactive	Reactive	Position Based	Delay Bounded	Cluster Based	Broadcast	Geo Cast
Prior Forwarding Method	Wireless Multi hop Forwarding	Wireless Multi hop Forwarding	Heuristic method	Carry & Forward	Wireless Multi hop Forwarding	Wireless Multi hop Forwarding	Wireless Multi hop Forwarding
Digital Map Requirement	No	No	No	No	Yes	No	No
Virtual Infrastructure Req.	No	No	No	No	Yes	No	No
Realistic Traffic Flow	Yes	Yes	Yes	No	No	Yes	Yes
Recovery Strategy	Multi Hop Forwarding	Carry & Forward	Carry & Forward	Multi Hop Forwarding	Carry & Forward	Carry & Forward	Flooding
Scenario	Urban	Urban	Urban	Sparse	Urban	Highway	Highway

- **Solution of Detecting Jamming Attacks in Vehicle Ad Hoc NETworks** [47]: authors have studied jamming affect on VANET and proposed a new algorithm to detect jamming attack. The proposed detection method is based on the PDR and its diminution. PDR value which consisting of PDR value and the rate PDR reduction is used to decide whether a network is jammed as soon as the change of PDR surpasses a threshold. Then warning messages will be issued with high priority. The basic concept is when a vehicle enters a jammed area the parameter Down_PDR is

considered to detect that it is jammed. That's because when a vehicle is jammed its PDR is high but the rate of PDR decrease is great. Hence, the vehicle considered jammed and (state_jam) will be true. This will lead to broadcast a warning message contains information of its state, direction, jammed time and jammed position. The paper provides a new scheme to detect jamming attack in VANET however; it only considers one type of jamming. In real world, jammers can use different strategies to block all communication and have more capabilities which were not considered in the paper.

Even though, much research has been conducted to defend VANET against jamming attack, there is not a perfect solution that can be used effectively to solve jamming problem in Vehicular Ad Hoc Network. Hence, jamming problem in VANET is still an open research and much research are still undergoing.

4.2 Wireless Sensor network.

A wireless sensor network (WSN) is a wireless network consisting of spatially distributed autonomous devices using sensors to monitor physical or environmental conditions. A WSN system incorporates a gateway that provides wireless connectivity back to the wired world and distributed nodes. The selection of the wireless protocol depends on the application requirements.

Challenges: The limited resources associated with the low cost of sensor hardware are what made defending jamming a challenge in WSN [24]. Another reason is the different attacks strategies (whether based on their mobility or behavior) that adversaries can exploit [25], [26], [27].

Related Work:

- **Performance analysis of error control codes for wireless sensor networks** [30]: the paper focuses on the performance analysis of various error control codes in terms of bit-error-rate (BER) performance and power consumption. The authors implement different error control codes using Very High Speed Hardware Description Language (VHDL) on Field-programmable Gate Arrays (FPGA) and application-specific integrated circuit (ASIC). In addition, the energy consumption for different error control codes is also measured. BER is the performance metric, evaluated by transmitting randomly generated data through a Gaussian channel. They found that binary-BCH (Bose,Chaudhuri and Hoquenghem) codes with ASIC implementation are best suitable for wireless sensor networks. In the presence of jamming attacks, the channel condition becomes worse, and error control codes can help reduce BER.
- **On adjusting power to defend wireless networks from jamming** [31]: the paper proposed a possible solution to cope with radio jamming. The idea is based on adapting the transmission power of nodes with respect to the power of the jamming radio. Authors found that the effect of jamming upon source-receiver communications is not isotropic. The effect of jamming is studied by improving the transmission power on a testbed with Mica2 motes. The author also show the complex jamming effect by applying the non-isotropic model of jamming to a multi-hop wireless networks. She also suggested to have a feed-back based power control protocol to compete with jamming interference.
- **Optimal jamming attacks and network defense policies in wireless sensor networks** [32]: Authors formulates the jamming issue as an optimization problem. By solving the optimization problem at the network and jammers, the probability to transmit the radio signals can be controlled to achieve the

optimal jamming and defense effectiveness. Authors suggested that the network should compute channel access probability to minimize the jamming detection time. This work studied the interaction between jammer and the nodes in the networks.

- **Compromise-resilient anti-jamming for wireless sensor networks** [34]: this paper focused in studying insider jammers. An attacker can gain cryptographic information through compromised nodes and then launch jamming attacks. The paper then proposes a compromise-resilient anti-jamming scheme to deal with the problem. According to the scheme, the physical channel used by a sensor network is determined by the group key shared by the sensor nodes. The solution of this paper is to determine the channels by the group key shared by all nodes. When insider jamming happens, the network will issue a new group key for nodes that are not compromised to protect the network from the insider jamming.
- **Channel surfing and spatial retreats: defenses against wireless denial of service** [35] **and Defending wireless sensor networks from radio interference through channel adaptation** [36]**:** the two papers introduced four common types of jammers: constant, random, reactive and deceptive. Authors studied those different types of jammers and proposed a technique called channel surfing which is developed to cope with the jamming interference. The channel surfing technique proposes that sensor nodes should change the communication channel when they detect jamming attacks. Two channel surfing methods are explored. One is coordinated channel switching, in which the entire sensor network changes the radio channel. The other is spectral multiplexing, in which the nodes in the jammed area change the radio channel and the nodes on the boundary act as relays.
- **JAM: a jammed-area Mapping service for sensor networks** [37]: a jammed area detecting and mapping service is developed. Authors described a mapping protocol for nodes that surround a jammer. As a result, this service allows network applications to reason about the region as an entity instead of broken links and congested nodes. Evaluation results show that regions can be mapped in 1–5 seconds. Authors found that the protocol is robust to failure rates as high as 25 percent in case of moderate connected network.
- **WisperNet: Anti-Jamming for Wireless Sensor Networks** [63]: the paper proposed a new protocol called WisperNet (time-synchronized protocol). The new protocol consists of two components: 1)WisperNet-Time, with the goal to reduce the censorship ratio of a statistical jammer to that of a random jammer. 2)WisperNet-Space in which network routes are adapted constantly to avoid jammed areas and select paths with max PDR. The evaluation of the protocol shows that WisperNet reduces the efficiency of jammers even a random one. The proposed protocol has been implemented on FireFly (which is a time synchronized real time sensor network platform) for evaluation purposes. Some limitations have been observed after experiments. One of the main observation is that WisperNet-Spatial routing scheme is incapable of scaling well in large networks (more than 500 nodes) under moderate to heavy attacks. That's because the message from the gateway may not get through.

Since wireless sensor network have been drawing much attention, research has contributed in solving jamming problems in WSN. Little research left to enhance current protocols to assure a better PDR. A tradeoff between PDR and security has been acknowledged when securing WSN against different attacks.

4.3 Wi-Fi

Challenges: freedom to mobile and strong connectivity has made WiFi a very popular technology that made Hotels, Restaurant and public locations adopting it. However, few issues

have been discovered with more WiFi being deployed around. WiFi connectivity links tend to be strong but as nodes started to distant links remains and quality drops. Another issue with WiFi is repeated authentication may be required as nodes switch from an access point to another. Moreover, WiFi can suffer from the presence of adversaries just like in any other type of network. Jamming, DoS, Impersonation, and eavesdropping are different types of attacks that can be carried easily in a WiFi network by a moderate skilled adversary.

Related Work

- **Carving Secure Wi-Fi Zones with Defensive Jamming** [48]: the paper focuses on turning jamming from being a problem to utilizing it to create a secure Wi-Fi zone. Authors referred to the technique as defensive jamming. The concept is to use jamming signals to protect Wi-Fi zone from any information leakage inside the boundaries. Authors assumed that an insider can try to leak information using cellular network and thus it needs to be monitored by the network administrator. Experiments details were giving where defensive jammers location was adjusted as well as its power to reach the optimal scenario.
- **The Feasibility of Launching and Detecting Jamming Attacks in Wireless Networks** [49]: in this paper, Xu et al. have studied the problem of launching jamming attack on wireless networks and its criticality. Based on the results of the study they proposed four different jamming attack models that can be launched easily to interfere with the operation of wireless networks. The paper provides evaluation of the different jamming attack models in term of their effectiveness and ability to block communication. Authors also concluded that signal strength and carrier sensing time are not enough to detect jammers presence effectively. They also conducted experiments where PDR was used to differentiate between congested and jammed network. However they found that using PDR was not sufficient to determine if the poor link is due jamming or nodes mobility. Based on their findings, authors proposed two detection protocols that employ consistency checking. One scheme uses signal strength measurements as a reactive consistency check for poor PDR while the other one utilize location information to serve as the consistency check. Experiments were deployed using MICA2 Mote platform and results were giving to prove the feasibility of the proposed scheme.
- **Modeling, Evaluation and Detection of Jamming Attacks in Time-Critical Wireless Applications** [50]: the paper aim at modeling and detecting jamming attacks against time-critical wireless networks with applications to smart grid. Authors introduced message invalidation ratio as a new metric to quantify the performance of time-critical applications. The proposed modeling approach was inspired by the comparison between the behavior of jammer and a gambler who intends to win a game. They found that by comparing gambling-based modeling and real-time experiments, there exists a phase transition phenomenon for successful time-critical message delivery under a variety of jamming attacks. That is, as the probability that a packet is jammed increases from 0 to 1, the message invalidation ratio increases dramatically to 1. Based on analytical and experimental results, Jamming Attack Detection based on Estimation (JADE) scheme was designed to achieve robust jamming detection, and implement JADE in a wireless network for power substations in the smart grid. Experiments and results showed that applying JADE achieved efficient and robust jamming detection for power networks.
- **SecureArray: Improving WiFi Security with Fine-Grained Physical-Layer Information** [64]**:** the paper proposed a new system called SecureArray to work alongside existing wireless security protocols to

enhance defense aginst active attacks. SecureArray utilize multi-antenna access points to profile the directions at which incoming signals arrive. The new system uses angle-of-arrival information to construct sensitive signatures to identify each client uniquely. The basic idea behic SecureArray is that when a suspicious transmission occurs, the client and AP initiate angle-of-arrival signature-based challenge-response protocol to confirm and mitigate threat. Authors have implemented the system and evaluated results in static and mobile environments. Results showed that in a typical environmental office, the proposed system was able to mitigate 100% of WiFi spoofing attack attempts with only .6% error rate. Some limitations to the system were introduced e.g. the performance of SecureArray degrades with fewer numbers of antennas on AP and in mobile environment.

4.4 MANET

Related Work

- **Jamming Attacks Impact on the Performance of Mobile Ad-Hoc Network and Improvement Using MANET Routing Protocols** [59]: the paper introduced the effect of jamming attacks in MANET and presented the improvement that can be resulted from using routing protocols in term of performance. The effect of the presence of jammers was studied by increasing delay, packet delivery ratio, and decreasing throughput of the network. The paper used four different protocols to measure the performance improvement (DSR, OLSR, TORA, and GRP). Authors concluded that using OLSR protocol showed more successful in increasing throughput and decreasing data dropped in the network however, caused larger delay.
- **Denial of Service Attacks Implementation and Detection Approach for MANET** [65]: Authors provided implementation and analysis of two types of DoS attacks known as explicit packet dropping attack (EPDA) and implicit packet dropping attack (IPDA). Then they presented the effects of both of these attacks which were measured during communication through a reactive MANET routing called Ad-hoc on-demand distance vector routing protocol (AODV). In EPDA, the adversary first gains access over the newly establish route between a source destination pair during the route discovery process. Then drop all the packets that go through it. While in IPDA the attacker does not know when to attack and which data flow it is going to attack. Authors proposed Data Packet Routing Information (DPRI) tables to defend against EPDA, IPDA attacks. These tables need to be modified to suit what type of attacks is intended to defend against.
- **Detection of Jamming Attacks in Wireless Ad Hoc Networks using Error Distribution** [62]: the paper focuses in detecting jamming attacks in MANET. Authors proposed a new detection method using measurement of error distribution. The new detection scheme is based on the measure of correlation among the error and the correct reception times in order to detect the presence of jamming attack. The correlation is defined as a measure of the association between two random variables. Authors applied this technique to resolve a detection problem of a specific case of jamming attack which is reactive jammers.

5. Future work

From what we have studied we see that jamming attack in VANET is an open problem. The affect of potential jamming attack is unbearable. At the same time, due to the network topology and the rapid change in network behavior, jamming solution is a hard problem to solve. Our plan is to study jamming attack intensively and propose a new detection, localization, and defense schemes.

The schemes have to satisfy VANET requirements while maintaining good QoS. Research has already started and results will be shown in the next paper.

6. Conclusion

The FCC acknowledged the seriousness of jamming affect and considered jamming a criminal offense. They stated that it is unlawful to market, sell or operate jamming in US. Offenders (jammers) can face fines (up to $112,500), seizure of equipment and jail time [39]. This section will provide information on jamming affect in different type of networks (Wireless Sensor Network, Wi-Fi, GPS, MANET, and VANET). We will also survey proposed solutions to defend against jamming attacks. Finally, the feasibility of these solutions to protect VANET against jamming attacks will be discussed and current research will be provided. In this work we extensively studied vehicular Ad-Hoc network in different aspects. We provided information regarding VANET standards as well as past and current projects in different parts of the world. Then more intensive research was done to provide solid information about security issues and in specific jamming attacks and their affect on the network. This paper surveyed jamming problem in different type of networks and provide key information regarding current progress of solving jamming problem. This paper works as a base study for our next work. Our future target is to study jamming effect in VANET and propose a strong yet easy to implement detection method to alert users of a potential jamming attack in the network.

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Sheng and Engsh: What they Are and What they Are Not

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Abstract
Kenya is a multilingual nation with over 40 ethnic languages, many foreign languages, and two codes whose classification is not yet clear. The two codes are called Sheng and Engsh and are respectively language varieties of the slum and affluent dwelling places in Kenyan urban centres – especially in Nairobi. The objective of the present paper is to locate the place of Sheng and Engsh on the Kenyan linguistic scene by finding out what Kenyans feel the two codes are as instruments of communication. Data for the paper was collected by use of questionnaire, interview schedules, participant observation and archival records. The theory used in this paper is Social Identity as developed by Tajfel (1970). The conclusion that the present paper gives is that Engsh is but a variety of Sheng and that Sheng can no longer be taken for granted on the Kenyan linguistic scene. The paper recommends Sheng's proper recognition and planning in Kenya.

Key words: Sheng, Engsh, Slang, Kiswahili, Kenyan linguistic scene.

1.1 Introduction

Young people in Kenya, and especially young people in Nairobi, talk to each other in
Sheng or Engsh (Nzunga 2002, Mukhwana 1990,2008, 2010, 2014, Abdulaziz and Osinde 1997, Githinji 2014). Sheng is spoken by young people, some of them working, and of all social classes. There is in Nairobi another variety of expression similar to Sheng but spoken by the children of the Kenyan elite. This variety of expression is called Engsh.

Thus, the sociolinguistic situation in Kenya is such that Kenyans live in an atmosphere constant inter-linguistic contact. The linguistic convergence in Kenyan urban centers is such that it is difficult to find an urbanite that understands and speaks only one language (Nzunga 2002). This may be the reason why in reference to Sheng, Webb and Sure (2000:37) say Sheng is a mixed language in Kenyan urban centers with pidginized and creolized features and that has the social meaning of 'young', city-dwellers with no links with traditional African culture.

Sheng is in Kenya an urban centers' language that has its syntax resembling that of Kiswahili and its phonology is also very similar to that of Kiswahili (Mbaabu&Nzunga 2003). On the other hand the elements of Sheng's vocabulary come from virtually any of the languages (ethnic or foreign) spoken in Kenya although more words are borrowed from local languages than from foreign languages (Nzunga 2002). Speakers of Sheng are themselves speakers of several of the other languages used as mother tongues in Kenya.The syntax and the phonology of Engsh remain comparable to that of Sheng, the vocabulary is borrowed predominantly from English (Nzunga, ibid). Sheng and Engsh are like two sides of the same coin. Given their position as peer languages spoken by the youth in Kenya their study is worthwhile. This is because Sheng and Engsh can hardly be qualified as a temporary linguistic phenomenon in Kenya. They may affect the teaching and/or learning of Kiswahili and English by the Kenyan youth. It is on the basis of this important linguo-_social phenomenon' that this paper sets out to find out what Kenyans feel Sheng and Engsh are or are not.

1.2 Method and Procedure

The research on what Sheng and Engsh are on the Kenyan linguistic scene adopted a descriptive research method, using questionnaire to collect data. For the purposes of the investigations the city of Nairobi was chosen. The choice of Nairobi was informed by the fact that Sheng and Engsh are predominantly languages of Nairobi. Subjects for the research comprised of one hundred (100) respondents of whom seventy two were males and twenty eight were females, with about twenty five respondents drawn from each of the estates of Komarock, Kangemi, Buruburu and Kileleshwa. Respondents included professionals (doctors, lawyers, teachers, journalists and politicians), civil servants, and university lecturers and students. Variables for the study included ethnic group, occupation, and age, level of education and estate of residence. Tables 1 and 2 below show this:

Number	Male	%	Female	%
Under 20 Years	6	66.7	3	33.3
20-35 Years	30	65.2	16	34.8
36-50 Years	22	81.5	5	18.5
Over 50 Years	14	77.2	4	22.2
TOTAL	**72**		**28**	

Source: Research Data

Table 2: Occupation of Respondents

Occupation	**Number of respondents**
Lawyers	1
Teachers	12
Journalists	6
Politicians	2
Civil Servants	6
University lecturers	8
Students	48
Others	17
TOTAL	100 respondents

Source: Research Data

Tables 1 and 2 show the ethnic groups and occupations of respondents respectively. The tables have been referred to as the issue of what Sheng and Engsh are or are not is analyzed.

1.3 What Kenyans Feel Sheng and Engsh Are or Are Not

Sheng and Engsh are 'popular' languages in Kenyan schools and colleges because it is said by elderly respondents that most students can express themselves fluently neither in Kiswahili nor in English. Unlike the two languages, Sheng and Engsh have no strict grammatical rules. There is no incorrect usage of a word as long as one person understands what the other is saying. 'What matters in Sheng and Engsh usage is "easy communication". This is, according to respondents aged 50 years and above, the reason why Sheng and Engsh are purely contextual languages to that extent that when you remove a context of usage, the interpretation will be varied. Sheng and Engsh, therefore to the above respondents, become poor instruments of communication for they cannot effectively communicate ideas outside the context of usage.

To elderly respondents, aged 50 years and above, Sheng and Engsh are regarded as languages for some 'spoilt youths' in the streets of Kenyan towns — especially Nairobi. Sheng and Engsh are thus regarded by the elderly respondents as street languages. Sheng and Engsh are resented by these respondents because the languages are highly colloquial. For that reason Sheng and Engsh are supposed to be considered as below the level of standard Kiswahili and English respectively, and consisting either of new words or of current words employed in some special sense. In this sense, Sheng and Engsh are to the respondents "childish languages". This is because Sheng and Engsh are to the diction that results from the favorite game among the young and lively of playing with words and renaming things and actions; they result in some inventing new words, mutilate or misapply the old words for the pleasure of novelty, and others take up surprise words for the pleasure of being in the fashion.

Youthful respondents aged 35 years and below argue that as Sheng is used by every one in the Kenyan society, the stigma once attached to the language has long since been removed. To the respondents, what is called Engsh is a social dialect of Sheng used by the children of the educated elite. Sheng is used in Kenya's rap music such that whoever is uninitiated into speaking Sheng will be at a loss to understand present. day Kenyan popular music.

Another observation about Sheng and Engsh by the elderly respondents stems from the fact that the two codes are not used as means of self-expression; they connote personality. The use of these languages comes from the wish of the individuals to distinguish themselves by oddity or unusual humor. In other words, what Sheng and Engsh consist of does not depend upon intrinsic qualities, but upon the surrounding circumstances. It is the users that determine the matter, and partly the users' habitual way of thinking. According to respondents, the use of poll-parroted terms in Sheng and Engsh and lack of sense of their shades and limitation of meaning makes the languages poor instruments of communication.

Sheng and Engsh are used for ease of communication; they are used by people who would like to be secretive such that they cannot be easily understood by the 'outsiders' around them. Respondents observe that the youth, the 'evergreen' youth and students use Sheng and Engsh for social interaction but without wanting to be understood by those persons who do not belong to their group.

Looking at the above use of Sheng and Engsh as reported by respondents, respondents aged 35 years and below are generally positive towards these codes, but respondents aged 50 years and above are scornful. These elderly respondents believe that 'Sheng and Engsh are codes of fools'. To respondents who hold this view towards Sheng and Engsh, people of discretion will not pervert Kiswahili and English to the unprofitable purposes of conversational mimicry. The reason for this observation is because Sheng and Engsh are opposed to standard languages.

Sheng and Engsh have also been condemned by respondents mostly aged 50 years and above on the ground that being evanescent, vague to those who use standard Swahili and English respectively, and ill-defined they have a deleterious effect to those who use them often. Due to this, Sheng and Engsh are seen by some of the respondents as 'lazy men's speech'. This is because the above respondents observe that to the users of Sheng and Engsh, when a word becomes definite in meaning it ceases to be a Sheng or Engsh word for another word is found and used in its place.

About word-formation in Sheng and Engsh, youthful respondents aged 35 years and below claim that Sheng (and Engsh) provides substitutes for the old words. Sheng becomes the source from which the decaying Swahili words are constantly refreshed. One respondent said, "Many of these Sheng words and phrases are but serving their apprenticeship after which they will enter main-stream Swahili". This

observation by the youthful respondent to Sheng and Engsh stems from the fact that idiomatic expressions in languages come from peer languages like these two (refer to standard Kiswahili words like kitututu, kingunge and kipanya).

As a support to Sheng and Engsh respondents who are aged below 36 years claims that Sheng and Engsh as languages have their domain of usage. Therefore, except in formal and dignified writing and in professional speaking, a vivid and extensive usage of these codes is likely to be preferable to conventional languages like standard Kiswahili and English. On the other hand, elderly respondents who oppose the use of Sheng and Engsh in Kenya are guided by the language loyalty attitude towards Kiswahili. To them Kiswahili as a language has to be preserved by encouraging its proper study and teach it in its standard form to the younger generation. This is one reason why the respondents try to protect Kiswahili from changes caused by Sheng and Engsh and which to them are perceived as adulteration of the purity of Kiswahili.

In referring to the origin of Sheng words respondents aged 50 years and above constantly commented; 'That is a Luo or Kikuyu or Luhya word". In this case, respondents deplored the use of 'unnecessary' loan words in Sheng.

Asked what they thought about the future of Sheng and Engsh elderly respondents, from the study sample, admitted that they are languages that are doomed to extinction. The reason given by respondents is that Sheng as a language does not have original native speakers who can claim it as theirs. One respondent said, "We started it in the late 1970s. We have now abandoned it. When we die, the language will be no more because it will lack original speakers. As for Engsh, it has already been assimilated by Sheng for it is a social dialect of Sheng". The youthful respondents, however, disagreed with this thinking. They see a bright future for Sheng where the publication of Sheng dictionaries by scholars like Ireri Mbaabu and Nzunga (2003) and Moga and Danfee (2004) and the use of Sheng in the media - especially in music by musicians like Nonini and Prczzo is a pointer to the language's future being bright. A typically ambivalent attitude to the future of Sheng by youthful informants goes thus:-

Sheng is the most enduring medium of expression which the people of Kenya have because it contains nearly all the elements of other languages used in Kenya.

This support of Sheng by youthful respondents, is in direct contradiction to the earlier one that claims Sheng is doomed to perish with the present generation of speakers. Most elderly respondents with the negative attitude towards Sheng and Engsh hold that although some booklets are written in Sheng, the booklets "are minutely studied".

From the data, it is indicative that the users of Sheng and Engsh do not regard them much as languages. Asked how many Kenyan languages they knew, none of the respondents ever mentioned Sheng or even Engsh. It was only when I remarked about Sheng that the respondents came up to say they spoke it as a peer language. Therefore, on the Kenyan linguistic scene. Sheng and Engsh as languages are spoken by people who will refrain from saying they speak them. Respondents note that this is because of the hostility felt toward the social and historical connotations of Sheng and Engsh. Thus, the extent to which Sheng and Engsh are remembered and spoken in Kenya seems to depend on individual circumstances and preferences. It is even surprising that some respondent users of Engsh words like *kamuu* for come, *mtell* for tell him/her and *Jamuu* for Jamhuri High School; think they are using Sheng words. Thus, to supporters or even opposers of Sheng and Engsh the two codes are one and the same.

To respondents who also are speakers Sheng and Engsh, Kiswahili and English respondent speakers are against the two languages because they feel threatened. These respondents observe that there is tension on the part of speakers of Kiswahili because its linguistic features are threatened by those of Sheng and Engsh. This is manifested in the refusal by some Kiswahili speakers to use Sheng and Engsh as an effort to keep Kiswahili 'pure' and free from the taint of Sheng and Engsh elements. 'This is further manifested in the insistence on recognition of standard Kiswahili, and the derogatory terms of reference respondents, who support Kiswahili use for Sheng and Engsh. For instance, to the elderly respondents, Sheng is no language at all and if at all it is, then it is a bustard'language. In all these instances, youthful respondents observe, it is the Kiswahili-speak1ng community or group who experience feelings of threat.

Generally, all respondents hold the view that Sheng is a mixed code with lexical items from English, Kiswahili, and other Kenya languages (mainly Dholuo and Kikuyu) superimposed onto the Kiswahili way of building sentences. From what respondents say the researcher can remark that Sheng users superimpose English,. Kiswahili and other Kenyan languages because they want to be said to be like the original speakers of these Kenyan languages. At the same time, respondents note that they may be out to be accepted by other speakers of Kenyan Languages. In this case therefore, Sheng speakers are guided by instrumental as well as integrative motivation. All respondents note that speakers of Sheng and Engsh stick to their native languages in order to ensure cohesion and emotional security from members of their respective ethnic group.

Elderly respondents oppose the use of Sheng and Engsh in Kenya and say they are adulterous to Kiswahili. Thus, elderly respondents act as guardians to Kiswahili's linguistic properties; they argue that standard Kiswahili should be the norm for use in public domains and not Sheng or Engsh., Thus, Sheng and Engsh usage is a deviation from standard Kiswahili.

As already mentioned, the acceptance of Sheng and Engsh by youthful respondents on the other hand implies an obligation to popularize them through the mass media, the publishing houses, and in government administration. This is the position now because, as respondents observe, the popular rap music on Kenyan televisions and the radios is in Sheng and Engsh. The famous novelist by the name David Mailu has one of the longest novels ever written by a Kenyan but in Sheng. Besides printing books like Mailu's**The Broken Drum,** respondents aged 35 years and below note that there is also the production of dictionaries like Ireri Mbaabu's (2003) and Moga et-al's (2004) that propagate Sheng. These processes in the development of these languages are important because they determine the positive attitudes of Kenyans to Sheng and Engsh. Renown scholars like Ireri Mbaabu and David Mailu help in nurturing a positive attitude towards Sheng and Engsh by giving them recognition and popularizing their use. Therefore, from respondents, this paper can argue that Sheng and Engsh languages have been institutionalized in Kenya.

In a general sense, what Sheng and Engsh are or are not can be divided into three categories: negative, neutral, and positive. These categories can be arrived at by an analysis of what the respondents think Sheng and Engsh are or are not, what they can do and what they cannot do as languages and as instruments of communication.

Elderly respondents note Sheng and Engsh originate and flourish best in colloquial speech. Elderly respondents observe that among the impulses which led to the invention of Sheng and Engsh, the two most important are the desire to secure increased vivacity and the desire to secure increased sense of

intimacy in the use of the two languages. Respondents quoted above note that the most favourable conditions for Sheng and Engsh are those of 'excitement' and 'artificial' life. Thus, to elderly respondents, any sudden excitement or peculiar circumstance is quite sufficient to originate and set going a score of Sheng and Engsh words. Thus, Sheng and Engsh are a product of an exuberance of mental activity, and the natural delight of language making. This point has been cited by elderly respondents as one of the reasons why in Sheng, as in Engsh, one speaks according to how one feels. So, to the elderly respondents, the purpose of Sheng and Engsh is not communication parse. No wonder, there are respondents across the divide who view the two codes as not being languages. "If they are languages at all, then they are each a mixture of languages", remarked one respondent (# 2). "Of what use are mixtures of languages when we have proper languages like our mother tongues, Kiswahili and English in Kenya?" he adds.

By asking the question above, the respondent quoted above shares the view that Sheng and Engsh are unconventional languages. This is because Sheng and Engsh are commonly made by the use of metaphors, obscure analogies, meaningless words, and expressions derived from the less unknown and less esteemed vocations or customs. Thus, to elderly respondents, Sheng and Engsh are languages composed of colloquialisms that are current but not refined enough to be admitted into standard speech. Examples of such Sheng/Engsh colloquialisms are as follows:

(a) Kukamata, Kusosi, Kumanga - to eat
(b) Kuishia, ku/cache, kuamburuka - to go
(c) Kobole, ngovo, punch - five

The above examples, and that are from the elderly respondents, show that Sheng and Engsh are aspects of language in which linguistic processes can be observed in unrestricted activity.

From the mostly elderly respondents, it was stated that speakers of Sheng and Engsh have that instinctive desire to speak bad Kiswahili and bad English respectively. Elderly respondents further state that there is also the synonymous desire to speak Sheng and Engsh of any kind, at any price. Thus, to the respondents aged 50 years and above, Sheng and Engsh do not easily obey propriety for they break the canons of good Kiswahili and good English. Therefore Sheng and Engsh are seen as a linguistic law unto themselves. Thus, Sheng and Engsh are not wholly accepted by all respondents as mediums of communication because they have a taint impropriety about them which makes them offensive. More so, the elderly respondents note that the very currency of Sheng and Engsh depends on the languages' allusions to things that are not supposed to be universally familiar or generally respectable. According to elderly respondents, Sheng and Engsh are thus vulgar, since they bring in associations with what is for the moment regarded as unknown or of bad repute. Because of this, Sheng and Engsh are therefore regarded as languages that attempt to express themselves illimitably.

From the study sample, it emerges that the use of Sheng and Engsh proves a certain freedom in speech. According to over 80% of respondents, Sheng and Engsh are much more spoken than written languages. Thus, Sheng and Engsh originated in Kenya in discontent with the words and phrases in far too general use in Kiswahili and English. This argument for Sheng and Engsh by respondents in essence supports the use of these codes. However, according to mostly elderly respondents, the fact that Sheng and Engsh are basically spoken languages reduces their social status - thus making them appear second -rate languages. As one respondent (No. 48) had to argue, "In the present day world where everyone is going computer, how can a language afford to remain oral?"

Respondents with some knowledge of linguistics observe that the use and prevalence of Sheng and Engsh is not based on the influence of culture or of lack of culture at home, efficiency or none-efficiency in the use of Kiswahili and English, but rather upon the individuality of the persons who uses the two languages. Although respondent #13 (Mr. 0) does not differentiate between Sheng and Engsh, he confesses that he uses Sheng although he is equally good in Kiswahili and English. What this respondent above likes most about using Sheng is the language's humor. "An element of humor is almost always present in Sheng. This humor usually appears in Sheng as humorous exaggeration". This labeling here implies that Sheng sets things in their proper places with a sense of smile. When young men are called *Tinis* and young women *Manzi,* this is obviously a language of a world that takes its passions lightly.

Youthful respondents observe that because these codes occasionally use catch — words or phrases in a special sense of which only the users of those languages are aware these languages' use becomes a kind of short-hand which enables them to express and to realize their experiences without elaborate analysis. Therefore, looked at from the stylistic point of view, Sheng and Engsh can be analyzed depending on the various trades and professions. Hence, every group of association that uses Sheng or Engsh feels, at some time or another, the need to defend it against outsiders. It is due to this stylistic device that a restricted kind of Sheng or Engsh is created with an aim to conceal its thoughts. This stylistic element is what leads to Sheng and Engsh being languages that are noted for their artistic possibilities and for the abundance of synonyms. Examples of Sheng and Engsh words with their synonyms are as follows:-

Illicit brew (Changaa) — Wege gin, BF (Blue flame), Mudi, (from mood), Machozi ya Simba, Cham and Cham-to-to (due to drops).
Girl - Kidosho, Demu, Chile, Chiki, Sheri, Manzi and Supuu.
Motor car-Moti, Murenga, Ndai and Buu.

Because Sheng and Engsh are languages that are rich in synonyms, "the element of boredom when using them in speech does not arise". On the other hand, elderly respondents argue that partly because so much of the vocabulary of these languages is short-lived, the languages are unsuitable as means of general inter-communications. This is because many of the languages' elements are obsolescent and also because of too much freedom of interpretability attached to so many of their recent accessions.

It was noted from the respondents that the value of many of the creations in Sheng and Engsh is often destroyed, frequently lessened by the obvious intent to surprise, to astonish, or even to shock. The perversions of form and ludicrous twisting of meaning are the result of that intent, and they form a considerable proportion of Sheng and Engsh words. It is only in the limbo of Sheng and Engsh that word intervention finds unhampered liberty. This is unlike the case is in Kiswahili and English where words, phrases and syntax are judged, not because of their vitality or their expressiveness, but by their conformity to standard'.

Sheng and Engsh are held in high esteem in Kenya due to the characteristic of word formation form in the two languages. Both Sheng and Engsh delight to curtail (clip, abbreviate, and shorten) words as in BF for blue flame, *Moti* for motorcar, and mathe for mother. This characteristic is not unique to Sheng and Engsh, and neither is it new to languages the world-over. All languages go in for what is commonly known as 'economy of language usage'. For instance, English has many such words that started as slang but have now passed into Standard English. Examples include flu for influenza and bus for omnibus. This kind of argument carries the view that words of this nature in Sheng and Engsh will eventually attain the dignity of Standard Kiswahili and Standard Kenyan English respectively.

Another point to note from Sheng and Engsh by youthful respondents is that many Sheng and Engsh vocabulary consist of old words changed in form or, far more often, old words with new meanings or new shades of meaning. Nevertheless, these changes of sense-which sometimes lead to a change in the basic meaning of a word - belong to the dynamics of semantic study; and is not unique to Sheng and Engsh. According to youthful respondents and those with some training in linguistics, reference can be made to Kiswahili words like Kupe, Husudu and Tarakanya.

According to respondents with some knowledge in linguistics, any language falls into the dichotomy of good and bad; so are Sheng and Engsh. Good Sheng and Engsh say clearly or concisely or forcibly what 'standard' Kiswahili or English can say obscurely or diffusely or feebly. To these respondents, the distinctive test of good Sheng or good Engsh is that they have a real meaning. Bad Sheng or Engsh have no meaning; they are simply a succession of sounds which impose upon the ignorant imagination of the reader or listener. On the other hand, respondents observe that good Sheng or Engsh is idiomatically expressive. Thus,such respondents think that it is wrong to condemn these two codes wholesale as being bad instruments of communication. Respondents with some background in linguistics argue that good Sheng or Engsh is that which gives new life to old or abstract ideas; bad Sheng or Engsh lacks the precision of statement of good Sheng or good Engsh. In short, expressing oneself in Sheng or Engsh which tells us something is better than the immaculate sentence in Kiswahili or English that is empty of everything but the consciousness of its own propriety.

According to this paper's sample, the use of Sheng and Engsh conveys the suggestion that the speaker and the listener enjoy a special 'fraternity', and thus, integrative motivation in its use. This is slightly different from the informality and familiarity of a general social situation. Respondents note that Sheng and Engsh words and expressions are peculiar to the users of these languages. Sheng and Engsh have conversational familiar idiom that is used and generally understood by speakers of these codes. According to youthful respondents aged 35 years and below, the users of Sheng and Engsh enjoy a special linguistic fraternity because they have secret vocabulary that is unique to the two languages. T

1 4 Conclusion

Language attitudes towards Sheng and its subsituary Engsh in urban Kenya -especially in Nairobi -bring it out as a language that has great emotional appeal to its advocates. Sheng is said to be beyond tribal or regional affiliations because its structure is a linguistic blend of all languages used in Kenya. The study can argue that Sheng/Engsh equate with lack of tribalism and with national cohesion in the Kenyan context. Therefore, according to this paper's sample, Sheng/ Engsh as a language has considerable national coverage of users.

Besides, the result of this paper on what Sheng and Engsh are or are not in Kenya shows that the languages are under great criticism especially from the elderly respondents and teachers who see it as irrelevant of Kenyans. This criticism means that there are some respondents whose attitudes towards Sheng can be said to be negative. In view of the fact that many youthful respondents favor Sheng, ways must be sought to accommodate this language in Kenya's language planning process. Some assets of Sheng, especially in context of the integrating function of language, are as follows:

(a) Sheng is ethnically neutral
(b) Sheng has an unplanned national spread, and
(c) Sheng has a utility as the bridge language in the teaching of Kiswahili.

In conclusion, the present paper realizes the importance of Sheng and Engsh to language policy and language planning processes in Kenya – hence the essence of saying exactly what the two codes are and what they are not. Ways and means should be sought to incorporate Sheng in Kenya's language plan.

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UBUNTU: LINGUISTIC EXPORATIONS

Kithaka wa Mberia

1. INTRODUCTION

In this paper, I aim to present an etymology or the history of the term "ubuntu" as it is currently used in social, religious and philosophical discourses especially in Southern Africa.

Etymological analysis is a linguistic endeavour. Ultimately, my paper is on the linguistics of Ubuntu. Since the paper is intended for a multidisciplinary publication and because some of the readers of the publication will not be familiar with linguistics terminology, I have considered it prudent to build a bridge to facilitate communication. This, I do by way of presenting a set of linguistic terms that I use in the paper.

I note the presence of the terms "abantu" and "ubuntu" and other terms that are similar to them in form and meaning in a wide range of Bantu languages outside the Republic of South Africa. I argue that, wherever and whenever those terms appear, they are related to the equivalent terms in Southern Africa.

I trace "ubuntu" and "abantu" to the cradle of Bantu speaking peoples in West Africa[1]. I then show the movement that part of Africa to the various parts of the continent where Bantu languages are currently spoken.

Using the comparative method of historical and comparative linguistics, I establish Proto-bantu forms which have given rise to "ubuntu" and "abantu" and show the phonological and morphological changes that account for the current form of "ubuntu". Furthermore, I point out that starting with the meaning of the proto-form that give rise to "ubuntu" to the meaning of the term as currently used especially in Southern Africa, some semantic modification has taken place. I argue that "ubuntu" as currently used in Southern Africa has shades of meaning and nuances that might not have in the semantics of the proto-form from which the current term has emerged.

2. SOME LINGUSTIC TERMS

Bantu languages: A group of related languages belonging to the Niger-Congo language family which are spoken in the area between the southerly most part of South Africa to the south and a line extending from western Cameroon, through the Central African Republic, the Democratic Republic of the Congo, Uganda, Kenya and Southern Somalia into the Indian Ocean. The languages are spoken by about a third of all Africans (Nurse, 2006).

Cognate: A word related in form and meaning to a word in another language of the same language family. The IsiKhosa and IsiZulu "umntu", the Kiswahili "mtu", the Kitharaka "muntu" and the Luhya "Omundu" all mean "a human being". Consequently, they are cognates (or "cognate words", Hartmann,1973).

Noun classes: Groups or categories into which nouns are divided in Bantu languages. For instance, nouns denoting human beings are generally grouped in Class 1 in singular and in Class 2 in plural. Unlike in many other language families, noun classification bantu does not indicate the gender of the noun.

Reflex: A form in a current language which is derived from an earlier form in a parent language. For instance, the German "gut" and the English "good" are reflexes. They are current forms of an earlier form in the Proto-Germanic language. The same is true of the German "morgen" and the English "morning".

Morpheme: The smallest meaningful unit in a language. "Nationality" has three morphemes, that is, "nation- al-ity". "Boyhood" has two, that is, "boy-hood".

Root: The morpheme that bears the central meaning in a word. "Africa" is the root in the "unafrican" (un-africa-an) and "colony" is the root in "de-colon-ize"

Prefix: The morpheme that precedes the root; for example "un" in "un-god-ly"

Pre-prefix: The morpheme that, in Bantu linguistics literature, precedes the prefix. "a" is a pre-prefix in "a-ba-ntu" because "ba" is the prefix. Likewise, "u" is the pre-prefix in "u-bu-ntu" because it precedes the prefix "bu"

Morpheme boundary: A boundary at either the beginning or the end of a morpheme. "Decongesting" has four morpheme boundaries as indicated by the hyphens: -de-congest-ing-

Sound change: A process that leads to a language sound manifesting itself in a different form. The "f" of "fafana" is a latter day manifestation of "b". At some point in the evolution of Zulu language, the word was "babana" meaning children. The "w" in Kiswahili "waana" is similarly evolved from "b" of an earlier "bana" also meaning children.

Semantic narrowing: The shrinking of the scope of meaning. If in a language there is a word that means "animal" and, with time the meaning changes to "domestic animal", the meaning of the word is said to have undergone semantic narrowing. We would arrive at a similar conclusion if a word that means "to drink" is modified to mean "to drink alcohol"

Semantic broadening: The expansion of the meaning of a word in a language. If in a language a word means "a baby girl" but with time its meaning changes to mean "a baby" , the word will be said to have undergone semantic broadening.

Semantic shift: The shift in meaning whereby a word that denoted a concept changes to denote a different concept especially in the same or related fields. In proto-Bantu and in many Bantu languages today, the word "tata/taata" or its cognates means "father". However, in Kitharaka, my mother tongue, it means "mother".

3. DEFININATION OF "UBUNTU"

Mapadimeg (2009) observes that the first attempt at an intellectual level to define and describe the ubuntu culture was made by Jordan K. Ngubane in the 1960's and 1970's. Mapadimeg (2009) observes that:

> Ngubane (1963) defined ubuntu/botho as a philosophy of life and practice of being humane which gave content to life for African people long before the arrival of white settlers, and that it rests on the supreme ethical code which attaches primacy to human personality as a sacred being.

Elsewhere, commenting on Ubuntu, Oppenheim (2012) comments that:

> The word Ubuntu comes from the Xhosa/Zulu culture, the community into which Nelson Mandela was born, and has been summarized in the phrase, "Umuntu ngumuntu ngabantu" in the Nguni language of Xhosa, Zulu, or Ndebele. The concept of this phrase can be translated to mean, "A person is a person through other persons," or "I am because we are"

The essence of Ubuntu that emerges from the above definitions constitute the essential meaning of "ubuntu". It is that meaning that, in this paper, I will be referring to when I say: "Ubuntu as used in Southern Africa". It is a meaning that embodies certain real and assumed functions at the cultural, political and spiritual spheres of live in Southern Africa

4. GEOGRAPHICAL SCOPE OF "UBUNTU" AND ITS COGNATES

The term "ubuntu" (humanity; Bantu Noun Class 14) as found in the Bantu languges of Southern African such as isiZulu and isiKhosa has the same nominal stem as "abantu" (people; Bantu Noun Class 2)[2]. Whereas the "abantu" has cognates in virtually all Bantu languages extending from Nyahururu and Kitale regions in Kenya, the Buganda territory in Uganda and the northern part of Rwanda, to the most southerly part of South Africa, the term "ubuntu" seems not to have cognates in some of the languages. Below, are eleven Languages showing the form of the words for "person", "people" and "humanness/humanity". [3]

Language	**Person**	**People**	**Humanity**
isiZulu	umntu	abantu	ubuntu
isiKhosa	umntu	abantu	ubuntu
Kiswahili	mtu	watu	utu
Ekegusii	omonto	abanto	obonyabanto
Luhya (Lubukusu)	omundu	babandu	bubundu
Luhya (Lunyala)	omundu	abandu	obundu
Luganda	muntu	bantu	ubuntu ubumuntu
Kinyarwanda	umuntu	abantu	ubuntu ubumuntu
Kitharaka	munto	antu	_____
Kikuyu	mondo	ando	_____
Shona	munhu/munu	vanhu	unhu

As I have pointed out above, Kitharaka (which happens my mother tongue) and Kikuyu as well as other languages of the central Kenya Bantu group appear not have the word for a cognate for "Ubuntu" When you ask for a word for "humanness/humanity" in their languages they do not readily provide it. When a Kikuyu speaker is pressed to think of the word, they come up with "umuntu" which is a recreation from "muntu" (person" rather than a cognate of "ubuntu".

Later in the paper, I will subject above forms to the comparative method

determine Proto-Bantu word for "humanness/humanity"

5. ORIGINS OF BANTU-SPEAKING PEOPLES

It is not a coincidence that isiZulu, isiKhosa, Luhya (Lubukusu, Lunyala), Luganda, Kinyarwanda, Ekegusii have basically the same word for "humanity". The word for "humanity" is each of the language is similar to all the other words in form and meaning. The similarity is not a coincidence just as much as similarity in body build, facial features of elevation of ears between two or more siblings is not unusual. It does not surprise us. The resemblance stems from having common parentage. Likewise, the resemblance in form and meaning of the words from IsiZulu, IsiKhosa, Luhya, Luganda, Kinyarwanda and Ekegusii results from the common parentage of the languages. They are all Bantu languages.

The cradle of Bantu languages has been established to be "the grassland area of Cameroun and the adjacent Benue region of southeastern Nigeria" (Afolayan, 2000) The area is shown on the map below. Also shown in the map, are parts of the Africa continent that are occupied by three branches of Bantu, namely, Western Bantu, Eastern Bantu and Northern Bantu.

(Afolayan, 2000)

The big question is: Why this region? Two reasons have been advanced in the choice of the area as cradle of Bantu languages:

a) It is in this area that the closest relatives of the Proto-Bantu can be found, notably, Tive and Efik of southeastern Nigeria and the Ekoi and Duala of southern Cameroon; and
b) The languages of the area have the greatest concentration of validated proto-Bantu words.

6. 'UBUNTU" AS A REFLEX OF THE PROTO-BANTU WORD */bubuntu/

As we have seen above, there are cognates of "ubuntu" in many areas of Bantu-speaking Africa. Furthermore, the cognates of "abantu" which contains the same nominal root with "ubuntu" are found in all Bantu languages. By inference, "ubuntu" as currently found in isiZulu and isiKhosa are reflexes of a form that was already in existence in proto-Bantu as spoken in its original home in Cameroon. Using glottochronology and lexicostatistics, it has been established that Bantu-speaking people were in their cradle in Cameroon around 3000 BC. It is reasonable to assume, therefore, that the word "ubuntu" has been in existence for about 5,000 years; that is, from 3000 BC to 2014 AD.

We need to address the issue of how the word "ubuntu" travelled from its original home in Western Cameroon to the Republic of South Africa as well as to other areas of the African continent. The answer is in the expansion of Bantu speakers. The expansion started after 3000 BC. It has been observed that the expansion was in stages. The first stage involved the separation of the original Bantu language (sometimes referred to as Narrow Bantu) from other Bantoid languages.[4] After the separation, it expanded eastward and became established on the fringes of savanna north of River Congo about 500 BC. (Afolayan, 2000).

Once in this area, the language split into a number of language clusters two of which were the proto-West Bantu cluster and the proto-East Bantu cluster. We will ignore the movement of proto-Western Bantu cluster as well as a northwest cluster which separated itself from the proto-Western Bantu and concentrate on proto-Eastern Bantu from which, eventually, Nguni languages sprang.

7. THE SPREAD OF "UBUNTU" AND ITS COGNATES

From the original home in Cameroon, Proto-Eastern Bantu speakers moved southeastwards to the middle of the River Zambezi. From there they spread to northern Mozambique, Northeast Tanzania and the Great Lakes region. Between the third and the seventh centuries, Bantu speakers had settled in the Lake Nyasa region. From the west of the lake, some of them moved southwards until they reached Zululand, Natal and Transkei. They arrived in these areas with some of the proto-Bantu words. Among these words, were 'abantu" and "ubuntu". The map shows the suggested movement of Bantu-speaking people from their original home to populate most of sub-Saharan Africa.

(Afolayan, 2000)

8. THE PHONOLOGY AND MORPHOLOGY OF /ubuntu/

What phonological shape, we may ask, did "ubuntu" have in the cradle of Bantu languages? In other words, how did the word look long before the birth of languages such as isiZulu, isiKhosa, Kiswahili, Ekegusii, Luhya, Luganda and Kinyarwanda? To get an answer to this question, we need to use comparative method which is a linguistic tool for reconstructing earlier shared forms. Let us compare the words for "person", "people" and "humanness/ humanity" from the languages we used above to demonstrate the occurrence of "ubuntu' and its cognates in various languages.

Language	**Person**	**People**	**Humanity**
isiZulu		abantu	ubuntu
isiKhosa	umntu	abantu	ubuntu
Kiswahili	mtu	watu	utu
Ekegusii	omonto	abanto	obonyabanto
Luhya (Lubukusu)	omundu	babandu	bubundu
Luhya (Lunyala)	omundu	abandu	obundu
Luganda	muntu	bantu	obuntu ubumuntu
Kinyarwanda	umuntu	abantu	ubuntu Ubumuntu
Kitharaka	munto	anto	_____
Kikuyu	mondo	ando	_____
Shona	munhu/munu	vanhu	unhu

As can be seen from the data above, the root morphemes in the words in nominal classes 1, 2 and 14, have five alternates. The alternates are:

/ntu/ (isiZulu, isiKhosa, Luganda, Kinyarwanda)

/ndu/ (Luhya)

/ndo/ (Kikuyu)

/tu/ (Kiswahili)

/nto/ (Kitharaka, Egegusii)

/nhu /and /nu/ (Shona)

We need to determine which of the six alternates would, if taken as the original form, evolve into the other four alternates through logical and preferably predictable diachronic sound changes. Let us take the route of choice through elimination.

We begin by eliminating /tu/ as in Kiswahili. If we posit it as a proto-form, we would have problems arguing for the diachronic introduction of /n/ in the emerging languages. Such introduction of a nasal before an obstruent would change the syllable structure from CV to NCV. The former is a more preferred syllable structure than the later. It would be difficult see the motivation for such a change

The Shona /nhu/ as well /nu/ would also give problems if any of them is posited as the proto-form. To derive /t/ or /d/ in all the languages (except Shona) would require diachronic consonant hardening for the change */nhu /> /ntu/ and consonant insertion for the change */nu/ >/ntu/. None of the two changes is likely before a syllable final syllable. In other words, none of the two changes would have a good motivation; at any rate not a phonetic motivation.

The same argument we have used against positing /nhu/ as a proto-form is applicable to the positing of /ndo/ as a proto-form. The change * /ndo/ > /nto/ would, among other things, require consonant hardening in a weak position within the word. After these eliminations, we are left with two candidates for the proto-form, namely, /ntu/ and /nto/. We have to determine whether the proto-form had a high back vowel or a tense mid-high back vowel.

As can be seen even from the limited data, /u/ is attested in more Bantu languages than /o/ as the final vowel in the morpheme under discussion. Of course, it is important to admit that frequency alone is not sufficient evidence to guide one on matters of reconstruction. However, when supported by other arguments, it is useful variable. Such argument comes in the form of the fact, the change */o/ > /u/ would be involve vowel heightening.

The change /u/ > /o/ would be vowel lowering. The weak syllable-final position, vowel lowering is more tenable than vowel heightening. It is my view that the vowel in the proto-form was */u/ and not */o/. Consequently, the form of the morpheme for “person”, “people” and “humanity” was */ntu/.

Let us now try to determine pre-root part of “ubuntu”. We have three alternates:

/u/ (Kiswahili and Shona)

/bubu/ (Luhya)

/obu/ (Luganda)

ubu – (all the other languages represented in the data).

Once again, we can get to the proto-form through elimination.

If we take *u- to have been the pre-root proto-form, one would required to argue for a diachronic word-initial insertion insertion of ubu- in languages with /bubuntu/, /bubundu/, /ubuntu/ and /ubundu/. Likewise taking ubu- to have been the pre-root part of the original form of “ubuntu” would require a diachronic insertion of b- in the word-initial position in languages where the cognates of “ubuntu” begin with bubu- . It is difficult to see any motivation for such historic sound changes. The tenable position is to argue that the pre-root part of the original word for “ubuntu’ was */bubu/. Consequently, it is our contention that the proto-form for the “ubuntu” was */bububntu/.

In the last part of my discussion I have used "pre-root part" rather the conventional linguistic term "prefix". I have do so deliberately. In the proto-form, *bubu was not a prefix. It was a pre-prefix and a prefix whereby the former was a copy of the later. In other words, prefix */bu/ was reduplicated before itself. Having said that, let me add that, today, speakers may not perceive /bubu/ (and ubu-) as a pre-prefix and prefix. It is more likely, through morphological reanalysis, the morpheme boundary between the two have been erased /bubu/ and /ubu-/ as the prefix in the respectively languages where the two variants are used.

9. ON THE SEMANTICS OF /ubuntu/

As we have seen above, it is 5,000 years since proto-Bantu emerged from the Bantoid languages. One of the language's words was */bubuntu/. As words go through a span of time and especially a long span, they may undergo semantic modification. They can experience a number of possibilities, especially:

i) Semantic broadening;
ii) Semantic narrowing;
iii) Semantic shift;
iv) Semantic merger;
v) Semantic shift; and
vi) Disappearance.

Some languages including Kitharaka, Kikuyu and Ekigusii do show any reflexes of */bubuntu/. The reflexes in some languages have undergone semantic narrowing. Such is the case with Kinyarwanda where the word refers to "generosity" rather than "humanness/humanity". In Nguni languages, the reflex "ubuntu" seems to have a wider semantic scope than what was in the original word.

The semantic field of "ubuntu" in South Africa has expanded transforming it from an ordinary word to an idea, an ideal, a philosophy and a potential political, social and economic tool. The semantic expansion and especially the direction it has taken has come about due to the unique and momentous challenges that people in Southern Africa, and especially the have faced both as individuals ad as communities. That is the nature of language: it is affected by and adjusts to its environment.

As Anttila (1972) points out, there are not exact rules in semantics for handling change. Consequently, whereas we can suggest with confidence the phonological rules and morphological processes that have produced the cognates in the various Bantu languages that we have used to arrive at the reconstruction */bubuntu/, we are not in a position to indicate semantic changes in the form of rule statements.

10. CONCLUSION

In the preceding sections, I have thrown some light on the origins of the term "ubuntu". Using the cognates of /ubuntu/ from a number of Bantu languages, and employing the comparative method, I have reconstructed */bubuntu/ as the Class 14 Proto-Bantu term for "humanness/humanity" and argued that that original form existed right at the cradle of Bantu languages in the area where current Cameroon borders the Benue-Congo area of southeastern Nigeria.

I have observed that */bubuntu/, underwent phonological, morphological and semantic changes eventually resulting in /ubuntu/ in isiZulu and isiKhosa, /unhu/ in Shona, /bubundu/and /ubundu/ in Luhya, /utu/ in Kiswahili, /obuntu/ in Luganda and "ubuntu" in Kinyarwanda.[5] Since there are differences in the historical changes through which */bubuntu/ has undergone in various Bantu languages, the cognates of "ubuntu" may differ shades of meaning and nuances while sharing the core meaning of" humanness/humanity".

ENDNOTES

1. The term Bantu was formed by William Bleek in 1962 when, on a trip to East Africa, he recognized a group of related languages in Africa that belong to the same language family. He called the language family Bantu. The name derived from the fact that in these languages the word for "people" is either "bantu" or a form very close to it (Afolayan, 2000).

2. Bantu are categorized in terms of classes as opposed to languages that categorise nouns in terms of gender. Indeed, in Bantu languages you can never tell by listening to a sentence whether it refers to a man and women. For example, Class is for all animate things in singular whereas Class 2 is for animate things in plural.

3. IsiXhosa and IsiZulu words are obtained from R. Kiogori (undated) and an anonymous document titled "Appedix: Zulu Nouns" respectively. Kitharaka and Kiswahili are from self whereas data from all the other languages is from informants

4. I use the word "Proto-Bantu" in this paper for want of a more appropriate term. Ideally, "proto-X" should be used when all languages of X family have been used in the reconstruction of the earlier form, (Anttila, 1972)

5. In Luganda, "obuntu" is a shorter frorm of "obuntu bulamu" meaning "human behavior" whereas in Kinyarwanda "ubuntu" means generosity. These changes have come about as a result of semantic shift. The word for "humanness/humanity" in Kinyarwanda it is "ubumuntu". It has been created from the Class 1 prefix and nominal root.

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Influence of Instructional Resources on Secondary School Students' Academic Performance in Makueni County, Kenya

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Abstract

Instructional resources are important factors during the implementation of curriculum. They help the implementers to realize their goals and give guidance to the teaching-learning process which leads to realization of good students' academic performance and more so Makueni County. The declining performance of students in the county from mean grade C+ to a mean grade of C- in 2007–2010 was disturbing since many of them were to lose opportunities for further education, training and job placement. Factors such as environment, parental involvement and nature of schools have been highlighted as factors that influence students' academic performance but instructional resources have not been studied in Makueni County as factor which influences students' academic performance. Therefore the study sought to investigate on the influence of instructional resources on students' academic performance in Makueni County. The study adopted a descriptive survey research design with a sample of population 93 head teachers and 418 teachers, making a total of 511 respondents. Data was analyzed using quantitative and qualitative techniques. Based on the research findings, it was concluded that students' academic performance depended on teachers' reference books and guides, students' and teachers textbooks, charts, chalk boards and chalk, classrooms, and laboratory apparatus and chemicals as teaching and learning materials. The study recommended that for secondary schools to perform better academically in their KCSE there was need to equip the schools with the necessary teaching-learning materials. Also teacher-student's ratio should be considered.

Keywords
Instructional Resources, Academic Performance, Curriculum Implementation, Teaching-Learning Process, Teaching Materials

1. Background of the Study

For realization of good performance in a school, instructional resources must be put in place and used effectively in classroom practice. Todaro (1992), noted that the formal education system of a nation is the principal institutional mechanism used for developing human skills and knowledge. Education is, therefore, viewed as an indispensable catalyst that strongly influences the development and economic fortunes of a nation and the quality of life of its people. In this context, nations, organizations and individuals spend huge sums on the provision and consumption of education for the citizen. In many developing countries formal education is the largest industry and greatest consumer of public revenues (Todaro, 1992).

The priority of all countries, especially the developing ones, is to improve the quality of schools and the achievement of student's (De Grauwe, 2001) since learning outcomes depend largely on the quality of education being offered (Barro, 2006). Barro further noted that higher quality education fosters economic growth and development. Appropriate use of instructional resources is important factor or component during the implementation of curriculum which helps the implementers to realize their goals and guide them in the teaching-learning process in the classroom practice (Shiundu and Omulando, 1992). This factor is one of the most important ingredients that help the school systems to achieve their objectives and realization of good student academic performance in examinations. Education has been described as an important determinant of upward social mobility and eligibility for employment within the modern sector. Internationally, student's' scores in examination have been accepted and used as a proxy of achievements. Deolalikar (1999) argued that, the most important manifestation of schooling quality are literacy, measurable cognitive abilities and observable student's' academic performance.

Evidence from the World Bank and other international organizations on the quality of learning in the developing countries pointed out the importance of certain school inputs. Some of the inputs include teachers, classroom size and its environment, instructional materials such as textbooks and other reading materials as well as school buildings and facilities (Eshwani, 1996). The Kenya government policy also entails allowing a broad based participation in the provision of education with all the stakeholders taking responsibility for planning and implementation. In line with this policy direction is the decentralization of decision making and resource management to lower level structures with Ministry of Education (MOEST, 2008). In addition inadequate resources among others have lead to poor services hence undesirable performance in Kenya Certification of Secondary Education (KCSE) in public secondary schools. The teacher resource is one of the most important inputs to education system. Being focus of classroom instructional activities and curriculum delivery, teachers are critical determinants of the quality education offered. Teacher's effectiveness at all levels of education has an implication on student's' academic performance (Okumbe, 2001).

Despite realization of low performance in some parts of Kenya, many student's continue to perform poorly. This has been a persistent outcry from all educational stakeholders about this poor performance. As schools are about teaching and learning to realize good performance of student's and other activities are secondary to these basic goals. These basic goals can only be realized through proper utilization of learning resources. No matter how well staffed the school is, without appropriate learning materials, the basic goals of the school that is teaching and learning to realize good performance in a school can be seriously handicapped (Okumbe, 1999). It is on this background that the researcher in this study investigated on the influence of instructional resources on student's' performance in Makueni County in Kenya. It is observed that each institution has its pertinent problem which includes unavailability, under utilization, overcrowding and rapid rise of student's population, turnover of staff and inadequate

learning facilities including infrastructure. If these factors are poorly utilized they may affect student's academic performance but if properly used may enhance student's academic performance.
This study was necessitated by the fact that Makueni County was performing fairly with mean grade of C+ in 2003-2006 KCSE out of decline of 5.25 in 2005-2010 respectively. Based on university entry point of grade C+ this means, student's going to university from the county have reduced substantially from grade C+ year 2003-2006 to grade C- 2007-2010 and therefore this needs to be determined.

In Makueni County, secondary school student's' KCSE performance had been declining from 2007 to 2010 (County Director of Education, Makueni County 2011). The declining performance of student's in the county is disturbing since many of them were to lose opportunities for further education, training and job placement. This scenario has jolted the researcher's curiosity. As a result, the researcher saw the need to investigate how instructional resources have had an influence on secondary school student's' academic performance in Makueni County, Kenya in order to enhance understanding and suggest solutions to this problem.

The purpose of this study was to investigate the influence of instructional resources on secondary school student's' academic performance in Makueni County, Kenya. The general objective of this study was investigating the influence of instructional resources on secondary student's' academic performance in KCSE in Makueni County.

2. Research Methodology

In research design this study adopted descriptive survey research design. According to Kothari (2011) descriptive survey research design studies were designed to obtain pertinent and precise information concerning the current status, phenomenon and where possible to draw conclusions from the facts obtained. This study design therefore enabled the researcher to collect data more appropriately. This is the influence of selected factors that affects student's academy performance. Similarly, according to (Kothari, 2011) survey as a descriptive design is referred because:

i) It enables the researcher to examine various data and the relationship between various other unknown situations in the circumstances.
ii) It enabled the researcher to collect data from a wide area in a short time.

The research design was concerned with the present relationship of factors, the present processes taking place in the study area, the effects that were going on there at that particular time and attitudes held by the respondents that were being cross examined (Mugenda and Mugenda, 1999). However the research design required enough provision of information, protection against bias and maximized reliability therefore the procedures used were carefully planned (Kothari, 2001).

Target population included 930 public secondary schools in Makueni County. These includes seven national schools, 162 county schools and 762 sub-county schools. The target population were headteachers, teachers and Quality Assurance and Standard Officers. The headteachers in the national schools were seven and 178 teachers. Headteachers in county schools were 162 and 2037 teachers. Sub-county schools had 762 headteachers and 1965 teachers. Nine Sub- county Quality Assurance and Standard Officers from the nine districts that make up the Makueni County were targeted. Therefore, the total target population was 5119.
The Headteachers were vital in the study because they are instructional leaders and carryout supervision during the teaching-learning activities. They were directly involved in the provision of human resource and learning resources in the schools (Education Office Makueni County, 2012). The teachers were

chosen in the study because they are implementers of the curriculum and that they are involved in instructional supervision and leadership when organizing the learning experiences in the classroom which influence the students' academic performance.

The sample size according to Kothari (2011) 10 per cent of a target population for a study gives respondents who ensures representativeness, efficiency, reliability and flexibility in a study. Using simple random sampling procedure the researcher selected the sample size as follows. Two national schools were sampled, two headteachers, 18 teachers making a total of 20. In the county schools category, 16 schools were sampled, 16 headteachers, 200 teachers making a total of 216. Of Sub-county schools, 75 schools, 75 headteachers and 200 teachers were sampled, making a total of 275. Hence the total number of respondents chosen were 511.

Sampling procedure was used to ensure that various categories of public secondary schools were represented, the researcher employed stratified random sampling techniques to sample out the schools as follows: National schools, County schools and Sub-county schools. Two national schools, 16 County schools and 75 sub-county schools were systematically sampled. Simple random sampling enabled each subject to have an equal chance of inclusion in the target population. This technique was employed to determine the sample size where 10 per cent (Kothari, 2011) of the target population in each category of the public secondary schools was appropriate. Therefore the researcher determined the desired precision as an acceptable confidence level for the estimate (Kothari, 2011).

Research instrument used to facilitate data collection were questionnaires. There gathered information from Headteachers Questionnaire (HQ) and Teachers Questionnaire (TQ). The researcher chose the questionnaire because the participants were all literate, and therefore could read and respond to the items. Closed-ended questionnaires could be answered more easily and quickly by respondents (Ary *et al.*, 2006). Similarly, due to the large number of respondents, interviewing all of them would be unrealistic.

The questionnaire for the head teachers solicited information for personal data, educational and professional enhancement and his or her role and provision of instructional materials in relation to student's' academic performance. The information gathered was to be important in the investigation on the factors affecting student's' academic performance as the head teacher plays a major role in the instructional supervision in the school.

Piloting of instruments was conducted in two schools which were not among the sampled schools for the study selected randomly. Inorder to determine on validity and reliability of the instruments two headteachers and four teachers were involved in piloting. (Kothari, 2011). The results of the respondents from the piloted schools were to show if the instruments were valid, detected mistakes were modified and clear instructions given to respondents so as to avoid misinterpretation in the actual data collection.

To test instrument reliability, test-retest method the researcher made a comparison between answers obtained in the two piloted schools and the responses were consistent with the instrument, therefore deemed reliable. Pearson's Product Moment correlation formula for the test-retest was employed to compute the correlation co-efficiency in order to establish the extent to which the content of the questionnaires were consistent in eliciting the same responses every time the instrument was administered. The reliability yielded a coefficient of 0.728 for teachers' questionnaires and coefficient of 0.7831 for headteachers questionnaires. According to Orodho (2008) reliability of a coefficient above 0.7 can be accepted as reliable.

After collecting data the researcher organized the data to facilitate analysis. Data analysis was facilitated by use of SPSS (Statistical Version 17 Package for Social Scientist) computer package. The research questions elicited both qualitative and quantitative data which was analyzed using descriptive statistics and Pearson's chi-square test to determine the association between the factors under study.

3. Results and discussions

Influence of Instructional Resources on Student's' Academic Performance

This sought to answer the study question on the influence of instructional resources on student's' academic performance. Resource endowment by any school could possibly be accounted by the teachers and head teachers in a school. In ascertaining the influence of instructional resources on student's' academic performance, the study relied primarily on the information provided by the teachers and head teachers.

Based on the head teacher's response on teachers reference books and guides, as a learning resource, the study showed that out of the 93 sampled schools, 73 (78 per cent) unanimous agreed that they were inadequate, while 20 (22 per cent) indicated they were adequate. When relating to K.C.S.E performance in Makueni County, 19 (20 per cent) of the sampled schools had a mean grade of C-, 68 (73 per cent) had C, five (5 per cent) had C+ and one (1 per cent) had an average of B- . Hence, it could be deduced that, the inadequacy of teachers' reference books and guides negatively affected student's academic performance as outlined in table 1.

Table 1: Headteachers responses on Teachers Reference Books and Guides

	5 (C-)		6 (C)		7 (C+)		8 (B-)		Total	
	f	%	*f*	%	*f*	%	*f*	%	*f*	%
Quite Adequate	1	1	1	1	0	0	0	0	2	2
Adequate	2	2	13	14	3	3	0	0	18	19
Inadequate	16	17	53	57	2	2	1	1	72	77
Quite Inadequate	0	0	1	1	0	0	0	0	1	1
Total	19	20	68	73	5	5	1	1	93	100

Chi^2 (9)=7.813 Pr=0.553

In order to determine the association between teachers reference books and guides and student's academic performance, the researcher applied Pearson's Chi square test. A probability value of 0.55 was obtained for the headteachers response. This showed that according to the headteacher, teachers reference books and guides was not associated with student's academic performance were examined. The findings of teacher's response on teachers reference books and guides on student's academic performance. Out of the 418 sampled teachers, 278 (67 per cent) indicated inadequacy while 140 (33 per cent) indicated that they were adequate. From the sampled teachers, 85 (20 per cent) indicated that the mean grade in their schools was grade C- (minus), 306 (73 per cent) reported their school mean grade was C (constant), 23 (6 per cent) said their schools obtained a mean grade of C+ (plus) and four teachers had their schools having a mean grade of B- (minus) in the years 2007-2010. Therefore, based on teachers reference books and guides it was most likely that they affected student's academic performance in KCSE as in Table 2.

Table 2: Teachers responses on Teachers Reference Books and Guides

	5 (C-)		6 (C)		7 (C+)		8 (B-)		Total	
	f	%	*f*	%	*f*	%	*f*	%	*f*	%
Quite Adequate	4	1	32	8	0	0	0	0	36	9
Adequate	15	4	86	21	2	0	1	0	104	25
Inadequate	62	15	170	41	21	5	2	0	255	61
Quite Inadequate	4	1	18	4	0	0	1	0	23	6
Total	85	20	306	73	23	6	4	1	418	100

Chi^2 (9) = 21.7513 Pr=0.01

In ascertaining the influence of teachers' reference books and guides on student's academic performance, a Pearson chi square test was conducted on the teachers' responses, which yielded a probability value of 0.01. This showed that based on the teachers response, teachers reference books and guides had an influence on student's academic performance.

Based on the head teacher's response on student's textbooks, as a learning resource, the study revealed that out of the 93 sampled schools, 77 (83 per cent) unanimous agreed that they were inadequate, while 16 (17 per cent) indicated they were adequate. In relation to K.C.S.E performance in Makueni County, 19 (20 per cent) of the sampled schools had a mean grade of C-, 68 (73 per cent) had C, five (5 per cent) had C+ and one (1 per cent) had an average of B-. Hence, it could be deduced that, the inadequacy of teachers' reference books and guides negatively affected student's academic performance as outlined in Table 3.

Table 3: Head teachers responses on Student's' Textbooks

	5 (C-)		6 (C)		7 (C+)		8 (B-)		Total	
	f	%	*f*	%	*f*	%	*f*	%	*f*	%
Quite Adequate	1	1	1	1	0	0	0	0	2	2
Adequate	1	1	10	11	3	3	0	0	14	15
Inadequate	17	18	55	59	2	2	1	1	75	81
Quite Inadequate	0	0	2	2	0	0	0	0	2	2
Total	19	20	68	73	5	5	1	1	93	100

Chi^2 (9)=11.197 Pr=0.262

In order to establish the association between student's textbooks and student's academic performance, a Pearson's Chi square test was applied, where a probability value of 0.26 was realized from the headteachers response. This implied that according to the headteacher, student's textbooks were not associated with student's academic performance. The findings of teacher's responses on the effect of student's textbooks on student's academic performance were examined. Out of the 418 sampled teachers, 286 (68 per cent) indicated inadequacy while 132 (32 per cent) indicated that they were adequate. From the sampled teachers, 85 (20 per cent) point out that the mean grade in their schools was grade C- (minus), 306 (73 per cent) reported their school mean grade was C (constant), 23 (6 per cent) said their schools obtained a mean grade of C+ (plus) and four teachers had their schools having a mean grade of B- (minus) in the years 2007-2010. Therefore, based on student's textbooks it showed that they affected student's academic performance in KCSE as in Table 4.

Table 4: Teachers responses on Students' Textbooks

	Student's' Textbooks									
	5 (C-)		6 (C)		7 (C+)		8 (B-)		Total	
	f	%	*f*	%	*f*	%	*f*	%	*f*	%
Quite Adequate	3	1	29	7	0	0	0	0	32	8
Adequate	15	4	82	20	2	0	1	0	100	24
Inadequate	63	15	179	43	21	5	2	0	265	63
Quite Inadequate	4	1	16	4	0	0	1	0	21	5
Total	85	20	306	73	23	6	4	1	418	100
Chi^2 (9) = 19.985 Pr=0.018										

To determine the influence of student's textbooks on student's academic performance, a Pearson chi square test was conducted on the teachers responses, which produced a probability value of 0.018. This implied that based on the teachers response, student's textbooks determined student's academic performance. Similar finding was supported by Fuller (1986), Tanner and Tanner (2007), and Peters (2009).

Charts were also used as instructional resource. Based on the head teacher's response on availability of charts, as a learning resource, the study showed that out of the 93 sampled schools, 75 (80 per cent) unanimous agreed that they were inadequate, while 18 (19 per cent) indicated they were adequate. When relating to K.C.S.E performance in Makueni County, 19 (20 per cent) of the sampled schools had a mean grade of C-, 68 (73 per cent) had C, five (5 per cent) had C+ and one (1 per cent) had an average of B-. This implied that, the inadequacy of charts affected student's academic performance negatively as outlined in Table 5.

Table 5: Head Teachers responses on charts

	5 (C-)		6 (C)		7 (C+)		8 (B-)		Total	
	f	%	*f*	%	*f*	%	*f*	%	*f*	%
Quite Adequate	0	0	1	1	0	0	0	0	1	1
Adequate	2	2	12	13	3	3	0	0	17	18
Inadequate	7	8	25	27	1	1	0	0	33	35
Quite Inadequate	10	11	30	32	1	1	1	1	42	45
Total	19	20	68	73	5	5	1	1	93	100
Chi^2 (9) = 8.3032 Pr=0.504										

In order to determine the association between charts and student's academic performance, the researcher applied Pearsons Chi square test. A probability value of 0.50 was obtained for the headteachers response. This showed that according to the headteacher, charts were not associated with student's academic performance.

The findings of teacher's response on charts on student's academic performance were shown. Out of the 418 sampled teachers, 312 (75 per cent) indicated inadequacy while 106 (26 per cent) indicated that they were adequate. From the sampled teachers, 85 (20 per cent) indicated that the mean grade in their schools was grade C- (minus), 306 (73 per cent) reported their school mean grade was C (constant), 23 (6 per cent) said their schools obtained a mean grade of C+ (plus) and four teachers had their schools

having a mean grade of B- (minus) in the years 2007-2010. Therefore, based on charts availability it portrayed that they affected student's academic performance in KCSE as in Table 6.

Table 6: Teachers responses on charts

	5 (C-)		6 (C)		7 (C+)		8 (B-)		Total	
	f	%	*f*	%	*f*	%	*f*	%	*f*	%
Quite Adequate	5	1	18	4	0	0	0	0	23	6
Adequate	8	2	73	17	1	0	1	0	83	20
Inadequate	67	16	196	47	22	5	2	0	287	69
Quite Inadequate	5	1	19	5	0	0	1	0	25	6
Total	85	20	306	73	23	6	4	1	418	100
Chi^2 (9) =20.2541 Pr =0.016										

A Pearson chi square test was conducted on the teachers responses to ascertain the influence of charts on student's academic performance. A probability value of 0.016 was produced, clearly showing that based on the teachers response, charts had an influence on student's academic performance.

Another factor for instructional resource was chalkboard and chalk. The study from the head teacher's response on chalk boards and chalk, as a learning resource, showed that out of the 93 sampled schools, 60 (65 per cent) agreed that they were inadequate, while 33 (35 per cent) indicated they were adequate. When relating to K.C.S.E performance in Makueni County, 19 (20 per cent) of the sampled schools had a mean grade of C-, 68 (73 per cent) had C, five (5 per cent) had C+ and one (1 per cent) had an average of B-. Hence, it could be deduced that, the inadequacy of chalk boards and chalk negatively affected student's academic performance as outlined in Table 7

Table 7: Head Teachers responses on Chalk Boards and Chalk

	5 (C-)		6 (C)		7 (C+)		8 (B-)		Total	
	f	%	*f*	%	*f*	%	*f*	%	*f*	%
Quite Adequate	2	2	4	4	0	0	0	0	6	6
Adequate	4	4	19	20	4	4	0	0	27	29
Inadequate	11	12	38	41	1	1	0	0	50	54
Quite Inadequate	2	2	7	8	0	0	1	1	10	11
Total	19	20	68	73	5	5	1	1	93	100
Chi^2 (9)= 15.7932 Pr=0.071										

In order to determine the association between chalk boards and chalk and student's academic performance, the researcher applied Pearsons Chi square test. A probability value of 0.071 was obtained for the headteachers response. This indicated that according to the headteacher, chalk boards and chalk was associated with student's academic performance.

The findings of teacher's response on chalk boards and chalk on student's academic performance showed that, out of the 418 sampled teachers, 292 (69 per cent) indicated inadequacy while 126 (30 per cent) indicated that they were adequate as in Table 8. From the sampled teachers, 85 (20 per cent) indicated that the mean grade in their schools was grade C- (minus), 306 (73 per cent) reported their

school mean grade was C (constant), 23 (6 per cent) said their schools obtained a mean grade of C+ (plus) and four teachers had their schools having a mean grade of B- (minus) in the years 2007-2010. Therefore, based on chalk boards and chalk it was likely that they affected student's academic performance in KCSE.

Table 8: Teachers responses on Chalk Boards and Chalk

	5 (C-)		6 (C)		7 (C+)		8 (B-)		Total	
	f	%	*f*	%	*f*	%	*f*	%	*f*	%
Quite Adequate	4	1	29	7	0	0	0	0	33	8
Adequate	13	3	77	18	2	0	1	0	93	22
Inadequate	64	15	174	42	21	5	2	0	261	62
Quite Inadequate	4	1	26	6	0	0	1	0	31	7
Total	85	20	306	73	23	6	4	1	418	100

Chi^2 (9)= 20.7644 Pr =0.014

To determine the influence of chalk boards and chalk on student's academic performance, a Pearson chi square test was carried out on the teachers responses, which gave a probability value of 0.014. This showed that based on the teachers response, chalk boards and chalk had an influence on student's academic performance.

Instructional resource factor on laboratory apparatus and chemicals were also tested. Based on the head teacher's response on laboratory apparatus and chemicals, as a learning resource, the study showed that out of the 93 sampled schools, 81 (87 per cent) unanimous agreed that they were inadequate, while 12 (13 per cent) indicated they were adequate. When relating to K.C.S.E performance in Makueni County, 19 (20 per cent) of the sampled schools had a mean grade of C-, 68 (73 per cent) had C, five (5 per cent) had C+ and one (1 per cent) had an average of B- . Hence, it could be deduced that, the inadequacy of laboratory apparatus and chemicals negatively affected student's academic performance as outlined in Table 9.

Table 9: Head Teachers responses Laboratory Apparatus and Chemicals

	5 (C-)		6 (C)		7 (C+)		8 (B-)		Total	
	f	%	*f*	%	*f*	%	*f*	%	*f*	%
Quite Adequate	1	1	0	0	0	0	0	0	1	1
Adequate	2	2	7	8	2	2	0	0	11	12
Inadequate	4	4	28	30	2	2	1	1	35	38
Quite Inadequate	12	13	33	35	1	1	0	0	46	49
Total	19	20	68	73	5	5	1	1	93	100

Chi^2 (9)=12.2908 Pr=0.197

In order to determine the association between laboratory apparatus and chemicals and student's academic performance, the researcher applied Pearsons Chi square test. A probability value of 0.197 was obtained for the headteachers response. This showed that according to the headteacher, laboratory apparatus and chemicals was not associated with student's academic performance.

The findings of teachers' response on laboratory apparatus and chemicals on student's academic performance were examined. Out of the 418 sampled teachers, 316 (76 per cent) indicated inadequacy while 102 (24 per cent) indicated that they were adequate. From the sampled teachers, 85 (20 per cent) indicated that the mean grade in their schools was grade C- (minus), 306 (73 per cent) reported their school mean grade was C (constant), 23 (6 per cent) said their schools obtained a mean grade of C+ (plus) and four teachers had their schools having a mean grade of B- (minus) in the years 2007-2010. Therefore, based on laboratory apparatus and chemicals it showed that they affected student's academic performance in KCSE as shown in Table 10.

Table 10: Teachers responses Laboratory Apparatus and Chemicals

	5 (C-)		6 (C)		7 (C+)		8 (B-)		Total	
	f	%	*f*	%	*f*	%	*f*	%	*f*	%
Quite Adequate	0	0	13	3	0	0	0	0	13	3
Adequate	11	3	76	18	1	0	1	0	89	21
Inadequate	18	4	53	13	2	0	1	0	74	18
Quite Inadequate	56	13	164	39	20	5	2	0	242	58
Total	85	20	306	73	23	6	4	1	418	100

Chi^2 (9)=19.5664 Pr=0.021

In ascertaining the influence of laboratory apparatus and chemicals on student's academic performance, a Pearson chi square test was conducted on the teachers responses, which yielded a probability value of 0.021. This showed that based on the teachers response, laboratory apparatus and chemicals had an influence on student's academic performance.

Another factor for instructional resource was laboratories. Based on the head teacher's response on laboratories, as a learning resource, the study showed that out of the 93 sampled schools, 60 (64 per cent) unanimous agreed that they were inadequate, while five (5 per cent) indicated they were adequate. When relating to K.C.S.E performance in Makueni County, 19 (20 per cent) of the sampled schools had a mean grade of C-, 68 (73 per cent) had C, five (5 per cent) had C+ and one (1 per cent) had an average of B-. Hence, it could be deduced that, the inadequacy of laboratories negatively affected student's academic performance as outlined in Table 11.

Table 11: Head Teachers responses Laboratories

	5 (C-)		6 (C)		7 (C+)		8 (B-)		Total	
	f	%	*f*	%	*f*	%	*f*	%	*f*	%
Adequate	1	1	2	2	2	2	0	0	5	5
Inadequate	4	4	12	13	1	1	0	0	17	18
Quite Inadequate	10	11	32	34	0	0	1	1	43	46
Not Applicable	4	4	22	24	2	2	0	0	28	30
Total	19	20	68	73	5	5	1	1	93	100

Chi^2 (9)=16.4486 Pr=0.058

In order to determine the association between laboratories and student's academic performance, the researcher applied Pearsons Chi square test. A probability value of 0.058 was obtained for the

headteachers response. This showed that according to the headteacher, laboratories was associated with student's academic performance.

The findings of teacher's response on laboratories on student's academic performance were examined. Out of the 418 sampled teachers, 336 (81 per cent) indicated inadequacy while 82 (20 per cent) indicated that they were adequate. From the sampled teachers, 85 (20 per cent) indicated that the mean grade in their schools was grade C- (minus), 306 (73 per cent) reported their school mean grade was C (constant), 23 (6 per cent) said their schools obtained a mean grade of C+ (plus) and four teachers had their schools having a mean grade of B- (minus) in the years 2007-2010. Therefore, based on laboratories it was likely that they affected student's academic performance in KCSE as in table 12.

Table 12: Teachers responses Laboratories

	5 (C-)		6 (C)		7 (C+)		8 (B-)		Total	
	f	%	*f*	%	*f*	%	*f*	%	*f*	%
Quite Adequate	1	0	14	3	0	0	0	0	15	4
Adequate	7	2	58	14	1	0	1	0	67	16
Inadequate	35	8	106	25	12	3	1	0	154	37
Quite Inadequate	42	10	128	31	10	2	2	0	182	44
Total	85	20	306	73	23	6	4	1	418	100

Chi^2 (9)=13.5633 Pr=0.139

4. Conclusion

This study adopted a descriptive survey research design. The sample for the study was 93 headteachers and 418 teachers making a total of 511. Date was analyzed by use of descriptive statistics and Pearson's chi-square test. The study revealed that student's academic performance in KCSE was influenced by instructional resources like chalk boards and chalk, student's' textbooks, teachers textbooks, classrooms, laboratories apparatus and chemicals. Based on the findings of the study, it was concluded that

- Students' academic performance depended on teachers' reference books and guides, students' and teachers textbooks, charts, chalk boards and chalk, classrooms, and laboratory apparatus and chemicals as teaching and learning materials. The presence of staff room, classrooms, dormitories, chairs, and laboratories as physical facilities in school influenced student's' academic performance.
- Ensuring student's had the necessary materials for learning and revision of any difficult areas as observed in evaluation significantly affected student's' academic performance.

5. Recommendation

As well based on the findings of the study, the following recommendations were made:
For secondary school student's to perform better academically in their KCSE examinations, there is need to reduce the number of lessons a teacher had per week, which could be achieved by employing more secondary school teachers. In addition, the head teachers ought to encourage and support teachers to attend seminars, since while in attendance, they would gain additional insights on better teaching techniques from the interactions and sharing with other teachers.

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THE RELATIONSHIP BETWEEN LAND USE/LAND COVER CHANGE AND FACTORS FOR ECOTOURISM DEVELOPMENT IN THE PARTIAL NATURE BASED WETLAND USING REMOTE SENSING AND GIS TECHNIQUES

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ABSTRACT

Sri Lanka has tremendous semi-nature based wetland resources that have great potential for further development in Southern Asia. The purpose of this study is to examine the effects of wetland expansion on land use/ land cover changes in southern Sri Lanka after 1980. This paper explores the use of image analysis approaches in mapping wetland land use and land cover. Spatial changes in the wetland area from 1983 to 2011 were analyzed using satellite remote sensing and GIS. Fourteen land use and land cover categories were identified and classified in order to reflect the objectives of this study. Major changes in land use types of the study area have occurred over the past three decades. The results of the image interpretation and classification indicate that majority of the land use changes took place after the implementation of the flood control scheme in the lower floodplain of the Nilwala River. The expansion process in Kirala Kele wetland would be useful for ecotourism development in Sri Lanka.

Key words: *Ecotourism development, Wetland, Land use, Remote sensing, Sri Lanka.*

1.1 INTRODUCTION

Wetlands are ecotourism and recreation sites because of their aesthetic appeal and biodiversity of ecosystems. Ecotourism involves visiting natural areas with the objectives of learning, studying or participating in activities that do not harm the environment; whilst protecting and empowering local communities socially and economically (Cristina, 2004; Butler, 1993; Walpola & Goodwin, 2000; Fennell, 2003; Mara, 2006; Blamey, 1995; Weaver, 2001; Allocoke & Smith, 1994). It is a multi-disciplinary field comprised of the natural and cultural environment. Both IUCN and TES stated that ecotourism activities can be implemented into the natural environment. Furthermore, they stated that man-made areas can be created after excavating some natural resources (Nelson, 2004). Ecotourism is defined as tourism, which demands a high level of human responsibility involving active contribution towards conservation and/or the improvement of host community welfare (Buckley, 2003; Stone & Wall, 2004) Page & Dowling, 2001; Boo, 1990; Fennell 1999; Stem et al., 2003). Many scholars now agree that ecotourism should require a two ways, link between tourism and environmental conservation (Ryngnga, 2008). Therefore, proper management and conservation plan of the ecotourism can develop the socioeconomic and eco-friendly environment of the host country. This provides local economic benefits to the host country such as, employment opportunities, infrastructural improvement, rural and urban productions and natural resource for tourism activities. Ecotourism brings closer to rural local market due to low cost mechanisms (Healy, 1994) and can provide foreign exchange and economic rewards for the preservation of natural systems and socioeconomic development of coastal wetlands. Semi nature based wetlands are areas characterized by a high percentage of artificial environments,

which are saturated with water, either permanently or seasonally, that determining the nature of soil development and the types of animals and plant communities in the soil (Charman, 2002). Cconcentration of partial nature based wetland has the ability to produce large amount of resources for the development of ecotourism. The Kirala Kele wetland enables a rich tourism potential with attractiveness, as various activities, boating, fishing, camping, bird watching, nature photography, and picnicking, visiting traditional villages, visiting traditional farming, as a solitude and research center (Buckley, 2004; Weaver, 2001).

Sri Lanka context

Sri Lanka tourism sector achieved the highest number of tourist arrivals and expected to rise further on as a result of the removal of travel restrictions imposed by various countries due to the past civil war. This favorable condition has been further boosted by the improvement of international tourism rating where Sri Lanka was given a splendid outlook by a number of key originating countries (Fernando & Noresah, 2013). Tourism has moved up its position as the sixth largest foreign exchange earner in the year 2009. Tourism sector of Sri Lanka earned USD million 1402.1 of foreign exchange in 2013 and aimed to earn USD Billion 3.1 in 2016.The economy of the country managed to achieve an impressive rate of growth at around 8 per cent in 2013 (Central Bank Report, 2013). In reality, among other developing countries, Sri Lanka can earn more benefits such as being able to provide direct financial benefits for conservation and management of wetlands, financial benefits and empowerment for local people and build environmental and, cultural awareness of how to sustain resources. The concentration of Kirala Kele partial nature based wetland has the ability to produce large amount of resources for the development of ecotourism.

The wetlands have hydrologic regimes that fluctuate relatively to local and regional precipitation (Eimers, Buttle, & Watmough, 2008). The total annual average rainfall in Sri Lanka is 1861mm and it is equivalent to 122 km^3 by volume. 59% of total volume of rainfall in Sri Lanka contributes to the evaporation and evopo-transpiration (Ratnasara, 1993). Therefore, change in rainfall pattern and decrease in quantity of rainfall is impacting to living organisms (Premalal, 2012) because wetland is a rain fed natural ecosystem in the biosphere. Wetland hydrology involves spatial and temporal distribution, circulation and physiochemical characteristics of surface and subsurface water and its catchment over time and space (Richardson, Arndt, & Montgomery, 2001).The upper and middle portion of the watershed boundary of the Nilwala river system has wider and narrow parts. The Nilwala River watershed is dispersed into the wet zone where the mean annual rainfall is 1300-3300mm in the upper basin and the annual rainfall process is 1900mm in the lower basin. The evaporation is 1550mm. Furthermore, high runoff/rainfall ratio (48%) signals the potential for storaging the excess water for future utilization (Nihal, 1996). According to data above watershed has a positive water balance which would be beneficial for the Kirala Kele wetland. The mean temperature in the upper basin of Nilwala River is between 22.5°c and 25.5°c, and the mean annual temperature in the lower basin of the Nilwala River is between 25.5°c and 27.5°c. The lowest recorded temperature is in January, while the highest values are recorded in March and April (Amarasinghe & De Silva, 1999). A unique geomorphological feature of the lower Nilwala basin has an oval shape of the flood plain, including the Kirala Kele back swamp. However, because of the lower elevation and low velocity of the river braided channels can be seen. The fluvial-marine process is the main denudation processes in the study area. The fluvial system was generated by two basic geomorphological units which are the flood plain with the back swamp and the river channel (Wolf, Cooper, & Hobbs, 2007) in the area. Flood plains are comprised with the alluvial fans across the Kirala Kele wetland area. The lower valley of the Nilwala River basin is structurally made up of a wide variety of rock types differing in age and lithology. The surface

geological stratum of the Kirala Kele wetland area is predominantly covered by clay, silt, organic matters and sand. Due to the low elevation of this area clay, silt and sand brought down by the river and deposited in the lower basin of Kirala Kele. They have been dominated by Quaternary marine aeolian deposits (Weerakkody, 1988) and fluvial deposits by temporal regime. The elevation of the wetland area ranges from 5-15 meters above Mean Sea Level in the southern part of Kirala Kele. The central and northern portion of the wetland is comprised of small denuded hills originated from the fluvial marine process (Figure 1).

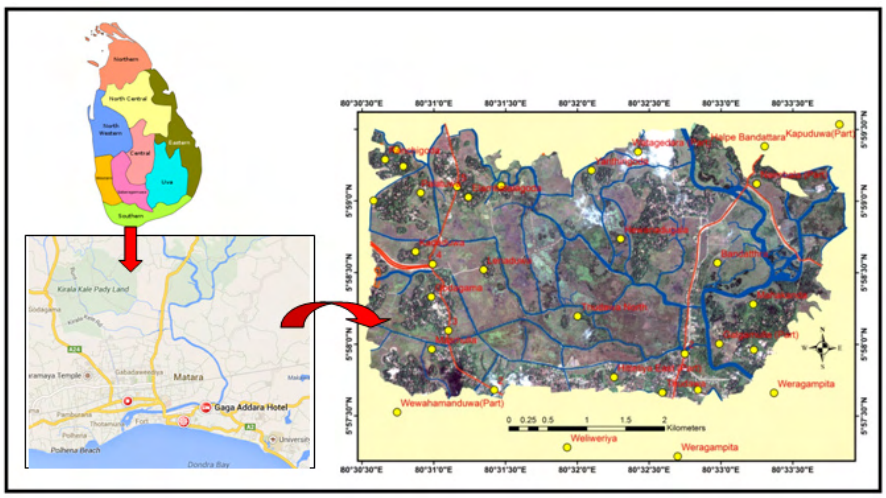

Figure 1 - Geographical location of study area

The purpose of this study is to examine the effects of wetland expansion of land use and land cover changes in Southern Sri Lanka after 1980. This paper explores the image analysis approaches in mapping wetland land use and land cover. Spatial changes in the wetland area from 1983 to 2011 were analyzed using satellite remote sensing and GIS. Visual interpretation was applied to two IKONOS images (2003 and 2011) and a stereo pair of Aerial Photographs (1983) covering the Kirala Kele wetland area in Matara, Sri Lanka.

1.2 MATERIALS AND METHODS

The sequential aerial photographs used for the study dated in 1983 and have a scale of 1:20,000 as a base map of land use estimation. The absolute changes of the land use, land cover in the wetland after Nilwala River Flood Control Scheme (NRFCS) were studied when comparing the IKONOS satellite images dated from 2003 and 2011 with 4 meter resolution.

The satellite images were provided by the Survey Department of Sri Lanka. The images were radio metrically and geometrically corrected and co-registered to Transverse Mercator Projection with UTM zone 47 North and WGS 84. The spatial resolution was 4m *4m. They were acquired between January and February in 2003 and 2011. Pair of black and white Aerial photographs in 1983, IKONOS 2003 and 2011 images were processed using ESRI Arc GIS 10 software systems. Spatial data base and attribute tables of land use maps were generated on this window. Basic land use data for this study was extracted from three dimensional stereo (Photograph No 169 and 170) pare of aerial photograph in 1:20,000 in 1983. They were scanned and georeferenced based on the satellite image in 2009 which has previously been georeferenced using ground control points. Furthermore, 2003 and 2011 high resolution IKONOS images were geometrically corrected based on the 2009 image using the Root Mean Square Error

(RMSE) < 0.5 pixel. Five control points were used at each corner of the image and represent the center. They were linked between unprojected and georeferenced data images.

Prior to image classification land use, land cover features were broad categories into twenty eight classes. Then broad categories were summarized into fourteen classes relevant to ancillary data and ecologically integrated features in the area. These fourteen categories were identified based on variables of visual interpretation and verified from the field inspection. Geo spatial analysis was done to obtain the result of the analysis. It involved creating a mosaic of classified maps for the entire area in the Data Management Window and calculating the total areas of every land use category using zonal statistics in the GIS environment. The data layers of these categories in 1983, 2003, and 2011 were calculated as separated layers and overlaid into each other for identification of changing trends in between input years.

1.3 RESULTS AND DISCUSSION

Proper land use planning and management should be an initial requirement because populations depend on land for food, fuel and employment will double within the next 25-50 years (Resources, Service, & Planning, 1993). Prior to land use planning decision makers should be required to do quantitative data on the spatial and temporal distribution of land use land cover of the proposed area. Different types of land can be used to sustain land use products and are suitable for ecotourism development in the Kirala Kele wetland area (Fernando & Noresah, 2013).

Before 1983, most of the cultivated area of the Kirala Kale wetland was covered by paddy cultivated lands. It can be seen in Figure 2 as the spatial distribution of these land use categories.

Figure 2 – Spatial distribution of land use, land cover of the Kirala Kele wetland.

In 1983 paddy land was the largest type of land used representing 35.44% (1599 acres) of the total land cover type in the entire study area. Although, paddy lands occupied a considerable portion of the total area of wetland in 1983, it rapidly decreased by 2003. In 2003, the amount of paddy lands decreased significantly compared to 1983. It has become 8.08% (323 acres) of the total amount. Therefore, 981acres of paddy land was lost in between 1983 – 2003 at 73.87% relatively. Even though the reduction of paddy land areas in this wetland occurred slowly in the field and came up to 177 acres or 4.45% of total areas in 2011, it efficiently decreased (85.61% or 1422acres) compared to 1983 and 2011 (Figure 3 and Table 1).

Ancillary data and the results of changes in paddy cultivation areas had good interrelationship visual interpretation data. Even though the paddy cultivated area of the river basin covered approximately 18000 hectares, the lower part of the basin included 9000 hectares subjected to seasonal flooding (Delpachitre.U, 1996).

Figure 3 – Temporal changes of paddy land area between 1983 and 2011

Nearly 2000 hectares of paddy land in the flood plain of the Nilwala River in Kirala Kele, Malimboda, Bandaththara and Palatuwa were abandoned due to the Nilwala Flood Protection Scheme. The total cultivated area of the Matara District in "Yala Season" has decreased from 14818 hectares in 1981 to 10517 hectares after the implementation of the Nilwala Flood Protection Scheme in 1983 (Department of Agriculture, 2003). A study (Perera, 1996) has been completed for land use, land cover mapping in the lower basin of the Nilwala River between 1982- 1994 to find out the changes of land use and land cover pattern due to implementation of the Nilwala Ganga Flood Protection Scheme. According to the results of the multi temporal comparison 3057.9 hectares and the highest percentage of total land use area (30.58%) were covered with paddy land. Whereas after 9 years (Land sat TM data) it reduced to 848.2 hectares and 8.48% of total land use area in 1992 and percentage of differences was – 22.10 between 1982 and 1992. Even though the abandoned paddy land was nil in 1983, since then, 1166.9 and 1428.4 hectares were abandoned in 1992 and 1994 after implementation of NGFPS.

The marsh areas of the wetland have increased up to 37.07% (1482 acres) of total land covers in 2003 compared to1983, including 20 years. However, the marshland had little covered area (356ac and 8.44%) out of the total land cover in 1983. Therefore, the increment of the marsh area in the field was 1126 acres and the variation trend was 28.63% between 1983 and 2003. In 2003, marshlands became the largest category of the study area. These huge marshlands could possibly have been abandoned agricultural areas after implementation of the Flood Control Scheme around Kirala Kele.

This change detection occurred continuously in the field from 1983 to date. In 2011, the highest class of land use in the study area was marsh lands. It consisted of 39.61% of total land cover of the area and represented 1575 acres. The variation trend was 31.17% between 1983 and 2011.

The increase of marsh land by approximately 1575 acres, more than the decrease of paddy cultivated land (1127ac) in 2011. The period from 1983 to 2011 has been characterized by more than a four times increase in marsh area while the number of farmers has sharply decreased. According to Kent (1994) wetlands generally includes swamps, marshlands, bogs and similar areas (Kent, 1994). Therefore, Kirala Kele wetland would become a usual wetland after 1980 (Figure 3).

Figure 4 – Temporal changes of marsh area between 1983and 2011

Wetland vegetation grows in relation to water depth and salinity, and can be observed in the distinct zones of the wetlands (Aber, Pavri, & Aber, 2012). Likewise, from 1983 to 2011 the upward trend of wetland vegetation was heavily weighted among other land use classes. It is clear when looking at the Table 1 that, wetland vegetation increased dramatically and reached a peak of 14.13% of total land use coverage in the study area in 2011. As seen from the data, the wetland vegetation coverage area was 283acres or 6.71% in 1983.This occupied 376 acres or 9.40% and 562 acres or 14.13% in 2003 and 2011 respectively. Compared to land use changes of this area, wetland vegetation was the third most important change detecting category in the Kirala Kale wetland area between 1983 and 2011. It was nearly twice as larger in 1983, 356 acres than 2011, 562 acres of total land use coverage area in the study.

Furthermore, in order to achieve a wide classification of water, logged areas within this wetland were delineated and classified in their respective classes. The three classes resulting from the classification are defined as follows, HWW3, MWW2 and LWW1 (High Water Wetland area, Medium Water wetland area and Low Water wetland area).

Out of the three sub wetland classes HWW3 was much higher, with 620 acres or 14.70% of the total area covered in 1983. After 20 years, it decreased to 342 acres or 8.55% of the total in 2003. This is nearly twice the losses as compared to 1983. The net changed the percentage of high water wetland areas between 1983 and 2003 is 8.96%. Similarly, a high water wetland in this area dropped to 243acres or 6.11% of the total in 2011. Even though slight decrease can be observed from Table 1 and the Figure 4, the net changed percentage of the LULC type between 2003 and 2011 was 12.60%.

There is a significant correlation between land use changes of High Water Wetland and the water logged areas in this wetland. Insufficient macro and micro level drainage systems in the central part of the wetland and water logged areas were created due to the low elevation. The main trend of land use changes in water logged area caused rapid falling from 90 acres or 2.13%, 27 acres or 0.68% to 23 acres or 0.58% of the total land used in the study area in 1983, 2003 and 2011, respectively. In accordance with rapid loss of the water logged area of the wetland, would have been attested to decline of High Water Wetlands from the Kirala Kale area. A high water wetland area is between 1m– 2m elevation in the center of the wetland, where it is easier to absorb and access the surrounding water sources.

Figure 5 - The annual rate of land use land cover change in Kirala Kele 1983-2011

At the same time, larger areas of High Water, Wetlands were converted into Moderate and Low Water Wetlands. Changes were noticeable in between 1983, 2003 and 2011. The coverage area of MWW2 was 221 acres or 5.24% of the total in 1983 and then increased to 275 acres or 6.88% in 2003. The net changed percentage of MWW2 was – 1.74 between 1983 and 2003. But the location of Moderate and Low Water, Wetlands were identified with little different elevation; both went from 4m to 6m elevation. These changes could have occurred from the rotation of land use activities or misclassifications occurred due to similar spectral reflectance of the objects.

Vegetation in the marsh is comprised of grasses, grass like plant (*Typha spp*) sedges, rushes and numerous forbs. This type of marsh vegetation can be found on the low latitude in the landscape (2-

10m) and saturated pond water due to the impervious alluvial soil (Thompson & Kolka, 2005). Furthermore, the Kirala Kele wetland can be identified as multi types of natural and homogeneous sub wetlands. Mangrove and marsh lands consist of natural wetlands, paddy lands, and irrigation canals which are man-made wetland. Therefore, it has eco-system diversity within the smaller premises. As a highly biodiverse, ecosystem in Kirala Kele wetland have been identified, some fauna species of amphibians, birds, reptiles, fishes, snakes, butterflies and mammals in the area. Chandana et al (2013) was attempting to observe the bird diversity of five sites in the Kirala Kele wetland area in 2010. These five sites were selected from different water retention and vegetation types of the southwest and northeast trail of the wetland (Chandan, Rajapaksha & Samarasekara, 2013). This study area supports a diversity of flora and fauna species, many of which are endemic to the area. Within the area 83 species of plant including a rich marsh vegetation and aquatic microphysics, 68 species of birds including 10 migrants, 6 amphibian species, 8 reptile species 9 snake species 47 butterfly species, 18 mammal species and 20 fish species including 10 endemics have been identified (Silva, 2002).

Pertaining to the ecotourism potential of the Kirala Kele wetland area, this destination has tremendous potential for managing the transport network, administrative facilities and infrastructure for the development of ecotourism. The total length of main roads inside the wetland is estimated to be 58Km covering two main roads, named Akuressa – Matara and Hakmana – Matara. It also covers a wide range of minor roads, jeep roads and cart roads join with the main roads to ease accessibility. The starting point of the expressway from Matara to Colombo (Capital of Sri Lanka) is established very near to the Kirala Kele wetland at Godagama and 5.4Km of the expressway is paved through the wetland. Even, integration of the wetland has been broken down by the expressway in spite of the easy observation of the beauty of nature and its aesthetic value can be observed on their way from outside.

It is clear that the low productivity of the paddy land and abandoned paddy lands in this area are because of excessive drainage and oxidation of Acid sulphate soil. The high percentage of marsh land is likely to be the results of poor drainage systems, water logging, salinization and changes of physical properties of soil and water, after the Flood Control Scheme that was carried out between 1983 and 1987. Many scholars identified the reasons for why there is more acidity in the paddy field; such as agricultural development, new drainage systems, road constructions, exposed sulphite minerals bearing peaty soils, thinner layer of fluvial deposits than the levees, and excavation of canals and fluctuation of ground water levels that are facilitated to release the highest amount of acidity in the soil and the associated environment (Fernando & Suranganee, 2009).

In the first stage of this project the depth of irrigation canals increased through the KiralaKele area to facilitate the outflow of flood water. As a result two main natural processes occurred within this area. On one hand, due to the surface water on the paddy field infiltrated into the subsoil and easily accumulated those into the deep channels and then the surface of the paddy land became dry. Lower river basin, including Kirala Kele back swamp was inundated in the Holocene Geological era by the marine transgression during 5000-6000 BP according to the geological time scale. 6-10 feet (1.81-3.04m) depth of subsoil of this area has continued with former marine deposits which is evident from abundant sea shells in the area.

The loss of mineral particles and the bulk of soil density is low (0.7-1.0/cm3) in the Kirala Kele back swamp area (Weerasingha, 1982) In addition, low exchange capacity (22.4 meq. per 100g) and high content of exchangeable aluminium (9.9 seq. per 100g) which can go up to 20 meq. per 100g is typical for soil in highly toxic patches (Dent, 1986). In accordance to the soil properties, some negative effects

of severe acidity, iron and aluminium toxicity, lack of availabilities of phosphate nutrient deficiencies and possibility salinity have been identified in the Kirala Kele area (Weerasingha, et al., 1996).

CONCLUSION

After having physical changes throughout the study area within a setting of the region's it reflected in the dynamics of the wetland ecosystem of the center of this wetland. With the implementation of flood control scheme, marshes and wetland vegetation have significantly increased where as there has been a decrease in the paddy land, water logged area, flood plain and high water wetland areas. Furthermore, the land use changes of the study can be identified as an inverse relationship between the paddy agricultural land use and marsh land area land use between 1983 and 2011. These physical and infrastructure tendencies would be beneficial, economically and environmentally for ecotourism development in the Kirala Kele wetland of Sri Lanka.

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